Using Binary Logistic Regression to Analyze the Predictive Validity of Undergraduate GPA and Standardized Test Scores in Forecasting Master’s Student Degree Completion

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ABSTRACT OF THE DISSERTATION

Using Binary Logistic Regression to Analyze the Predictive Validity of Traditional Measures of Success in Master’s Student Degree Completion

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Wedged between undergraduate and doctoral students exists the oft-understudied population of master’s students. The dearth in master’s-specific research is astounding considering master’s degrees are the fastest growing degree credential. Why is there such a lack of information about master’s students from a national perspective in comparison to other degree-seeking students? Perhaps it is because assessment, like Integrated Postsecondary Education Data System (IPEDS), and prestige, like U.S. News & World Report rankings, are not tied to it. In simple terms, a carrot does not exist to incentivize it nor a stick to mandate it. The absence of research has far-reaching implications and manifests primarily as a disconnect between the efficacy of admissions and anticipated student degree completion, but has further implications on our grasp of master's student graduation rates and time to degree. This study bridges this gap by employing binary logistic regression to analyze the relationship between the independent variables; admissions-, demographic-, and environment-based attributes, and the dependent variable master’s degree completion. In looking specifically at the traditional measures of success within the master’s admissions process; undergraduate GPA and standardized test scores,
statistical significance was not found. However, the disproportionately high rates of graduation for master’s students is in conflict with these findings. Within the environment attributes; institution, academic discipline, attendance pattern, start term, representation by race/ethnicity, and representation by gender, the model indicated statistical significance across categories within institution, academic discipline, attendance pattern, and start term. Certain institutions and academic disciplines are associated with greater odds of graduation than others, full-time students more likely to graduate than their part-time peers, as are students that start their program in the Fall term when compared to those that start in the Spring. Finally, within the demographic attributes; age, race/ethnicity, gender, citizenship, and residency, only age was statistically significant. Simply, the odds of graduation decrease as students grow older. Additionally, this study provides university administrators with a comparative benchmark for both master's student graduation rates and time to degree. This is the first-ever, multi-university study to employ a statistical model to analyze the predictive validity of the traditional measures of success, and accompanying environmental and demographic attributes, in forecasting degree completion. It is also the most comprehensive in terms of program breadth.
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CHAPTER 1: INTRODUCTION

General Description of the Area of Concern

Public colleges and universities are becoming increasingly reliant on tuition dollars for their survival (Goldstein, 2012; Grawe, 2017; Mitchell, Palacios, & Leachman, 2014; Selingo, 2016). This is in part due to a decrease in state appropriations which has positioned tuition revenue as the primary revenue source for institutions of higher education (Mitchell, Leachman, & Masterson, 2017). The shift from relying on state appropriations to tuition revenue has caused colleges and universities to reexamine their balance sheet and has compelled these institutions to invest heavily in student recruitment as an attempt to bring in more tuition dollars. Unfortunately, this recruitment-focused strategy cannot continue indefinitely due to the expected decline in the number of college-bound students over the next decade (Grawe, 2017; Selingo, 2016). Simply, if college attainment rates remain the same into the future, it could mean there are fewer college graduates and fewer applicants who are eligible to apply to graduate school. Subsequently, the anticipated population change, effected by a contraction of the birth rate caused by the recession of 2008 and intensified by a massive shift to inter-state and immigration patterns, will have implications on national student enrollment and the recruitment of new students, whether they come directly after completing their bachelor’s degree or years later, does not represent the only strategy colleges and universities can employ to address revenue concerns.

Though perhaps not sustainable in the years to come, recruitment as a strategy has been incredibly successful over the last six decades. College and university enrollment has grown dramatically over that same time and master’s students have outpaced all other degree-seeking populations (Digest of Education Statistics, 2017a). Every year,
thousands of students are recruited and admitted to master’s programs causing a surge in master’s degree attainment. It is puzzling then how little is known about the rate in which admitted master’s students complete their degrees and in what time frame considering that one out of every five degrees earned in 2016 were master’s degrees (Digest of Education Statistics, 2017a). Unlike undergraduates and doctoral students, there isn’t a national imperative or accompanying national data set to address master’s student completion rates. The causes behind the lack of impetus and subsequent missing information for master’s students, when compared to other populations, is not the intent of this study, but is interesting nonetheless. Perhaps it is because assessment, like IPEDS, and prestige, like US News rankings, are not tied to it. Effectively, there isn’t a carrot to incentivize it nor a stick to mandate it. Regrettably, graduation rates among undergraduate students have remained stagnant, and there is embarrassingly scant information in regard to doctoral and master’s student graduation rates or time to degree (Committee on Revitalizing Graduate STEM Education for the 21st Century et al., 2018; Digest of Education Statistics, 2017c; Okahana, 2018).

Unfortunately, the disconnect between admitted students and those that persist onto degree completion has an impact limited to not only the tuition revenue of institutions seeking immediate and long-term institutional survival. Rather, the master’s completion quandary has pervasive downstream repercussions for students, administrators, and society as well. These repercussions will be addressed in the subsequent “Significance of the Problem” section. Accordingly, it is critical that institutions not only seek to recruit more students, but to make a concerted effort to ensure that those who are admitted persist on to graduation (Habley, Bloom, & Robbins, 2012). After all, one purported purpose of the master’s admissions process is to forecast
student success with some degree of certainty (Okahana, Augustine, & Zhou, 2018).

More specifically, master’s program admission decision makers, including administrators, coordinators, directors, and admissions committees, seek to evaluate admissions candidates’ cognitive and noncognitive attributes, such as problem solving, analytical thinking, and written communication abilities and persistence, dependability, and collegiality, respectively (Okahana et. al, 2018). As such, admission decisions are based on a proprietary set of relatively homogenous parameters, with varying thresholds, determined by each institution or their program, as is typically the case for master’s programs. Effectively, no two programs will use exactly the same criteria in exactly the same way. Nevertheless, institutions, both currently and historically, disproportionately rely on two parameters to evaluate cognitive attributes; undergraduate grade point average (GPA) and standardized test scores. Subsequently, the predictive validity of these two parameters; or the degree in which these measures relate to or can predict future performance, in this case graduation, is often debated in the master’s literature (Clemens, Ragan, & Prickett, 2018; Cronbach & Meehl, 1955). Many researchers extol the efficacy of these measures and just as many who objurgate their continued use (Hansen & Pozehl, 1995; Jin et al., 2004; Kass, Kim, LaMacchia, & Bekisz., 2019; Kirchner, Stone, & Holm, 2001; Kjelgaard & Guarino, 2012; Kuncel, Hezlett, & Ones, 2001; Kuncel, Credé, & Thomas, 2007; Kuncel, Wee, Serafin, & Hezlett, 2010; Kuncel & Hezlett, 2007; Michel, Belur, Naemi, & Kell, 2019; Miller & Stassun, 2014; Newton & Moore, 2007; Rhodes, Bullough, & Fulton, 1994; Schuler, Cotner, Lafferty, & Dowling, 1993; Tanguma, Serviere-Munoz, & Gonzalez, 2012; Wamala, Kizito, & Kakumba, 2012).

Clearly, the care institutions take to ensure their admissions processes are properly calibrated in order to achieve one of many desired goals of admitting future
graduates cannot be overstated. As such, the primary intention for this dissertation is to address the predictive validity of the two previously mentioned admissions parameters; undergraduate GPA and standardized test scores. Accompanying these admissions parameters in the analysis are a host of additional factors not typically considered in the admissions process, including environmental attributes (institution, academic discipline, attendance pattern, start term, representation by race/ethnicity, and representation by gender) and demographic attributes (age, race/ethnicity, gender, residency, and citizenship status). This first-of-its-kind, quantitative study, building upon relevant past research on this topic, examines these attributes and their association with master’s student completion for thousands of students in hundreds of master’s programs across four large public, doctoral universities – very high research activity (Carnegie Classification “R1”) within the United States (“participant institutions”). The study utilizes binary logistic regression to quantify these associations as this statistical tool is well-suited to answer the research question (Creswell, 2014; Hosmer, Lemeshow, & Sturdivant, 2013; Miller, 2008; Osborne, 2015), has the ability to use multiple independent variables to predict a two-category, dichotomous dependent variable (e.g., yes or no, 0 or 1, etc.), and can offer insight into the relationship between variables (Egerton, 2018; Hosmer et al., 2013; Menard, 2001, 2010; Miller, 2013; Osborne, 2015). In addition to exploring the association between the aforementioned admissions data and degree completion, this study has an accompanying intention; to offer supplemental context surrounding the dearth in national benchmarking regarding master’s completion rates and time to degree.
Significance of the Problem

Undoubtedly, institutions battling an already inhospitable present, worsened by the global pandemic, will be further impacted by the eventualities of a changing population, but it is the manner in which they respond that has the potential to confront several wicked problems - the social or cultural problems that are incredibly difficult to solve - beyond their own survival (Churchman, 1967). Thus, it is imperative that institutions seek to evaluate applicants more holistically through a protocol that is properly calibrated and more comprehensive in nature (Kent & McCarthy, 2016; Okahana et al., 2018). The failure to address even the slightest disconnect between the master’s admissions process and degree completion will have significant and far reaching implications on not only institutions of higher education, but current and future students and society as well.

Touted as a means to evaluate potential graduate success, the master’s admissions process is a student selection mechanism that not only has an immediate effect on those students who were admitted, but those not admitted and those who never apply. For all three groups of students, an administrative over-reliance on undergraduate performance and standardized test scores could promote phenomena such as stereotype threat, range restriction, socio-economic status, and implicit bias, all of which serve to foster detrimental self-selective behavior, inhibit degree completion, and shape the future of higher education.

Within this context, these phenomena effectuates biases inherent in standardized tests and undergraduate academic performance, often quantified as GPA, despite any attempt to ensure the admissions process itself is blind to demographic characteristics such as race, ethnicity, gender, and age (Kuncel & Klieger, 2007; Small, 2017).
Unfortunately, selection is not limited to master’s program administrators. Applicants may engage in a self-selection behavior based on published or perceived admissions and avoid applying to programs they perceive to be out of reach, where they may have been otherwise admitted (Kuncel & Klieger, 2007). For those students who fail to complete their degrees, those who were not admitted, and those who never applied, unfinished and unstarted degrees can mean lower salaries, less job satisfaction, and less job security (Baum, Ma, & Payea, 2013). Moreover, for those students that started but did not finish their degree, it could mean crippling student debt without the benefit of the degree to offset monthly student-debt payments (Baum et. al, 2013; Habley et al., 2012). It would also impact the student-administrator and student-faculty pipelines thus changing the landscape of higher education, specifically those who make decisions and those who set the research agenda (Brunsma, Embrick, & Shin, 2017; Holley & Gardner, 2012; Kent & McCarthy, 2016; Minefee, Rabelo, Stewart & Young, 2018, Okahana et al., 2018).

Admissions decisions, therefore, can have unintended insidious side-effects by reinforcing systemic inequities that permeate beyond the student to also include one’s families, communities, and broader society.

In addition to the impact observed by students and institutions, society too feels the consequences of unfinished and unstarted degrees - in both monetary and non-monetary terms. The positive economic impact of an educated and degreed labor force is further observed by broader society when the promise of increased knowledge creation and expansion, enhanced worker-employer and skills-job matching, and better working conditions foster increased productivity. These benefits further enhance societal outcomes in that their cumulative effects create a type of recursive loop of positivity where economic returns accelerate and compound further economic growth (Lucas, 1988;
Moretti, 2004; Romer, 1988; Wolfe and Havemen, 2002). As such, the subsequential ramifications of stagnated completion rates and an under-educated citizenry compromises national prosperity, economic performance, and global competitiveness (Baum et al., 2013; Labi, 2015; McMahon, 2015).

However, the impact of completed degrees on society is not limited solely to economic or monetary outcomes, there are non-monetary outcomes as well. When students complete their degrees, society at large benefits through lower crime rates, increased civic participation and voting rates, increased savings among citizens, less reliance on social programs, increased charitable giving, increased social cohesion, and an overall healthier population (Wolfe and Havemen, 2002). There are also generational effects for society, the cognitive development of children whose parents are educated is also positively affected (Wolfe and Havemen, 2002).

Fortunately, change at the institutional level can begin to counter many of these concerns and more. This research, an exploration of the efficacy of admissions in predicting degree completion, is important because it seeks to provide administrators much needed insight into the attributes associated with master’s degree completion, identifies inequity and areas for improvement or resource reallocation, provides master’s degree-granting universities a benchmark in which to compare their institution’s completion rates across many disciplines and programs, and encourages administrative action that has the potential for pervasive long-lasting benefits for students, institutions, and society.

**Theoretical Basis for the Study**

The scholarship of Hagedorn and Nora (1996) will be used as the conceptual framework for this study. Adapted from the work of Stark, Lowther, and Hagerty (1986),
Hagedorn and Nora (1996) offer a three-phase model which focuses on graduate admissions criteria in the first phase; graduate skills, behaviors, and attitudes in the second phase; and success outcomes in the third phase. The first phase, “admissions criteria,” includes “traditional predictors of achievement” (undergraduate GPA and standardized admission test scores) as well as “alternative predictors of cognitive and noncognitive skills” (previous participation, writing samples, critique of a report or articles, interviews, presentations, completion of a report, plan for research, and peer-group discussion). The second phase, “graduate skills, behaviors, and attitudes” includes “traditional factors of interest” (first-Year GPA) and “alternative factors of interest,” which is further broken down into “skills” and “behaviors” (conceptual competence, technical competence, contextual competence, interpersonal communication, integrative competence, adaptive competence), and “attitudes” (career marketability, professional identity, professional ethics, scholarly concern for improving the profession, and motivation for continued learning). The final phase, “outcomes of success in graduate school,” offers three variations on “success” and includes “traditional measures of success” (first year GPA) and “alternative measures of success” (professional competency, attitudinal competency, and degree completion and retention) (Hagedorn & Nora, 1996).

There is also a clear connection between the conceptual framework proposed by Hagedorn and Nora (1996) and the student retention theories of Tinto (1975), Metzner and Bean (1987), Pascarella and Terenzini (1979, 1991), Astin (1984), Cabrera (1992), Gardner (2009a) and so on, in that they all offer a multi-phase, multi-input model where the output is a version of success; degree completion, GPA, professional success, or its opposite; attrition, departure, or withdrawal (Aljohani, 2016). However, a unique quality
of the model proposed by Hagedorn and Nora (1996) is that it focuses specifically on graduate and professional students, where many of the aforementioned studies focus on undergraduate students, with the exception of Gardner’s model (2009) which pertains specifically to doctoral students.

Though this key differentiation - a focus on master’s students - makes the Hagedorn-Nora model more appropriate for the purposes of this study, concerns linger regarding the overarching disconnect between the body of literature surrounding retention and its inclusion of admissions. The retention research incorporates the admissions process as one variable, or a cluster of variables, at the onset of the student journey, but places a heavier emphasis on the time after a student is admitted. More specifically, on the institutional environment and the role it plays in facilitating the student experience and traditional measures of success, subsequently. As such, it is hard to imagine that any admissions criteria and process would be suitable to adequately predict degree completion, given the role the academic and social environments play in student outcomes, positive or negative.

This dissertation focuses on the first and final phases of the Hagedorn-Nora model with a particular focus on the predictive validity of the traditional predictors of achievement (undergraduate GPA and standardized test scores). It will also incorporate environmental factors available to decision-makers during the admissions process (academic discipline, institution, attendance pattern, start term, representation by race/ethnicity, and representation by gender) and demographic attributes (age, race/ethnicity, gender, residency, and citizenship status). The purpose of the inclusion of these additional attributes and factors is to recognize and integrate the surfeit of retention
scholarship and account for the role of the environment and its impact on student outcomes.

**Synthesis and Critical Analysis of the Relevant Literature**

Despite the abundance of research for undergraduate students and a modest amount for doctoral students, retention and graduation rates among these populations have remained static and information regarding master’s students is exiguous at best. At four-year institutions, fewer than 60% of undergraduate students earned a bachelor’s degree after four years, at two-year institutions, only 30% of students complete an associate’s degree within three years, and it has been widely accepted that only 56% of all doctoral students complete their degree within ten years (Digest of Education Statistics 2017b, 2017c; King, 2008). In all of these studies, graduation rates are accompanied by a designation of time to signal a start and end to the measurement and provide context around the term “time to degree”. Used often by researchers and practitioners, “time to degree” is broadly defined as “the total time... between initial enrollment in a postsecondary institution and subsequent degree attainment, regardless of whether or not the student was actually enrolled” and for the purposes of this dissertation, regardless of level (Shapiro et al., 2016, p. 5). Clearly, timing matters when measuring degree completion. Not only do we not know the rate at which master’s students complete their degrees, we do not even know what timeframe would be suitable for measurement. Considering master’s degrees have outpaced the growth and pervasiveness of all other degree credentials over the past sixty years, the gap in master’s-specific research is astounding (Digest of Education Statistics, 2017a).

Though there is a significant amount of research surrounding “graduate” students; an umbrella term that includes all post-baccalaureate degree- and certificate-seeking
students (Wakeling, 2020), many of those studies focus specifically on doctoral students or students within “professional” master’s programs (Hansen & Pozehl, 1995; Jin, Kwon, & Yun, 2004; Kass et al., 2019; Kirchner et al., 2001; Kjelgaard & Guarino, 2012; Kuncel et al., 2001, 2007, 2010; Kuncel & Hezlett, 2007; Michel et al., 2019; Miller & Stassun, 2014; Newton & Moore, 2007; Rhodes et al., 1994; Schuler et al., 1993; Tanguma et al., 2012; Wamala et al., 2012). For the purposes of this dissertation, “master’s degrees” are defined as “a type of post-baccalaureate credential, which in the United States typically requires credit hours equivalent to 1 or 2 years of full-time studies beyond a baccalaureate degree at institutions of higher education” (Okahana & Hao, 2020, p. 1024). Similarly, the context of “professional” is broadly defined as a master’s degree that “emphasize[s] professional practices, and in some cases are requisites for entering into a particular profession” and where “practitioners and higher education stakeholders often refer to these programs as professional degrees since many of these programs are housed in professional schools (e.g., business schools, schools of education, schools of public affairs) within colleges and universities.” (Hao & Okahana, 2020, p. 1206). In addition to professional master’s degrees, master’s degrees can also be segmented into those programs that have a focus on research and scholarship, which, depending on the discipline, have either grown or withered over the last decade (Okahana & Hao, 2020; Okahana, Zhou, & Gao, 2020).

In consideration of the programs outside those predominant master’s disciplines, it must be noted that the literature surrounding doctoral and professional master’s students, even if published under the “graduate” nomenclature, may not be broadly applicable to the master’s student experience, just as the literature surrounding undergraduate students may not.
Nevertheless, to offset the dearth in master’s-specific information, this study looks to the surfeit of knowledge surrounding the makeup and experience of both undergraduates and doctoral students to elucidate the most relevant information. As such, this study will be situated within the most germane research as it pertains to admissions-based variables, and more specifically; the predictive validity of undergraduate performance and standardized test scores on master’s degree completion, while controlling for environment-based attributes; a student’s chosen academic discipline, where they chooses to study, attendance pattern, start term, and racial and gender representation, and demographic-based attributes; a student’s age, race/ethnicity, gender, residency, and citizenship status.

For decades researchers have sought to determine whether the traditional predictors of achievement are viable in forecasting traditional and alternative versions of student success. As such, the literature surrounding the predictive validity of standardized test scores and undergraduate GPA is abundant, but it is also conflicted. Until relatively recently, these studies indicated a strong correlation between achievement and success, reinforcing a long history of their use and locus within master’s admissions (Jin et al., 2004; Kirchner et al., 2001; Kjelgaard & Guarino, 2012; Kuncel et al., 2001, 2007, 2010; Kuncel & Hezlett, 2007; Schuler et al., 1993; Wamala et al., 2012). The work of Kuncel and his colleagues, in particular, has championed this connection across both the GRE and GMAT (Kuncel et al., 2001, 2007, 2010; Kuncel & Hezlett, 2007). However, historically, results of predictive validity studies have been mixed, and in some cases, contradictory to the findings of Kuncel (Hansen & Pozehl, 1995; Heritage, 1977; Kass et al., 2019; Miller & Stassun, 2014; Newton & Moore, 2007; Rhodes et al., 1994; Tanguma et al., 2012). The disparity could suggest that certain academic programs have tighter
connections between the traditional measures for gauging future success, or that these measures are becoming less predictive over time. Despite these new findings, undergraduate GPA and standardized test scores continue to represent two of the most commonly used, and heavily weighted, components in making master’s admission decisions across a broad spectrum of disciplines and ever-growing programs (Okahana et al., 2018).

To provide context to the predictive validity of master’s admissions-based components such as undergraduate GPA and standardized test scores, master’s students’ demographic- and environment-based attributes must also be considered. Within the context of degree completion, the Master’s Completion Project, initiated by the Council of Graduate Schools, focused specifically on master’s students and analyzed retention and completion data from select master’s programs in science, technology, engineering, math (STEM) and business (MBA) across five research institutions. The study resulted in the 2013 publication, *Completion and Attrition in STEM Master’s Programs* (Council of Graduate Schools, 2013), that provided insights into the rates of completion and the factors associated with program completion, including identifying disparities across age, race, attendance pattern, academic discipline, and institution. Though the study looked at only five institutions, only a specific subset of academic disciplines represented, and did not examine the role of prior academic success in completion, the study is a success for master’s research in that it offers insight into the role that demographics and environment may play in degree completion. Moreover, it succeeds in reinforcing prior master’s degree completion studies, and has its findings subsequently reinforced (Aiello, 2017; Barry & Mathies, 2011; Cohen, 2012; Gándara & Toutkoushian, 2017; Mercer, 2015).
Similarly, at the undergraduate level, disparities within demographic- and environment-based attributes have also been associated with degree completion. However, within the undergraduate context, master’s students may exhibit qualities, attributes, circumstances, and needs more homogenous to non-traditional populations. Both groups have more commitments outside of their educational endeavors, attrition unrelated to social experience, thrive in environments centered on their experience, have greater reservoirs of experience from which to draw, and possess similar intentionality and levels of commitment (Metzner & Bean, 1987; Alhassan, 2012; Brown, 2002; Fairchild, 2003; Mancuso, 2001). Many of these facets relate directly to the age, race/ethnicity, gender, academic discipline, institution, and attendance pattern of the students in question.

Like non-traditional populations, master’s students may exhibit qualities and phenomena similar to doctoral students across race, gender, academic discipline, age, and GRE scores (King 2008; Lott, Gardner, & Powers, 2009; Most, 2008). Master’s and doctoral students have both experienced some level of previous academic success regarding their undergraduate performance, have similar admissions criteria and experiences, are immersed in their discipline or department, and have a comparable reliance on faculty interaction and socialization as it pertains to academic progress (Baird & Holtzman, 1969; de Valero, 2001; Gardner, 2008a, 2008b, 2008c, 2009a, 2009b, 2010; Golde, 2000; Golde, 2005; Lott et al., 2009; Maddox, 2017; Turner & Thompson, 1993; Weidman & Stein, 2003; Weidman, Twale, & Stein, 2001).

Clearly, the similarities between these master’s students and their non-traditional undergraduate and doctoral peers are abundant and evident, not only when looking at the significance of demographic and environmental attributes on degree completion, but also
the admissions-based attributes such as undergraduate GPA and standardized test scores. However, it must be noted that these groups differ from master’s when considering disparities in the types of programs available at the master’s level, the shorter duration, the increased expense, the limited availability of funding, and the different academic expectations of master’s programs. Nevertheless, this literature provides a deeper look into demographic and environmental factors and highlights their connection to the master’s-specific literature mentioned earlier.

**Problem Statement**

The absence in master’s-specific degree-completion research manifests primarily as a disconnect between the efficacy of admissions and anticipated student degree completion, but has further implications on our grasp of master's student graduation rates and time to degree. Moreover, the lack of attention paid to master’s student degree completion has far reaching implications on prospective student admission, student success, institutional sustainability, and societal well-being. This study seeks to address these concerns by exploring the predictive validity of undergraduate GPA and standardized test scores, while controlling for environmental and demographic variables, as they pertain to master’s degree completion. Binary logistic regression will be employed as the predictive model for this analysis.

**Research Questions**

To address the gaps in the literature around master’s degree completion, my research questions are as follows:

1. **Research Question 1 (RQ1):** What is the relationship between admissions-based attributes, specifically undergraduate GPA and standardized test score percentile,
and master’s degree completion, while controlling for environment- and
demographic-based attributes?

2. **Research Question 2 (RQ2):** What is the relationship between environment-
based attributes, specifically attendance pattern and representation, and master’s
degree completion, while controlling for admissions-, environment-, and
demographic-based attributes?

3. **Research Question 3 (RQ3):** What is the graduation rate and time to degree for
the 2009 master’s cohort?

**Hypotheses, Control Variables, and Reference Categories**

To operationalize research questions RQ1 and RQ2, I offer the following
hypotheses and reference categories. The basis for these hypotheses and reference
choices will be discussed in the “Literature Review” section.

**Admissions-based Variables (RQ1)**

- Undergraduate GPA (H1)
  - Higher undergraduate GPA will be associated with greater odds of
    graduation than lower undergraduate GPA.

- Standardized Test Score Percentile (H2)
  - Higher test score percentile will be associated with greater odds of
    graduation than lower test score percentile.

**Environment-based Variables (RQ2 and control variables/reference categories)**

- Attendance Pattern (H3)
  - An attendance pattern of full-time will be associated with greater odds of
    graduation than an attendance pattern of part-time.

- Representation by Race/Ethnicity (H4)
○ Higher proportion of race/ethnicity representation will be associated with greater odds of graduation than those with lower proportions of like-race/ethnicity representation.

● Representation by Gender (H5)
○ Higher proportion of gender representation will be associated with greater odds of graduation than those with lower proportions of like-gender representation.

● Academic discipline
○ Students matriculated in a Business-related academic discipline will be associated with greater odds of graduation than students matriculated in non-Business-related academic disciplines, such as Arts and Humanities, Biological and Agricultural Sciences, Education, Engineering, Health and Medical Sciences, Mathematics and Computer Sciences, Other Fields, Physical and Earth Sciences, Public Administration and Services, and Social and Behavioral Sciences.

● Institution
○ Institutional impact will be statistically significant, but a specific institution has not been identified as more impactful.

● Start Term
○ A Fall start term will be associated with greater odds of graduation than Spring or Summer.

*Demographic-based Variables (control variables/reference categories)*

● Age
Older students (those with higher ages) will be associated with lower odds of graduation than younger students (those with lower ages).

- **Race/Ethnicity**
  - Students identifying as Asian will be associated with greater odds of graduation than students identifying as Black, Hispanic or Puerto Rican, International, Multi/American Indian/Hawaiian or Pacific Islander, White, and those students whose racial identity is unknown or was not reported.

- **Gender**
  - Female students will be associated with lower odds of graduation than male students.

- **Residency**
  - In-state residency will be associated with greater odds of graduation than out of state.

- **Citizenship**
  - U.S. citizenship and permanent residency is associated with lower odds of graduation than non-U.S. citizenship.
CHAPTER 2: LITERATURE REVIEW

The concerns around master’s student degree completion are pervasive and far-reaching for students, institutions, and society. Despite the relative absence of master’s-specific research, we can draw upon the abundance of knowledge surrounding both the predictive validity of traditional measures of success and the makeup and experience of undergraduates and doctoral students, most applicable to the master’s experience. As such, this chapter will be divided into two sections. First, I will provide a summary of the history of higher education, highlighting admissions and the concerns with the traditionally-used measures of success within admissions. Within this section, I will also explore the master’s-specific literature centered on the predictive validity of undergraduate GPA and standardized test scores in forecasting master’s degree completion. Within the second section, I will summarize the most salient theories regarding student retention and persistence. I will also examine the environmental factors, structural and systemic, that impact the student experience and degree completion and will highlight the role of attendance pattern, representation by race/ethnicity, representation by gender, academic discipline, institution, and start term. I will then focus on the demographic-based attributes and the disparities in degree completion between students of diverse backgrounds, including age, race, gender, residency, and citizenship.

Admissions and Degree Completion

History of Admissions

Just as colleges and universities have evolved over time, so too have their admissions practices. What began with the colonial colleges, where selection was embedded into the choice of wealthy families to send their sons to study for careers as ministers, priests, and men of the cloth, has given way to the modern university, where
super-selective admissions processes have become a mechanism to manufacture prestige and bolster recruitment. Veysey (1980) suggests there have been five phases of history, as they relate to admissions, since Harvard opened their doors and launched the American system of higher education nearly 400 years ago. The first phase dates back to the colonial colleges, where admission was faith-based and diverse though highly segregated according to the branches of Christianity. The curriculum and subsequent admissions process leaned heavily on a mastery of the classics; Greek, Latin, and mathematics, tailoring the process for the elite to shine and predicated on their ability to fund their educational pursuits (Geiger, 2016; Veysey, 1980). The second phase began in the mid-19th century and de-emphasizes the classics; disputing the need to develop “intellectual culture” and the “disciple” and “furniture of the mind,” despite the staunch defense of the Yale Report of 1828. Nevertheless, the Yale Report of 1828 signaled the start of a sweeping change to college admissions that would remove the barriers for entry for other social elite less proficient or familiar with Latin and Greek (Geiger, 2016; Veysey, 1980). In response to this change, the College Entrance Examination Board is introduced to maintain the ability to regulate the pathway into universities (Geiger, 2016; Veysey, 1980; Wechsler, 2014). However, the Morrill Act of 1862 served to further dismantle what had been traditional admissions, as universities sought to expand their footprint and increase enrollment of students who would or could not have previously attended (Geiger, 2016). It is during the second phase that the first graduate degree, a doctoral degree, is awarded (Holli, 1945). The third phase, which began during World War I and lasted until shortly after World War II, stressed selective admissions as a meritocracy, but could not have been further from the truth. Colleges and universities introduced quotas, which focused heavily on limiting enrollment of Jewish students, along with other
groups, effectively preserving the same access and student body of the past - white, male, and wealthy (Geiger, 2016; Veysey, 1980). The fourth phase, known as the “Golden Age,” is the time after WWII through the 1960s and was fueled by three changes. First, there is an increased scrutiny, though not a complete elimination, of racially-motivated exclusionary practices of the previous phase as a response to the atrocities committed by the Nazi party during the Second World War (Veysey, 1980). Second, the introduction of the Servicemen's Readjustment Act of 1944, known today as the GI Bill, provided unprecedented access to, and the ability to afford, a college education to millions of returning soldiers who would have otherwise never had the chance to earn a college degree (Olson, 1973; Snyder, 1993). Third, the launch of Russian satellite Sputnik compelled an era of competition and achievement (Veysey, 1980). It is during this phase that the United States, driven to compete with the Soviets and funded by federal dollars, transitions from elite to mass higher education with a new emphasis on research and graduate education (Gumport, Iannozzi, Shaman, & Zemsky, 1997; Wechsler, 2014; Weislogel, 1950; Willingham, 1974). The fifth phase, the late 1960s through 1980, represents a return to the unfortunate quotas and racial exclusion of the third phase (Geiger, 2016; Veysey, 1980; Wechsler, 2014).

Given that Veysey’s work was published in 1980, it could be argued that a sixth phase of admissions practices exists between the time of publication and today. This phase struggles with the paradoxical nature of the mission of admissions - to recruit and admit the elite, yet limit bias and extirpate inequity (Posselt, 2016). The concern regarding access to research-grade education is further exacerbated by the limited capacities of institutions offering such an education (Crow & Dabars, 2020). Moreover, the intent to expand that capacity is troubled and can be seen as both well-demonstrated,
but poorly implemented, when considering the history of MOOCs (Khalil & Ebner, 2014).

The second of these goals is particularly difficult to achieve when nearly every modern measure of cognitive and noncognitive competencies is affected by bias; high school or undergraduate transcripts, standardized test scores, letters of reference or recommendation, internships, and more (Posselt, 2016). The path forward for even the most progressive institution is limited given the prisoner’s dilemma they face, spurred on by US News rankings, and the need to outcompete their peer institutions for students and the potential tuition revenue they represent. Nevertheless, colleges and universities attempt to mitigate the endemic bias within the traditional standards of admissions via “holistic review” or “holistic admissions” which endeavor to consider a broad range of cognitive and noncognitive applicant qualities in the admissions decision-making process, but whose practices lack any consensus in that they differ depending on the practitioner’s meaning and intent (Kent & McCarthy, 2016).

**Concerns with Traditional Measures of Success**

Unfortunately, within graduate admissions, regardless of discipline, the most commonly used materials in making admissions decisions have been, and continue to be, standardized test scores and previous academic performance via undergraduate transcripts (Kent & McCarthy, 2016; Michel et al., 2019, Okahana et al., 2018). Researchers have expressed concern that the overreliance on standardized test scores and undergraduate GPA could continue to limit the admission of quality students into graduate programs across gender (Attiyeh & Attiyeh, 1997; Bleske-Rechek & Browne, 2014; Hagedorn & Nora, 1996; Kuncel & Hezlett, 2007; Miller & Stassun, 2014; Small, 2017; Steele & Aronson, 1995; Sternberg and Williams, 1997), race/ethnicity (Awad,
2007; Attiyeh & Attiyeh, 1997; Bleske-Rechek & Browne, 2014; Hagedorn & Nora, 1996; Kuncel & Hezlett, 2007; Miller & Stassun, 2014; Small, 2017; Steele & Aronson, 1995), age (Hagedorn & Nora, 1996; Swinton, 1987), citizenship (Attiyeh & Attiyeh, 1997), and attendance pattern (Kuncel et al, 2007). These practices would have an adverse effect on applicants, students, institutions, and society, as biases within these admissions components would deter certain populations of students from applying, constrain the entry of those that do, perpetuate inequality within the academic pipeline (i.e. from student to faculty to university leadership and administration), and limit access to future leadership roles within these disciplines (Hagedorn & Nora, 1996; Holley & Gardner, 2012; Minefee et al., 2018; Posselt, 2016).

The endogenous inequity within graduate admissions is further exacerbated by stereotype threat, range restriction, socio-economic status, and implicit bias within admission committee decision-making. The phenomenon known as “stereotype threat,” according to Steele and Aronson (1995), is the “risk of confirming, as self-characteristic, a negative stereotype about one's group” (Abstract, p. 797). The study suggested that black students underperformed on standardized tests compared to their white peers, not because of a disparity in their cognitive abilities, but because of their fear of confirming a woefully inaccurate stereotype about black students. As such, the concerns around stereotype threat are particularly salient for other demographic groups where comparable stereotypes may exist. Similarly, Kuncel and Klieger (2007), and Small (2017) express concern over the effects of “range restriction,” a statistical phenomenon that manifests within the admissions process as a form of sample bias as it pertains to those admitted and those not. This disconnect can contribute to a possible false correlation between traditional measures of success; previous academic performance and standardized test
scores; and outcomes. Simply, any measurement of student performance is restricted to those students that are admitted and cannot speak to the unlived performance of those applicants who were not, which may perpetuate the employment of poorly calibrated admissions processes. With the use of standardized test scores seemingly justified, academic programs may broadcast minimum test scores outwardly which can compound the problem of range restriction as it elicits “undermatching”; a form of self-selective behavior exhibited by students (Kuncel & Klieger, 2007; Posselt, 2016; Smith, Pender, & Howell, 2013). Furthermore, undermatching is particularly common among student populations from low socioeconomic statuses - an additional disadvantage to contend with when compared to their wealthier peers who can afford to hire test-preparation coaches and take these tests multiple times to extract the best possible scores (Zwick, 2002, 2007). By the same token, internal institutional response to the perceived efficacy of standardized test scores, courtesy of range restriction, may induce further bias within an already inconsistently implemented admission decision-making process (Hagedorn & Nora, 1996; Michel, et a., 2019). Consequent to the research surrounding the many disparities effectuated by these phenomena and their impact on specific populations, a greater scrutiny has been elicited over the predictive validity of these traditional measures of success and their individual and combined ability to adequately forecast student success and degree completion. In light of these many concerns, coupled with the limitations posed by the pandemic, many colleges and universities have made standardized test scores optional (Reuters, 2020; Vigdor & Diaz, 2020). The University of California, and its system of ten schools, intends to eliminate them all together by 2025 (Hubler, 2020).
Admissions-based Variables

Standardized Test Scores and Undergraduate GPA. A primary intent of admission decision-makers is to implement policies that “facilitate the matriculation of applicants who indicate promise of successfully completing their chosen programs” (Council of Graduate Schools, 1992, p. 1). According to Okahana, Augustine, and Zhou (2018), 99% of graduate schools required academic transcripts and roughly two-thirds (67%) of them focused on upper division GPA as a means to evaluate past academic performance. Similarly, 52% of master’s program directors used standardized test scores to evaluate past academic performance (Okahana et al., 2018). Given the prevalence, prominence, and use of standardized test scores and undergraduate GPA within graduate admissions, perhaps the scrutiny surrounding these components is justified. Accordingly, researchers have regularly questioned the predictive validity of these admissions components with mixed results.

The vast and impressive body of work by researchers Kuncel and his associates has indicated time and time again that, across a broad spectrum of academic disciplines, standardized test scores and undergraduate GPA, are generally valid predictors of student success both individually and combined. Student success, within the context of these studies, is defined in many ways, including degree completion or attainment, first-year graduate GPA, over all graduate GPA, and comprehensive examination scores (Kuncel et al., 2001, 2007, 2010; Kuncel & Hezlett, 2007). This work reinforces prior studies and has been reinforced by subsequent studies that are master’s-specific across multiple disciplines (Kuncel et al., 2001, 2007, 2010; Schwager, Hülsheger, Bridgeman, & Lang, 2015) and individual disciplines; including programs in accounting (Jin et al., 2004), business (Kuncel, Credé, & Thomas, 2007; Wamala et al., 2012), clinical psychology
(Symons, 1999), dietetics (Schuler et al., 1993), library science (Broadus & Elmore, 1983), occupational therapy (Kirchner et al., 2001), and speech language pathology (Kjelgaard & Guarino, 2012).

Contrary to this work is an opposing body of research that suggests the predictive validity of standardized test scores and undergraduate GPA is mixed, if not outright suggesting they are poor indicators of future success (Bedsole, 2013; Bleske-Rechek & Browne, 2014; Covert & Chansky, 1975; Hansen & Pozehl, 1995; Heritage, 1977; House, 1989; Kass et al., 2019; Miller & Stassun, 2014; Newton & Moore, 2007; Rhodes et al., 1994; Swinton, 1987; Tanguma et al., 2012). Like the research that supports the predictive validity of the traditional measures of success, the research that challenges it is master’s-specific and includes studies that aggregate multiple disciplines (Bleske-Rechek & Browne, 2014; House, 1989; Miller & Stassun, 2014; Swinton, 1987) and focus on individual disciplines; including accounting (Grace & Black, 2011), business (Bedsole, 2013; Kass et al., 2019; Tanguma et al., 2012), college student affairs (Hughey, 1995), criminal justice (Carman, 2009; McKee, Mallory, & Campbell, 2001), education (Covert & Chansky, 1975), nursing (Hansen & Pozehl, 1995; Newton & Moore, 2007; Rhodes et al., 1994), public administration (Thompson, 2019), and reading (Heritage, 1977).

Exacerbating the contrary findings of these predictive validity studies is more disagreement between researchers on both sides of the conversation, not only in terms of whether these traditional measures of success are in fact predictive, but which of the two is more so. There is some consensus within the research that suggests, of the two measures, undergraduate GPA is a stronger predictor of master’s student success than standardized test scores alone, regardless of the academic discipline (Bedsole, 2013; Hansen & Pozehl, 1995; Hughey, 1995; Jin et al., 2004; Kass et al., 2019; Kirchner et al.,
2001; Newton & Moore, 2007; Rhodes et al., 1994; Schuler et al., 1993). Other researchers, conversely, have found that standardized test scores more accurately predict student success - in some form; degree completion or attainment, first-year graduate GPA, over all graduate GPA, or comprehensive examination scores (Broadus & Elmore, 1983; Kjelgaard & Guarino, 2012; Kuncel et al., 2001, 2007, 2010; Kuncel & Hezlett, 2007; Schwager et al., 2015; Wamala et al., 2012).

Given the conflicting research around the predictive validity of standardized test scores and undergraduate GPA, researchers and policy advocates continue to support other methods of gauging the potential of graduate applicants, including a focus on noncognitive attributes such as study habits, motivation, knowledge, skills, abilities, persistence, grit, resilience, time management, ethics, life experience, work experience, leadership experience, community involvement, long-term goals, drive, diligence, and even the willingness to take scientific risks (Cortes, 2013; Fischer, Schult, & Hell, 2013; Hagedorn & Nora, 1996; Kent & McCarthy, 2016; Michel, et al. 2019; Miller & Stassun, 2014; Posselt, 2016; Zwick, 2002, 2007). In addition to incorporating additional or alternative measures into the decision-making process, researchers have advocated for changes to the process itself, including training and tools for decision-makers, addressing the decentralized nature of graduate admissions, injecting transparency into the process, and clarifying what is meant by “holistic admissions” and “holistic review” (Kent & McCarthy, 2016; Michel, et al. 2019; Okahana et. al, 2018; Posselt, 2016).

In light of the fact that master’s students make up such a large, growing, and important student population, it is imperative for colleges and universities to ensure their admissions processes, and the cognitive and noncognitive measures within, are sophisticated enough to adequately predict success. After all, that is the purported
purpose of the graduate admissions process. It’s efficacy, however, is questionable in that it does not take into account the environment - the institution, the program, the term in which the student begins, the cadence in which the student pursues their education, or the makeup of the student body - to which the student is admitted or the resources available within such an environment. Accordingly, admissions - an assessment at the onset of an educational career - alone may not yield as valid a prediction if other environmental aspects were also considered. As such, we turn to the retention literature which incorporates the admissions process as one variable, or one cluster of variables, but places a heavy emphasis on the experience had by students while attending the institution.

**Student Retention and Degree Completion**

*History of Student Retention*

In 1971, Spady famously applied Durkheim’s theory of suicide to the undergraduate student experience as the model for “student departure,” what we know today as “attrition”. However, where Durkheim’s theory suggests that a suicide is a less likely outcome for people well-integrated into society, Spady suggests that student departure is a less likely outcome for students well-integrated into their college environment. Simply, the more integrated the student, the more likely they will persist to degree completion. Spady, however, was not the first to link the morbidity of death with the educational experience of undergraduates. Thirty-three years earlier, McNeely (1938) coined the phrase “student mortality” in one of the first studies that sought to explore and understand undergraduate student departure. McNeely’s effort was ahead of its time. In a single study, McNeely intended not only to understand why students did not finish their degrees, but also to create a nation-wide measure of student departure where colleges and
universities, both large and small, could compare themselves. Thus, Spady’s work built on McNeely’s; seeking to better understand the causal relationship between the student experience and student departure. Moreover, by rooting “student departure,” within Durkheim’s theory of suicide and furthering much of the language from McNeely’s (1938) study on “student mortality,” Spady (1971) nearly reinvented this phenomenon and certainly reignited an area of research within higher education. To this day, the language of Spady and McNeely; “dismissal,” “dropout,” “mortality,” “stopout,” and “withdrawal,” is still used and is still a concern for universities and their students. Unfortunately, however, this language centers the student within the phenomenon and by doing so, thrusts an inherent blameworthiness upon the student for failing to integrate into the established environment of their chosen institution. This critical sentiment persists in the literature to come.

In 1975, Tinto continued to build on Spady’s work with his model of student integration, suggesting that undergraduate degree completion was a product of academic and social integration. Simply, the more a student felt part of both the academic and social communities of their institution, the more likely they were to complete their degrees - quite similar to Spady’s model (1971). In Tinto’s model, the student transition into their institution is predicated on their commitment to degree completion and career goals. It focuses heavily on the student as the primary actor. Pascarella and Terenzini (1979) synthesize the work of Spady and Tinto, acknowledging the role of the student in degree completion and highlighting the importance of the student-faculty relationship as a contributing factor.

Astin’s (1984) theory of student involvement also centers the student as the focal role in facilitating degree completion. However, where Tinto asserts that students must
integrate themselves into the university, both academically and socially, Astin suggests that a student’s effort is critical for their success. Astin calls this effort, “involvement” which postulates that a successful undergraduate experience is based on an investment of physical and psychological efforts expended in pursuit of degree completion, measured both in terms of the number of hours invested and the intensity of that investment. As such, he builds on Tinto’s model where the responsibility rests with the student to not only insert themselves into the pre-existing institutional communities, but do so with vigor and purpose. Astin begins to address factors external to the student in affecting student decision-making and motivation, but falls short.

That onus on the student, where they serve as the principal actor who is solely responsible for their own success or failure, is echoed throughout much of the student development scholarship even until relatively recently. This is in spite of the great efforts of Pascarella and Terenzini (1991) to synthesize what is known about the student experience and point to the influence of institutions and other external considerations on retention. The relatively recent resurgence of scholarship focusing on student effort, now called “grit” - an amalgamation of passion and perseverance, hearkens back to Tinto’s and Astin’s earlier work (Duckworth, 2016; Duckworth, Peterson, Matthews, & Kelly, 2007). Unfortunately, grit, like its theoretical predecessors, does not take into account the environment in which students find themselves on different campuses, nor does it address the agency or lived experiences of students from different backgrounds or students in educational programs.

After decades of stagnated undergraduate retention rates, scholars began to identify that there was more to the retention puzzle than simply student-centered interactions and moved to a more social constructionist worldview (Kalsbeek, 2013;
Seidman, 2012; Tinto, 2010). Fairhurst suggests that within social constructionism people "make their social and cultural worlds at the same time these worlds make them” (2010, p. 173). The work of Kuh, Kinzie, Buckley, Bridges, and Hayek (2007) embraces social constructionism and clearly emphasizes the role of external factors, particularly the university environment, as a major component to student success and critical to suppressing student departure. These researchers offer the concept of “engagement” and suggest that student success is largely contingent not only on the efforts of the student, but that of the institution. Furthermore, that engagement, and ultimately degree completion, is a dyadic relationship between student and institution. Success therefore is largely dependent on an institution’s ability to create conditions that endorse and promote an environment and culture conducive to high levels of student engagement.

The nature and quality of these conditions, subsequently, are largely reliant upon the people who make the university run, including, but not limited to faculty, staff, and administration. Demetriou and Schmitz-Sciborski (2012) build on the work of Kuh et al. (2007) and emphasize that “programs and initiatives designed to support undergraduate retention should address both formal and informal student experiences inside and outside of the classroom” (p. 4). This represents a significant ideological shift; for students to succeed, the university must provide the conditions for students of diverse backgrounds in diverse academic programs to engage in their academic endeavors and the university community and persist on to graduation. As such Kuh et al. (2007) and Demetriou and Schmitz-Sciborski (2012) make a clear distinction between integration, involvement, and grit in that student success is co-facilitated and co-authored by students and their institutions.
The ways in which universities go about creating such an environment is extensive and progressively comprehensive (Habley et al., 2012). This is to say that, in addition to populating the classroom with students likely to succeed, via the admissions process, and stellar instructors to offer a world-class education, universities are engaged in success strategies that are increasingly concerned with issues surrounding the student experience set outside the classroom. This engagement is spurred on at all levels; ranging from university-wide issues involving campus climate (Greathouse et al., 2018) down to student-specific issues with food insecurity (Brescia, 2020; Cuite, Brescia, Porterfield, Weintraub, & Willson, 2018) to adapting housing policies for students with disabilities (Miele, Hamrick, & Kelley, 2018). As such, universities must be attuned to their unique and diverse student population in both identifying and supporting students exhibiting the most need. This body of research has provided university practitioners with an enhanced understanding of their role in improving retention rates, but specifically for the traditional undergraduate experience.

Non-traditional Students

The studies regarding undergraduate student retention are incredibly valuable in that they create the foundation on which persistence and degree completion are built (Astin, 1984; Kuh, Kinzie, Buckley, Bridges, & Hayek, 2007; Pascarella & Terenzini, 1979; Spady, 1971; Tinto, 1975). However, this literature focuses exclusively on the traditionally-aged undergraduate experience and if we seek to understand the factors that contribute to master’s student completion, we must probe the applicability of these studies to master’s students. Moreover, we must look to a population that is more homogenous to a master’s student population. The work of Metzner and Bean (1987) begins to bridge the gap between undergraduate and master’s students as it focuses
specifically on retention of non-traditional or adult students. Most often non-traditional students are identified as those students that are older than their direct-from-high school peers and that they may have more commitments outside of their educational commitments (Fairchild, 2003; Radford, Cominole, & Skomsvold, 2015). However, the National Center for Education Statistics (NCES) suggests that nontraditional students exhibit at least one of the following seven characteristics: delays enrollment into postsecondary education (thus, older), attends part-time, is financially independent, works full-time while enrolled, has dependents other than a spouse, is a single parent, or did not obtain a standard high school diploma (Horn & Carroll, 1996). Moreover, NCES also defines the degree in which a student is nontraditional should they exhibit multiple characteristics; “minimally nontraditional” (one characteristic), “moderately nontraditional” (two or three characteristics), or “highly nontraditional” (four or more characteristics) (1996, p. i). As such, master’s students are well-represented within the entire nontraditional spectrum in that they are at the very least “moderately nontraditional,” given their age and financial independence, but may be highly nontraditional, given their personal circumstances.

Nevertheless, Metzner and Bean (1987) found that the factors that lead to non-traditional student attrition were different than the findings for undergraduate students. More specifically, Metzner and Bean (1987) found that reasons for student departure were unrelated to their social and environmental experience at their institutions. The subsequent research surrounding non-traditional students is contradictory and suggests environment as a critical factor and disparities in persistence across demographics, highlighting age, as well (Alhassan, 2012; Brown, 2002, Fairchild; 2003; Mancuso, 2001; Polson, 2003). However, there is consensus in this subsequent literature with regard to
the needs of non-traditional students. Put simply; like traditionally-aged students, non-traditional student success requires an institutional and programmatic environment that is purposefully crafted with their unique needs in mind. Though there are similarities between non-traditional students and master’s students, it is difficult to generalize the research as completely applicable to the master’s student experience. Especially, when considering the differences in the types of programs available at the master’s level, the shorter duration, the increased expense, the limited availability of funding, and the higher academic expectations of master’s programs. Perhaps then, Polson’s (2003) focus on graduate students provides the appropriate direction to take in looking to better understand master’s student completion. Like Brown (2002), Fairchild (2003), Mancuso (2001) and Alhassan (2012), Polson (2003) too focuses on non-traditional students and acknowledges the importance of a unique, tailored effort on the part of institutions in creating conditions for degree completion. However, where the previous research centers non-traditional undergraduate students, Polson focuses on graduate students, but more exclusively on doctoral students. It is important to define the term “graduate” student as it is not exclusive to either “doctoral” student or “master’s” student. Rather, the term “graduate” student encompasses both populations, and is best represented by acknowledging graduate students as those enrolled in a post-baccalaureate degree- or certificate-granting program.

**Doctoral Students**

Most (2008) suggests that despite decades of interest in doctoral student outcomes, there have been few comprehensive studies that address doctoral degree completion. Perhaps the increased attention was due in part by the success of the Ph.D. Completion Project (Council of Graduate Schools, 2008), which sought to better
understand the role of gender, citizenship, and race/ethnicity in completion and attrition. The critical finding of the comprehensive study, which started in 2001 and incorporated data from 30 institutions, identified that the ten-year graduation rate for doctoral students sat just above the halfway mark at 56% (Council of Graduate Schools, 2008). Prior to the Ph.D. Completion Project, Most (2008) also sought to produce a longitudinal study of doctoral completion and found that completion rates varied by academic field, gender, ethnicity, and whether students possessed a Master’s degree upon entering their respective doctoral program. The work of Lott et al. (2009) reinforces the work of Most (2008) and the Council of Graduate Schools (2008) in that it also shows a difference in doctoral attrition across race, gender, academic program, and GRE scores. Though these studies do not have the breadth, depth, or thrust of comparable completion studies administered at the undergraduate level by IPEDS, the value of these studies is in starting the conversation by identifying the issue - that approximately half of doctoral students complete their degree. Despite the aforementioned limitations, these studies also have a secondary benefit in that they identify a number of populations that struggle with degree completion. One of the earliest studies, and one that predates the work of Most (2008) and the Council of Graduate Schools (2008) by nearly fifty years is the work of Baird & Holtzman (1969). Their foundational study identified two factors, the importance of the relationships (student to student and student to faculty) and the need for support, in retaining graduate students. These factors would seem like a throwback to the work of Tinto, Astin, Pascarella and Terenzini, and Kuh, but Baird and Holtzman’s (1969) study predates their work by decades. Golde (1998), however, reinforces not only the work of Baird and Holzman (1969), but also that of Tinto (1975) and Pascarella and Terenzini (1979), stressing the importance of academic and social integration, and the work of
Astin (1984) and Kuh (2007), acknowledging the shared responsibility of student and institution. Building on the work of these scholars, Golde (1998) introduces the concepts of socialization along with discipline-specific nuances that may play a role in doctoral completion. The work is foundational and stimulates the genesis of a number of other studies which identify the impact of department- or discipline-specific factors on doctoral degree completion (de Valero, 2001; Golde, 2005; Lott et al., 2009). This literature is critical in addressing the concerns about the high attrition and low completion rates plaguing doctoral education, but is particularly relevant to the master’s student experience as well.

**Master’s Students**

Many of the studies using the term “graduate” do little to focus on student populations and experiences outside of doctoral students. As stated earlier, the term “graduate student” is an umbrella term that includes all post-baccalaureate degree- and certificate-seeking students including master’s and doctoral degrees. Though typically grouped together, these populations of students are distinct enough that perhaps they should not be. This is particularly true for master’s students whose distinctiveness manifests not only as a dearth in scholarship regarding degree outcomes, but also the student experience itself.

Studies which focus on master’s degree outcomes, including overall graduation rates and time to degree, are simply not as readily available as undergraduate benchmarking or as lauded as doctoral scholarship. The Master’s Completion Project, initiated by the Council of Graduate Schools, sought to bridge the gap between student populations and determined at the master’s level MBA students had a four-year graduation rate of 86% and STEM students had a rate of 66%. The study provided
possible benchmarks for graduation rates and time to degree, but was constrained by the limited number of participant institutions and fields of study. Unfortunately, simply too little is known about the rates in which master’s students graduate, in what timeframe, and thus, there is little conversation or consensus in determining a time frame suitable for measurement.

Those differences within the master’s experience itself also emerge within the types of programs available, the shorter duration, the limited availability of funding, and the very purpose of the degree. Where doctoral degrees prepare students to research and create new knowledge, master’s degrees prepare students for professional advancement or for entry into doctoral programs (Council of Graduate Schools, 2013; Gordon, 2016). Master’s students seek “to improve skills and knowledge” (Council of Graduate Schools, 2013, p. 46) and “to increase opportunities for promotion, advancement, and/or pay” (Council of Graduate Schools, 2013, p. 46). These sentiments are not unfounded, according to the Bureau of Labor Statistics (2019), those with a master’s degree will earn, on average, nearly half a million dollars more over the course of their career than their peers with only a bachelor’s degree. Gándara and Toutkoushian (2017) agree and suggest that the financial returns are “positive and substantial” (p. 40) for master’s degree recipients, albeit in business and education programs, specifically. Moreover, the perceived financial return of a master’s degree is a powerful motivator in degree completion.

Motivation and determination, whether rooted in finances or not, are frequently identified factors critical to successfully completing their program (Council of Graduate Schools, 2013; Kuncel & Hezlett, 2007, Swinton, 1987). These researchers suggested that the mere desire to complete a program was a driving force in being able to do so. The
concept of motivation as a precursor to degree completion does not exist in a vacuum, it is echoed by Cohen (2012) in a study that describes the drive as “Intent to Persist”. In the study, the “finding suggests that for master’s students as a whole, the commitment to the degree, their commitment to earning the degree at their home institution and their commitment to returning to the same program the next term, had the strongest positive effect on retention” (p. 26). Mercer (2015) and Aiello (2017) would agree; as both of their studies suggest that motivation is critical and is connected to a number of factors; including the value a degree offers financially. However, as powerful as motivation can be in completing a master’s degree, there are uncontrollable factors that can dampen the drive of even the most talented students. Similar to traditional, non-traditional, and doctoral students, systemic inequities can negatively impact master’s degree completion by manifesting as disparities across environmental factors; including institution, academic disciplines and attendance pattern, and demographic attributes; including age, race, ethnicity, and gender (Aiello, 2017; Barry & Mathies, 2011; Cohen, 2012; Council of Graduate Schools, 2013; Mercer, 2015; Ott, Marewich, and Ochsner, 1984).

**Environment-based Variables**

**Attendance Pattern.** Two early studies; the previously mentioned work of Ott, Markewich and Ochsner (1984) and Ott and Markewich (1985), both found disparities in graduation rates by attendance pattern (“registration status”); full-time and part-time students. The findings of both studies indicate that students enrolled full-time had higher rates of graduation. The work of Pyke and Sheridan (1993) corroborates this finding and too find that full-time students fare better than their part-time peers, but only when a research paper is a requirement. This finding is subsequently reinforced by the 2011 study of Barry and Matheis who also found that “were significantly more likely to be
retained and graduate than part-time students.” (p. 20). Thus, over the past four decades, there has been considerable amount of research to corroborate the finding that students enrolled in a full-time schedule have higher rates of graduation than part-time students.

**Representation (Gender, Race/ethnicity).** Most of the literature addressing the impact of racial and gender representation focuses on the doctoral student retention. In 2001, Ellis launched a study to better understand the impact of race and gender on degree completion and finds that black women are less likely to persist on to graduation. Ellis (2001) suggests that the disparity is due to a disconnect to their advisors and peers perpetuated by an inhospitable racial climate and lack of socialization opportunities experienced as both a female and a person of color. Ferreira (2003) found that females in science programs experienced a similar phenomenon regarding what had been traditionally male spaces. In 2009, Lott et al. highlight the term “critical mass” and offer “[w]hen students, such as women and students of color, are surrounded by a critical mass of others who are like them, they tend to be retained and finish at higher levels than students who are relatively isolated demographically” (p. 262). The work of Ostriker, Kuh, and Voytuk (2011) too addresses the concern over racial representation at the doctoral level and suggests that the problem is self-propagating due to the limited proportion of underrepresented students in doctoral programs. This literature suggests that the community of students, and your ability to see yourself in your peers, impacts graduation outcomes.

**Institution.** The history of the models of student retention have clearly recognized the institution in which students reside as a factor that impacts degree completion. At the master’s level, this may be best exemplified by the exploratory study of the Council of Graduate Schools. Within this study, the Council of Graduate Schools
(2013) looked at completion data from five U.S. institutions and found the three-, four-, or six-year completion rates for all programs ranged from as low as 68% to as high as 80%, with the three remaining institutions reported completions rates of 75%, 77%, and 77%. Unfortunately, there are few additional studies that identify or address differences in degree completion rates by institution at the master’s level. However, considerably more is known about the differences in completion rates for specific academic programs and disciplines.

Academic Discipline. One of the earliest studies to investigate master’s degree completion was the work of Ott, Markewich, and Ochsner (1984) which employed a logit model to analyze certain variables and their connection to retention and degree attainment. They found retention rates were results of two sets of interaction effects; between academic division and between registration status and academic division and race/visa status. Interestingly, the follow-up study of Ott and Markewich (1985) did not find the same association between these variables and degree completion at the master’s level.

Similar to the earlier study of Ott, Markewich and Ochsner (1984), the Higher Education Division of the Department of Education, Training, and Youth Affairs in Australia conducted a study which looked at students that started a master’s program in 1992 (Martin, Maclachlan, & Karmel, 2001). They found differences in the seven-year completion rates between academic disciplines with students enrolled in science programs outcompeting their colleagues in architecture, arts, humanities and social sciences, and business and economics by 12-21%. Reinforcing the findings of Martin, Maclachlan, and Karmel (2001) is the study of the Canadian Association for Graduate Studies (2004), which also looked at students entering a master’s program at Canadian
Universities in 1992. This study also found that students enrolled in sciences (physical and applied) had higher degree completion rates than students enrolled in the social sciences; 83% and 73% after ten years, respectively. Barry and Matheis’ 2011 study also found disparities in three-year graduation rates by academic discipline. Their work, which focused on 3799 students enrolled in master’s programs between 2006 and 2008, found higher graduation rates for students enrolled in arts and humanities (72.0%), business (89.9%), education (73.3%), social sciences and psychology (91.2%), and other programs (85.0%), and lower rates for engineering (42.1%), life sciences (69.1%), and physical and earth sciences (57.0%). However, it should be noted that these are three-year graduation rates and though engineering, life sciences, and physical and earth sciences had lower rates and higher attrition rates after their first year on the program, these programs also had the highest percentage of students enrolled after their third year of the program; 15.8%, 9.2%, and 15.2%, respectively. This could mean a boost to the graduation rates of these disciplines upon the close of years four and beyond, albeit a modest one. In 2013, as part of the Master’s Completion Project, the Council of Graduate Schools found that across five institutions, students in MBA programs had a four-year degree completion rate of 86% where students in STEM programs had a rate of 66%.

**Start Term.** Unfortunately, little is known about the impact of the term (Fall, Spring, Summer) in which students begin on degree completion. Nevertheless, any disparities could indicate unintended differences between terms in which students are admitted, how those students are on-boarded (new student orientation), what resources are made available to these students, and even down to the availability, selection, and instruction of courses. As such, this variable will be included in the model to control for its effects.
Demographic-based Variables

Age. The seminal work of Metzner and Bean (1987) regarding non-traditional students suggested that age played a role, albeit indirectly, in student retention. That role is subsequently brought to the forefront by many researchers whose studies suggest that age can negatively impact undergraduate graduation rates (Alhassan, 2012; Brown, 2002; Fairchild; 2003; Mancuso, 2001; Polson, 2003). At the master’s level, age is also a mitigating factor in graduation. The work of Barry and Matheis (2011), Cohen (2012), and Aiello (2017), all suggest that as a student ages, their likelihood of graduation begins to diminish. This finding is corroborated at the doctoral level as well (Hagedorn and Doyle, 1993)

However, two much earlier studies found that age was not statistically significant, either individually or as an interaction effect, in predicting graduation (Ott and Marewich, 1985; and Ott, Marewich, and Ochsner, 1984). Nevertheless, much of the subsequent research mentioned earlier indicates that age plays a factor in graduation outcomes, across all student populations; undergraduate, master’s, and doctoral.

Race/ethnicity. Though there is little evidence specific to master’s student degree completion, as it pertains to race and ethnicity, there is an abundance of research on “graduate” students with a particular focus on doctoral students. What is known about master’s students was uncovered during the first component of the Master’s Completion Project, when the Council of Graduate Schools (2013) found disparities in graduation outcomes by race and ethnicity. According to the study, Hispanic/Latino/Latina and Black/African American have lower two-, three-, and four-year cumulative completion rates than their White and Asian/Pacific Islander peers. Similar findings manifest at the doctoral level as well. The longitudinal studies of both Most (2008), the Council of
Graduate Schools (2008), and Lott, Garder, and Powers (2009) also found that rates
varied by race and ethnicity. However, where the Council of Graduate Schools identified
that African American students had the lowest rates of graduation, Most (2008) and Lott,
Garder, and Powers (2009) found that Asian American students had the lowest
graduation rates. However, Shapiro et al. (2017) found that degree completion gaps
between racial groups diminish as students age. In the supplement to their signature
report that looked at completion rates by race and ethnicity for students who started
programs in Fall 2010, they found a 24 percent disparity in completion rates between
white and black students and a 17.5 percent disparity between white and Hispanic
students, among traditionally-aged students. That gap shrunk for white and black and
white and Hispanic non-traditional students to 12.3 and 9.1 percent, respectively.

**Gender.** According to the National Center of Education Statistics, female
master’s students graduate at a lower rate than males within three years (Wine, Camisole,
Wheeless, Dudley, and Franklin, 2005). These results were somewhat supported when
the Council of Graduate Schools (2008) found that women enrolled in PhD programs had
higher rates of graduation in the humanities and social sciences but had lower rates of
graduation overall and within STEM programs; engineering, life sciences, and math and
physical sciences. Most (2008) and Lott et al. (2009) also found that female PhD students
graduated at lower rates, but where Lott et al. found a more pronounced disparity, Most
(2008) found the gap to be marginal and span only 2-3%. Aiello (2017) suggests that
women enrolled in master’s programs are less likely to persist on to graduation, not due
to the nature and difficulty of the coursework, but rather due to the juggling act incurred
by women with multiple identities; mother, employee, and student. This work supports
the earlier findings of Hagedorn and Doyle (1993) which focused on female PhD
students, but placed a larger emphasis on socialization and stresses the gap between male faculty and female students. Furthermore, the work of Aiello (2017) and Hagedorn and Doyle (1993) suggest the disparity in graduation rates for women is intensified with age.

However, in a master’s specific study, the Council of Graduate Schools (2013) found that though fewer women were enrolled in MBA and STEM programs, they graduated at a higher rate than their male peers within four years. Further confounding this research is the much earlier work of Ott, Marewich, and Ochsner (1984), who found that for both master's and doc students, retention was not related to the gender (“sex”) of the student or any type of statistical interaction involving this variable.

**Citizenship.** Unfortunately, there is limited information regarding how a master’s student’s citizenship, whether international or domestic, impacts their progression towards degree completion. However, Ott, Marewich, and Ochsner (1984), found that among master’s students, international students (“foreign” students), had higher rates of retention than domestic students. Likewise, as part of the Master’s Completion Project, the Council of Graduate Schools (2013) also found that international students (“temporary residents”) had a four-year completion rate that is 7% higher than domestic students (“U.S. citizens” and “permanent residents”) within master’s STEM programs, and 11% higher for MBA programs. These studies corroborate King’s (2008) study, which found that the 10-year doctoral completion rate for international students was higher than the completion rate for domestic students. The Council of Graduate Schools (2013) suggests that the difference “may be explained by motivations to return to their home country after graduation, and/or the fact that their status as a temporary resident is only possible during the program of study” (p. 40). However, Pyke and Sheridan (1993) found that financial support was a significant predictor of successful master’s degree
completion and O’Brien (1992) found that international students were more likely to receive financial support. Regardless of what is causing it, there is a small consensus that a student’s citizenship can be a factor in degree completion for graduate students, and master’s students specifically.

**Residency.** As little information is available regarding the effects on citizenship on retention, even less is known about impact of residency status (in-state, out of state) on student success and degree completion for either master’s or doctoral students. Nevertheless, it will be included in the model, if only to control for its possible effects.

**Chapter Summary**

Historically, retention had been folded into the admission process (Seidman, 2012). Students would make their selection among a number of colleges, focused on a set of prioritized parameters and personal criteria, and institutions would attempt to admit graduates based on their proprietary process (Cortes, 2013; Perna, 2006; Seidman, 2012). Evidence suggests that college and university decision-making around admissions may not be calibrated to accomplish one of its primary goals regarding degree completion, given that graduation rates for two-year students, four-year students, and doctoral students have remained stagnant and without substantive improvement for decades. In exploring the scholarship surrounding admissions and retention, across undergraduate, doctoral, and master’s degree completion, differences and similarities emerge. The differences between these populations are clear and abundant, but center around the admissions process (centralized vs. decentralized) and experience of the student within the context of their degree. The similarities reside in the importance admissions processes place on traditional measures of success and cognitive attributes, but also within the importance of the environment of the student. Within this literature review, I have
attempted to convey the point that students do not access their education equally and there are an abundance of factors that can impact degree completion. These common factors undergird the importance of this dissertation in investigating the predictive validity of undergraduate GPA and standardized test scores and their combined ability to forecast degree completion while controlling for environment-based variables (institution, academic discipline, attendance pattern, start term, gender representation, racial/ethnic representation) as well as demographic-based variables (race/ethnicity, gender, age, residency, citizenship).
CHAPTER 3: METHODS

Within this section, I discuss the research design of this dissertation, the procedures used in its implementation, the new measures created, the characteristics of the sample, and the details of the data analysis, including the appropriateness of binary logistic regression in examining the relationship between admissions-, demographic-, and environment-based attributes, and master’s degree completion.

Research Design

This dissertation employed binary logistic regression analysis to determine the attributes (independent variables), such as admissions data (undergraduate GPA, test scores), environmental data (attendance pattern, representation, institution, academic discipline, start term), and demographic data (age, gender, race/ethnicity, residency status, citizenship), most associated with the dependent variable; master’s student degree completion. Two additional intention, examining master’s completion rates and time to degree were included in the analysis and used descriptive statistics to determine student graduation rates and the length of time it takes students to complete their degrees, respectively.

Data Collection

This study was submitted to the Rutgers University Institutional Review Board (IRB) on March 17, 2019 and approved on July 3, 2019 with IRB protocol number Pro2019000634. Upon receiving authorization to move forward, the researcher initiated the data collection phase of the study. Seeking to recruit a sample of students from a homogenous group of institutions, a purposeful sampling technique was employed (Creswell, 2006). Inclusion criteria for the study was institution-specific, not student-specific, in that eligible participant institutions had to be large, public research
institutions, members of the Association of American Universities (AAU) - a group of sixty-five American research universities with a strong focus on academic research and education, and offered master’s degrees between 2009 and 2018. The recruitment strategy included sending an invitation to participate to all of the deans of the eligible institutions with the promise that they would remain anonymous, findings would be shared in aggregate, and the researcher would provide institution-specific results with the respective institutions. These invitations (Appendix 1) were developed and distributed with the intent to describe the study, its benefits, and garner participation. Five institutions agreed to participate upon the execution of a data use agreement (DUA), prepared by Rutgers University’s Office of Research and Economic Development - Sponsored Research Agreements. The agreements guaranteed anonymity for institutions and their students, ensured FERPA and HIPAA compliance, defined a security protocol, and communicated appropriate data transmission procedures. Consequent to the mutual execution of the respective data use agreements, the institutions were provided a template (Appendix 2) and instructions for data transmission to box.com, a secure, encrypted, cloud-based file storage location. All five participant institutions uploaded the datasets to an institution-specific box.com location between August 26, 2019 and February 25, 2020.

Data Normalization

Each participant institution submitted a dataset with its own manner in which to report data; a unique controlled vocabulary, category codes, naming conventions, and column headers, and thus had to be normalized. The process of normalization is the action of organizing disparate datasets and all of their varying categories and classifications so that they adhere to a standard classification effectuating consistency
within the final dataset (Codd, 1971). This process was completed using Microsoft Excel for Mac version 16.16.25.

**Variables**

**Dependent Variable.** The dependent variable for this study is operationalized as a binary outcome; either the student graduated or they did not graduate, and must be one or the other - the outcome cannot be both. As such, not all students within the sample have graduated, but all of them have been included in the model. Similarly, all students, regardless of graduation outcome, have been included in the descriptive statistics.

**Independent Variables.** The following independent variables have been included in the statistical model and all descriptive statistics.

1. Undergraduate GPA
2. Test Score Percentile
3. Attendance Pattern
4. Representation by Race/Ethnicity
5. Representation by Gender
6. Academic discipline
7. Institution
8. Start term
9. Age at start of program
10. Race/Ethnicity
11. Gender
12. Residency
13. Citizenship
A data dictionary for all dependent and independent variables, and their operational definitions, variable type, and coding values, including reference categories, has been provided in Table 1 below. The methodology for determining test score percentile, academic discipline, and representation are included within the “Measures” section below.

Table 1. Data Dictionary; variables, operational definitions, type, and coding values.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Operational Definition</th>
<th>Type</th>
<th>Coding Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Age at time of program start.</td>
<td>Continuous</td>
<td>n/a</td>
</tr>
<tr>
<td>Undergraduate GPA</td>
<td>The GPA the student earned at their undergraduate institution.</td>
<td>Continuous</td>
<td>n/a</td>
</tr>
<tr>
<td>Test Score Percentile</td>
<td>The percentile earned on the standardized test taken. Represents GMAT score or GRE score converted to GMAT score via conversion tables.</td>
<td>Continuous</td>
<td>n/a</td>
</tr>
<tr>
<td>Representation Race/Ethnicity</td>
<td>The proportional representation of a student's race/ethnicity within their academic program at their institution.</td>
<td>Continuous</td>
<td>n/a</td>
</tr>
<tr>
<td>Representation Gender</td>
<td>The proportional representation of a student's gender within their academic program at their institution.</td>
<td>Continuous</td>
<td>n/a</td>
</tr>
<tr>
<td>Academic Discipline</td>
<td>The academic discipline of the student.</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>Academic discipline is within Arts and Humanities</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Biological and Agricultural Sciences</td>
<td>Academic discipline is within Biological and Agricultural Sciences</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Business*</td>
<td>Academic discipline is within Business*</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Education</td>
<td>Academic discipline is within Education</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Engineering</td>
<td>Academic discipline is within Engineering</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Health and Medical Sciences</td>
<td>Academic discipline is within Health and Medical Sciences</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Mathematics and Computer Sciences</td>
<td>Academic discipline is within Mathematics and Computer Sciences</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Other Fields</td>
<td>Academic discipline is within Other Fields</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Physical and Earth Sciences</td>
<td>Academic discipline is within Physical and Earth Sciences</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Public Administration and Services</td>
<td>Academic discipline is within Public Administration and Services</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>Academic discipline is within Social and Behavioral Sciences</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Start Term</td>
<td>The term in which the student intended to begin master’s coursework.</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Fall*</td>
<td>Intended term is Fall</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Spring</td>
<td>Intended term is Spring</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Summer</td>
<td>Intended term is Summer</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Attendance Pattern</td>
<td>The intended course load of a student at time of</td>
<td>Categorical</td>
<td>1, if else 0</td>
</tr>
<tr>
<td>Full-time</td>
<td>Intended course load is 9 credits or more.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Part-time*</td>
<td>Intended course load is less than 9 credits.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Residency</td>
<td>The permanent residency of the student as it pertains to the state of the institution.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In State*</td>
<td>Permanent residency within the same state as the institution.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Out of State</td>
<td>Permanent residency not within the same state as the institution.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>The reported race/ethnicity of the student.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not report or unknown</td>
<td>Race/ethnicity not reported or unknown</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>Race/ethnicity reported as Asian</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Black or African American</td>
<td>Race/ethnicity reported as Black or African American</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Hispanic or Puerto Rican</td>
<td>Race/ethnicity reported as Hispanic or Puerto Rican</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>International</td>
<td>Race/ethnicity reported as International</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Multi/American Indian/ Hawaiian or Pacific Islander</td>
<td>Race/ethnicity reported as Multi/American Indian/Hawaiian or Pacific Islander</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>White*</td>
<td>Race/ethnicity reported as White</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td>The reported gender of the student.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>Reported gender is female.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Male*</td>
<td>Reported gender is male.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Institution</td>
<td>The institution where the data originated.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institution 1</td>
<td>Originated at institution 1.</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Institution 2</td>
<td>Originated at institution 2.</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Institution 4*</td>
<td>Originated at institution 4.</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Institution 5</td>
<td>Originated at institution 5.</td>
<td>Categorical 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Graduation Outcome</td>
<td>The outcome of the student after ten years of potential enrollment.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not graduate</td>
<td>Student did not earn a master's degree.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
<tr>
<td>Graduated</td>
<td>Student earned a master's degree.</td>
<td>Dichotomous 1, if else 0</td>
<td></td>
</tr>
</tbody>
</table>

Note: Reference category*

Measures

In addition to completing the process of normalization, four new variables were computed: academic discipline, test score percentile, and two representation-based variables.
**Academic Discipline**

To include academic discipline in the model, the variable needed to be reduced significantly from 372 different academic programs. To achieve this reduction, each academic program was reviewed and reclassified according to the “broad fields of study” taxonomy employed by Okahana and Zhou (2019). Consequently, the academic discipline variable is now represented across eleven fields: Arts and Humanities, Biological and Agricultural Sciences, Business, Education, Engineering, Health and Medical Sciences, Mathematics and Computer Sciences, Other Fields, Physical and Earth Sciences, Public Administration and Services, and Social and Behavioral Sciences. A full taxonomy of each academic discipline, and the corresponding academic programs, has been provided in Appendix 3.

**Test Score Percentile**

The test score percentile variable (“test_”) was created to standardize two commonly-used admissions-based tests used by the participant institutions and their specific academic programs; the Graduate Record Examination General Test (GRE) and the Graduate Management Admission Test (GMAT). To achieve this standard score, students with GMAT scores had their scores converted to percentiles and students with GRE scores had their scores converted to equivalent GMAT percentiles, per the high correlation between performance of test-takers on GMAT and GRE (Pesta, Fuerst, Kirkegaard, & Papaleo, 2019).

Those students with GMAT scores had their raw score (range 200 to 800) converted to percentile via the GMAT concordance table which was derived from the “How did I do?” tool published on the GMAC website (How Did I Do? GMAT™ Score Distributions 2007-2009, 2009). In order to more easily calculate simultaneous
comparisons for the thousands of students contained within the sample, each score and corresponding percentile was recorded in a table within Microsoft Excel. This obviated any reliance on using the web-based tool for each individual calculation.

Those students with GRE scores required a three-step conversion to obtain a GMAT equivalent. The first step involved converting the GRE verbal and quantitative scores (range 200 to 800) from the scores of the “Old” test (range 200 to 800), tests taken before 2011, to the “New test” (range 130 to 170), tests taken in 2011 and thereafter. The scores contained within the GRE concordance tables were used to make this conversion (GRE Concordance Tables, 2011). In step 2, the converted GRE verbal and quantitative scores (range 130 to 170) were then converted to GMAT scores using the “GRE® Comparison Tool” (GRE Business School Comparison Tool (For Institutions), 2017). The Microsoft Excel version of the tool was used, again to more easily calculate for the large sample of students. The third step involved converting the new GMAT score to the equivalent percentile. With both scores adequately converted to a percentile (range 0.0 to 1.0), an appropriate comparison between the two can be included in the model.

**Representation**

The representation-based variables; representation by race/ethnicity (“rep_race”) and representation by gender (“rep_gender”), are the proportion of the number of students of a given race/ethnicity or gender within a specific academic program at a specific academic institution compared to the total number of students in that same program at that same institution. Meaning, if there are ten people in a given program at a given institution and five are white, three are Asian, and two are black, then the white, Asian, and black students have a rep_race value 0.5, 0.3, and 0.2, respectively.
Sample

The research sample included a population of students pursuing their master’s degree at the participant institutions; a group of five large, public, research universities within the United States. As such, this study represented a secondary analysis of data that have already been collected by the participant institutions, with each institution using its own data source(s), and sharing that information with the researcher. The data were retrieved with the assistance of a data custodian at each participant institution and were sourced from their respective student information systems, admissions databases, and diploma databases. This dataset is an appropriate choice for this study because it offered consistency, a requirement for binary logistic regression and, because it dated back to 2009, it mitigated time as a detractor to completion. Accordingly, the students within the sample were diverse across the dependent variable and all independent variables.

The study focused on a ten-year enrollment period, included students admitted during the 2009 calendar and/or academic year, and assessed rates through the end of 2018. Both calendar and academic year were used to accommodate the participant institutions’ varied semesters, start terms, and academic calendars. A ten-year timeframe was used because a standard measurement of time has not been established for master’s students, unlike associate degree-seekers (three-year standard), bachelor’s degree-seekers (four- and six-year standards) and doctoral students (ten-year standard).

The full sample size of this student population across all five of the participant institutions is 10,704 observations (students). However, due to incomplete undergraduate GPA and test score percentile data “institution 3” was dropped entirely. Similarly, “modality,” the variable capturing program’s delivery method, was incomplete and thus also excluded from the model. This lack of information pertaining to modality is likely
due to the limited number of institutions delivering fully-online programs in 2009 and the lack of reporting surrounding those that did. Subsequent to the aforementioned listwise deletion, only four institutions and 4,039 students (n=4,039) have been included in the statistical analysis (Table 2).

Table 2. *Institution Descriptive Statistics.*

<table>
<thead>
<tr>
<th>Institution</th>
<th>n</th>
<th>Students excluded</th>
<th>Students included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institution 1</td>
<td>3358</td>
<td>2104</td>
<td>1254</td>
</tr>
<tr>
<td>Institution 2</td>
<td>1489</td>
<td>723</td>
<td>766</td>
</tr>
<tr>
<td>Institution 3</td>
<td>1273</td>
<td>1273</td>
<td>0</td>
</tr>
<tr>
<td>Institution 4</td>
<td>3044</td>
<td>1622</td>
<td>1422</td>
</tr>
<tr>
<td>Institution 5</td>
<td>1540</td>
<td>943</td>
<td>597</td>
</tr>
</tbody>
</table>

**Data Analysis**

The primary goals of research questions one and two (RQ1 and RQ2) were to better understand admissions-, environment-, demographic-based attributes associated with master’s degree completion. Binary logistic regression was selected as the method of statistical analysis in determining which attributes (independent variables) can predict the odds of degree completion for students (dependent variable). Stata: Software for Statistics and Data Science (Stata) version 16.0 was used to conduct all statistical analyses (Stata: Software for Statistics and Data Science, 2020). The secondary goals of research question three (RQ3) were to explore master’s student retention and persistence by computing completion rates and time to degree. This analysis leaned on the descriptive statistics and was performed using Microsoft Excel for Mac version 16.16.25 (Microsoft Excel, 2018).
**Statistical Approach**

When selecting a statistical method, Creswell and Creswell (2018) suggest using a “quantitative approach for testing objective theories by examining the relationship between variables” (p. 4). The method must also be well suited to answer the research question (Creswell, 2014; Hosmer et al., 2013; Osborne, 2015). As such, the statistical method utilized in identifying the attributes associated with master’s degree completion was binary logistic regression. Also known as logistic regression or logit regression, binary logistic regression represents one of many quantitative research methods, but is one of the most commonly used statistical approaches to understanding relationships between variables (Hosmer et al., 2013). As a quantitative method, binary logistic regression enlists a post-positivist worldview, often referred to as the “scientific method,” which questions positivism in that it “represents the thinking after positivism, challenging the traditional notion of the absolute truth of knowledge” (Creswell & Creswell, 2018, p. 6; Phillips & Burbules, 2000). Consequently, the nature of this research did not seek to identify an all-encompassing universal truth, nor can it. Rather, the goal was to identify independent variables associated with master’s degree completion within the sample of participant institutions.

The power of binary logistic regression rests in its applicability and utility. Researchers with a congruent dataset containing multiple independent variables and a dichotomous dependent variable are well-served in utilizing binary logistic regression for their analysis. Hosmer et al. (2013) further suggests that “the strength of the logistic regression model is its ability to handle many variables, some of which may be on different measurement scales” (p. 35). Binary logistic regression can accommodate continuous variables and, with basic transformations, ordinal and categorical variables, as
well. Finally, Hosmer et al. (2013) suggests that the goal of binary logistic regression is to “find the best fitting and most parsimonious, clinically interpretable model to describe the relationship between an outcome (dependent or response) variable and a set of independent (predictor or explanatory) variables” (p. 1). Additionally, binary logistic regression allows the researcher to identify those variables with the most impact, whether the finding is statistically significant in predicting the dichotomous dependent variable, and the direction of that relationship, should one exist (Egerton, 2018; Menard, 2001). Meaning, not only can binary logistic regression tell us the strength of the relationship between independent and dependent variables, communicated by the value of the coefficient, but also how the relationship changes with a change in each additional unit, positively or negatively (Egerton, 2018; Miller, 2008). Finally, logistic regression can indicate as to whether this relationship is caused by something other than chance (Egerton, 2018). In addition to being broadly applicable and useful, its deployment and consequent results are relatively easy to perceive, thus making it accessible to both the researcher and their audience.

Though easy to conceptualize, the results of the calculation and the corresponding coefficients are not as easily interpreted and must be converted to “odds” and then to “odds ratios”. The calculation from coefficient to odds uses base $e$, given that binary logistic regression is based on natural logarithm, and uses the coefficient as the exponent. The challenging interpretation, however, does not end there. Odds (and in the case of logistic regression log-odds) are not probabilities and there may be a penchant for audiences unfamiliar with odds to confuse the two. Where probability is the chance for success on a scale from 0 to 1, odds represents the ratio between success and failure. Further complicating the interpretation is “log-odds,” or the logarithmic function of the
odds. Accordingly, it is critical that researchers utilizing a logit model be explicit in their interpretations and explanations as they relate to the other variables (Miller, 2008). Due to these considerations, all of the models within this dissertation are presented with both coefficients and odds ratios.

For these reasons, within quantitative research methods, binary logistic regression represents one of the most commonly used statistical approaches to understanding relationships between variables. Though Osborne (2015) suggests that “logistic regression is a relative newcomer to the statistical toolbox, particularly in the social sciences, but it is currently considered the best practice when dealing with outcomes that are dichotomous or categorical in nature” (Chapter 1, p. 14), the benefits of binary logistic regression are extolled in higher education (Hosmer et al., 2013). This is in part because the logit model is an appropriate and powerful statistical tool for researchers interested in the binary outcomes of the college experience; those who have graduated and those who have not. Consequently, logistic regression is ubiquitous throughout the higher education literature and often surrounds a similar dependent variable; college completion, student success, or student retention (Glover, 2012; Medrano, 2015; Murray, Ireland, & Hackathorn, 2016; Overholt, 2016; Pyke & Sheridan, 1993). In fact, binary logistic regression was used so frequently that there was a study that examined its use (Peng, So, Stage, & St. John, 2002). Within this study, Peng and her colleagues (2002) found that though logistic regression was used often in the leading higher education journals, it was used capriciously. The researchers identified issues with appropriate sample sizes, use of modeling terminology, and the interpretation of the outcomes. To address these concerns, a guide was created and provided to established and fledgling researchers to promote consistency (Peng, Lee, & Ingersoll, 2002). Thus, all subsequent
research involving logit modeling within higher education has had the benefit of such a resource and higher education researchers continue to gravitate to binary logistic regression, albeit better equipped, for many of the reasons already discussed within the context of this section. Accordingly, the findings of prior research and their ability to advocate for policy change by more soundly identifying areas of student need, particularly as they relate to access, affordability, student support and success, and ultimately degree completion, have been strengthened considerably (Astin & Oseguera, 2004; Glover, 2012; Jaeger & Hinz, 2008; Medrano, 2015; Murray et al., 2016; Overholt, 2016; Pyke & Sheridan, 1993; Stage, 1988).

**Required Sample Characteristics.** In order to implement a binary logistic regression model, an appropriately-sized and consistent sample is required. The size of the sample must be large enough to handle all of the independent variables and account for the required number of degrees of freedom (Cohen, Cohen, West, & Aiken, 2002). For every additional independent variable included in the model, the sample must increase in size and every variable must be represented at a ratio of at least forty to one (Osborne, 2015). Meaning, any variable not represented across at least forty observations cannot be included in the model. Peduzzi, Concato, Kemper, Holford, and Feinstein (1996) offer a different perspective regarding effective sample size. Their formula $N = 10k/p$, suggests that a sample should be ten times the number of independent variables (k) over the smallest proportion between dependent variables (p). Doing so would both ensure statistical power and prevent over- and under-estimates of parameters of the logistic regression analysis. The dataset utilized within this dissertation has a sample size (n=4039) large enough to satisfy both sets of statistical criteria:

- Osborne (2015):
In addition to size, consistency is important. Every variable included in the model must be represented consistently across all of the observations. For example, a study that involves a sample dataset of students as the observations and seeks to include high school GPA as an independent variable within the model, requires that all observations (students) indicate a high school GPA. There cannot be any inconsistencies or missing data in the form of blank entries across any of the observations, unless deliberately imputed and incorporated by the researcher. Osborne (2015) offers, “logistic regression is a bit of a fickle process, and loss of power (sample size) due to missing data can dramatically harm power to detect effects” (Chapter 11, p. 2). Therefore, the manner and detail in which the dataset is collected can become a limitation if the dataset is inconsistent or incomplete.

**Correlation and Multicollinearity.** Tests were performed to determine if any of the variables are correlated or if multicollinearity exists between variables. Simply, these tests aim to ensure that each variable is independent from one another (correlation) and affects the dependent variable independently of one another (multicollinearity) (Stockburger, 2018). To address the concern over correlation, all covariates were analyzed via a correlation matrix. Correlation values will range from -1 to 1, where 0 indicates no correlation and -1.0 and 1.0 indicate high correlation and possibly multicollinearity (Pampel, 2000). All values with 0.9 and below within the matrix indicate low correlation (Egerton, 2018). In cases where variables are highly correlated, the regression model was modified to only include one of the correlated variables.
Regarding multicollinearity, Sim offers the following supplementary information suggesting that “it occurs when two or more predictors are highly correlated, such that they are each explaining much the same variance in the outcome variable” (2018, p. 3). And though correlation between variables will prove troublesome, multicollinearity, or linearly dependent variables, can be uniquely ruinous to a logistic regression model (Osborne, 2015). This is because multicollinearity makes for an unsolvable regression equation (Osborne, 2015). To address this issue, the following two statistical tests were performed to ensure multicollinearity is absent within the model; variance inflation factor (VIF) and tolerance. If the model produces VIF values above 10 (Allison, 2001) and tolerance values below 0.1 (Menard, 2001), it may mean that the issue of multicollinearity needs to be addressed. In doing so, the dangers of multicollinearity and subsequent limitation to binary logistic regression can be avoided (Osborne, 2015).

**Alpha Level.** To signal statistical significance of an odds ratio, the alpha level was set at .05, a commonly used threshold (Egerton, 2018). Any odds ratio with a p value less than .05 limits the likelihood that the association is by coincidence to only 5%. Meaning, there is a 95% confidence that variables do indeed have an association and not simply by chance (Egerton, 2018). This threshold also limits the chance of a type one error to 5% (Kim, 2018). A type one error, also known as a false positive, is when a null hypothesis is true, but has been rejected (Egerton, 2018).

**Research Questions**

To address the gaps in the literature around master’s degree completion, my research questions are as follows:

1. **RQ1:** What is the relationship between admissions-based attributes, specifically undergraduate GPA and standardized test score percentile, and master’s degree
completion, while controlling for demographic- and environment-based attributes?

2. **RQ2:** What is the relationship between environment-based attributes, specifically attendance pattern and representation, and master’s degree completion, while controlling for admissions-, demographic-, and environment-based attributes?

3. **RQ3:** What is the graduation rate and time to degree for the 2009 master’s cohort?

**Hypotheses, Control Variables, and Reference Categories**

To operationalize research questions one and two, I offer the following hypotheses and reference categories. The basis for these hypotheses and reference choices were discussed in the “Literature Review” section.

**Admissions-based Variables (RQ1).**

- **Undergraduate GPA (H1)**
  - Higher undergraduate GPA will be associated with greater odds of graduation than lower undergraduate GPA.

- **Standardized Test Score Percentile (H2)**
  - Higher test score percentile will be associated with greater odds of graduation than lower test score percentile.

**Environment-based Variables (RQ2 and control variables/reference categories).**

- **Attendance Pattern (H3)**
  - An attendance pattern of full-time will be associated with greater odds of graduation than an attendance pattern of part-time.

- **Representation by Race/Ethnicity (H4)**
Higher proportion of race/ethnicity representation will be associated with greater odds of graduation than those with lower proportions of like-race/ethnicity representation.

- Representation by Gender (H5)
  - Higher proportion of gender representation will be associated with greater odds of graduation than those with lower proportions of like-gender representation.

- Academic discipline
  - Students matriculated in a Business-related academic discipline will be associated with greater odds of graduation than students matriculated in non-Business-related academic disciplines, such as Arts and Humanities, Biological and Agricultural Sciences, Education, Engineering, Health and Medical Sciences, Mathematics and Computer Sciences, Other Fields, Physical and Earth Sciences, Public Administration and Services, and Social and Behavioral Sciences.

- Institution
  - Institutional impact will be statistically significant, but a specific institution has not been identified as more impactful.

- Start Term
  - A Fall start term will be associated with greater odds of graduation than Spring or Summer.

**Demographic-based Variables (control variables/reference categories).**

- Age
○ Older students (those with higher ages) will be associated with lower odds of graduation than younger students (those with lower ages).

● Race/Ethnicity
  ○ Students identifying as Asian will be associated with greater odds of graduation than students identifying as Black, Hispanic or Puerto Rican, International, Multi/American Indian/Hawaiian or Pacific Islander, White, and those students whose racial identity is unknown or was not reported.

● Gender
  ○ Female students will be associated with lower odds of graduation than male students.

● Residency
  ○ In-state residency will be associated with greater odds of graduation than out of state.

● Citizenship
  ○ U.S. citizenship and permanent residency is associated with lower odds of graduation than non-U.S. citizenship.
CHAPTER 4: RESULTS

This chapter summarizes and discusses the descriptive statistics of the sample and the results of the binary logistic regression derived following the application of the methodology framed in Chapter 3. As such, this section is organized in a manner to address the three research questions posed in the introduction as they pertain to admissions-, environment-, and demographic-based variables, and the hypotheses. In reviewing the results of the binary logistic regression model, each variable will be addressed in terms of its significance, power, and direction. Stata: Software for Statistics and Data Science (Stata) version 16.0 and Microsoft Excel for Mac version 16.16.25 were used to conduct all statistical analyses (Microsoft Excel, 2018; Stata: Software for Statistics and Data Science, 2020).

Descriptive Statistics

A total of 4,039 students (n=4,039) across four participant institutions were included in the sample. Regarding the admissions-based variables, the range for undergraduate GPA was 1.3 to 4.0, the mean GPA was 3.41, the median was 3.46, and the standard deviation was 0.38. Standardized test score percentile spanned the full range of possible scores; 0.00 to 0.99, had a mean score of 0.40, a median score of 0.36, and a standard deviation of 0.26.

Demographic-based variables were varied as well. The mean age of a student in the model was 26.37 years old, the median age was 25.0, standard deviation was 5.2, and participants ranged in age from 20 to 60 years. Race/ethnicity was segmented into seven groups; Asian (8.07%), Black or African American (4.53%), Hispanic or Puerto Rican (3.94%), International (4.93%), Multiple Races, American Indian, or Hawaiian or Pacific Islander (1.51%), White (69.5%), or did not report (7.53%). Gender was segmented into
only two groups, given the available data; female (51.1%) and male (48.9%). Residency was also segmented into two groups; in-state (71.01%) and out-of-state (28.99%). Finally, the variable Citizenship was omitted from the model due to issues with correlation with the “international” segment of the race/ethnicity variable.

The final cluster of variables included in the model were environment-based. Academic discipline was organized into eleven overarching academic categories; Arts and Humanities (8.17%), Biological and Agricultural Sciences (6.14%), Business (31.94%), Education (8.64%), Engineering (11.19%), Health and Medical Sciences (4.61%), Mathematics and Computer Science (2.62%), Other Fields (12.9%), Physical and Earth Sciences (3.14%), Public Administration and Services (6.93%), and Social and Behavioral Sciences (3.71%). Start term was divided into three categories; Fall (75.02%), Spring (16.07%), and Summer (8.91%). Similarly, Attendance Pattern is a two-category variable and is broken down into full-time (76.06%) and part-time (23.94%).

Finally, graduation outcomes were binary in nature; graduated (85.81%) and did not graduate (14.19%). All descriptive statistics can be found in Table 3.
<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>%</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Median</th>
<th>Mode</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate GPA</td>
<td>3.41</td>
<td>0.38</td>
<td>3.46</td>
<td>3.30</td>
<td>1.30</td>
<td>4.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Test Score Percentile</td>
<td>0.42</td>
<td>0.27</td>
<td>0.38</td>
<td>0.28</td>
<td>0.00</td>
<td>1.00</td>
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<td>Attendance Pattern</td>
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<tr>
<td>Full-time</td>
<td>3072</td>
<td>76.06%</td>
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<tr>
<td>Part-time</td>
<td>967</td>
<td>23.94%</td>
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<td>Arts and Humanities</td>
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<td>8.17%</td>
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<td></td>
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<tr>
<td>Biological and Agricultural Sciences</td>
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<td>6.14%</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Business</td>
<td>1290</td>
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<td></td>
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<tr>
<td>Education</td>
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<tr>
<td>Engineering</td>
<td>452</td>
<td>11.19%</td>
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</tr>
<tr>
<td>Health and Medical Sciences</td>
<td>186</td>
<td>4.61%</td>
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<td></td>
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<tr>
<td>Mathematics and Computer Sciences</td>
<td>106</td>
<td>2.62%</td>
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<td></td>
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<tr>
<td>Other Fields</td>
<td>521</td>
<td>12.90%</td>
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<tr>
<td>Physical and Earth Sciences</td>
<td>127</td>
<td>3.14%</td>
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<tr>
<td>Public Administration and Services</td>
<td>280</td>
<td>6.93%</td>
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<td></td>
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</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>150</td>
<td>3.71%</td>
<td></td>
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<td>Institution</td>
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<td>Institution 1</td>
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<tr>
<td>Institution 2</td>
<td>766</td>
<td>18.97%</td>
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<tr>
<td>Institution 4</td>
<td>1422</td>
<td>35.21%</td>
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<tr>
<td>Institution 5</td>
<td>597</td>
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<td>Start Term</td>
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<td>Fall</td>
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<td>Spring</td>
<td>649</td>
<td>16.07%</td>
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<tr>
<td>Summer</td>
<td>360</td>
<td>8.91%</td>
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<td>Age</td>
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<td>26.37</td>
<td>5.20</td>
<td>25.00</td>
<td>22.00</td>
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<td>60.00</td>
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<td>Race/Ethnicity</td>
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<tr>
<td>Did not report</td>
<td>304</td>
<td>7.53%</td>
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<td>Asian</td>
<td>326</td>
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<td>Black or African American</td>
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<td>Hispanic or Puerto Rican</td>
<td>159</td>
<td>3.94%</td>
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<tr>
<td>International</td>
<td>199</td>
<td>4.93%</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Multi/American Indian/Hawaiian or</td>
<td>61</td>
<td>1.51%</td>
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</tr>
<tr>
<td>Pacific Islander</td>
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</tr>
<tr>
<td>White</td>
<td>2807</td>
<td>69.50%</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Gender</td>
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</tr>
<tr>
<td>Female</td>
<td>2064</td>
<td>51.10%</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
<td>1975</td>
<td>48.90%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Residency</td>
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<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>In State</td>
<td>2868</td>
<td>71.01%</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Out of State</td>
<td>1171</td>
<td>28.99%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Graduation Outcome</td>
<td></td>
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<tr>
<td>Did not graduate</td>
<td>573</td>
<td>14.19%</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Graduated</td>
<td>3466</td>
<td>85.81%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>All Students</td>
<td>4039</td>
<td>100.00%</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Correlation Matrices and Multicollinearity

A correlation test was run to determine if any of the variables were correlated. None of the variables were correlated and that all had a correlation that clustered closer to zero, with the range being -0.2012 to 0.3575. (Table 4)
Additionally, multicollinearity was not found. All VIF values are less than or equal to 3.43 and have a mean VIF of 1.50. (Table 5)

Table 5. VIF Test.

<table>
<thead>
<tr>
<th>Representation</th>
<th>VIF</th>
<th>1/VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Representation: Race</td>
<td>3.43</td>
<td>0.291765</td>
</tr>
<tr>
<td>Race: Asian</td>
<td>1.84</td>
<td>0.544347</td>
</tr>
<tr>
<td>Institution 5</td>
<td>1.71</td>
<td>0.584407</td>
</tr>
<tr>
<td>Race: Did not report/Unknown</td>
<td>1.70</td>
<td>0.587708</td>
</tr>
<tr>
<td>Discipline: Other Fields</td>
<td>1.69</td>
<td>0.592900</td>
</tr>
<tr>
<td>Discipline: Engineering</td>
<td>1.68</td>
<td>0.595935</td>
</tr>
<tr>
<td>Test Score Percentile</td>
<td>1.66</td>
<td>0.603590</td>
</tr>
<tr>
<td>Discipline: Education</td>
<td>1.65</td>
<td>0.604330</td>
</tr>
<tr>
<td>Institution 1</td>
<td>1.65</td>
<td>0.606794</td>
</tr>
<tr>
<td>Discipline: Arts and Humanities</td>
<td>1.59</td>
<td>0.629424</td>
</tr>
<tr>
<td>Race: Black or African American</td>
<td>1.56</td>
<td>0.642030</td>
</tr>
<tr>
<td>Institution 2</td>
<td>1.51</td>
<td>0.663315</td>
</tr>
<tr>
<td>Race: Hispanic Or Puerto Rican</td>
<td>1.51</td>
<td>0.663893</td>
</tr>
<tr>
<td>Race: International</td>
<td>1.49</td>
<td>0.671231</td>
</tr>
<tr>
<td>Discipline: Health and Medical Sciences</td>
<td>1.47</td>
<td>0.682201</td>
</tr>
<tr>
<td>Discipline: Biological and Agricultural Sciences</td>
<td>1.44</td>
<td>0.692350</td>
</tr>
<tr>
<td>Discipline: Public Administration and Services</td>
<td>1.41</td>
<td>0.711177</td>
</tr>
<tr>
<td>Residency: Out of State</td>
<td>1.35</td>
<td>0.739868</td>
</tr>
<tr>
<td>Attendance Pattern: Full-Time</td>
<td>1.33</td>
<td>0.751281</td>
</tr>
<tr>
<td>Discipline: Social and Behavioral Sciences</td>
<td>1.26</td>
<td>0.793455</td>
</tr>
<tr>
<td>Start Term: Summer</td>
<td>1.25</td>
<td>0.799712</td>
</tr>
<tr>
<td>Race: Multi/Amer. Indian/Hawaiian or Pac. Isl.</td>
<td>1.24</td>
<td>0.809061</td>
</tr>
<tr>
<td>Gender: Female</td>
<td>1.23</td>
<td>0.814368</td>
</tr>
<tr>
<td>Undergraduate GPA</td>
<td>1.20</td>
<td>0.833838</td>
</tr>
<tr>
<td>Discipline: Physical and Earth Sciences</td>
<td>1.19</td>
<td>0.841496</td>
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<tr>
<td>Age</td>
<td>1.16</td>
<td>0.863915</td>
</tr>
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<td>Representation: Gender</td>
<td>1.15</td>
<td>0.868174</td>
</tr>
<tr>
<td>Start Term: Spring</td>
<td>1.13</td>
<td>0.884010</td>
</tr>
<tr>
<td>Discipline: Mathematics and Computer Sciences</td>
<td>1.11</td>
<td>0.898401</td>
</tr>
<tr>
<td>Mean VIF</td>
<td>1.50</td>
<td></td>
</tr>
</tbody>
</table>
Binary Logistic Regression Model

To find the model with the best fit, several variations were explored and focused on transforming and testing the age variable. A naturally continuous variable, age was tested in four models: linear, quadratic, cubic, and natural log to unearth the association of age on graduation. The tests resulted in the following log likelihood statistics; -1535.7103 for linear, -1533.7906 for quadratic, for -1533.7061 cubic, and -1534.7956 for natural log. As such, the linear model was the best fit of the four models tested because its log likelihood was the largest.

Though the results in Table 6 below report the pseudo R-squared (“R2”), its value should not be interpreted for logistic regression in the same way it is interpreted for linear regression where higher values are typically associated with better-fitted models. Hosmer et al. suggest “low R2 values in logistic regression are the norm and this presents a problem when reporting their values to an audience accustomed to seeing linear regression values” (2013, p. 185). As such, this value, admittedly-low at 0.0689, should not be used to judge model fitness. Rather, to ensure the selected model accommodated the dataset overall, two more appropriate goodness-of-fit tests were performed. The Pearson chi-square test is a goodness-of-fit test that determines whether the observed frequency distribution within the model differs from a theoretical distribution whereas the Hosmer-Lemeshow goodness-of-fit test which divides subjects into ten groups based on predicted probabilities and then computes a chi-square predicated on observations and expectations (Hosmer et al., 2013). Within the results, the Pearson chi-square and Hosmer-Lemeshow goodness-of-fit tests have p-values of 0.7882 and 0.1557, respectively. These values, both greater than the significance level of 0.05, suggest that there is not enough evidence to conclude that the given model does not fit the data.
However, despite these goodness-of-fit tests indicating *some* degree of model fitness, the relatively low p-value of the Hosmer-Lemeshow test suggests a weaker overall model fitness.

The results of the binary logistic regression indicate statistical significance across several independent variables and will be explored in greater detail below. (Table 6)
Table 6. Binary Logistic Regression.

| DV: Graduated = 1 | Coef.   | Odds Ratio | Std. Err. | z       | P>|z|  | [95% Conf. Interval] |
|-------------------|---------|------------|-----------|---------|-----|---------------------------|
| Undergraduate GPA | 0.241697| 1.273408   | 0.165495  | 1.86    | 0.063| 0.987061 - 1.642826      |
| Test Score Percentile | -0.050458| 0.950794 | 0.217693 | -0.22 | 0.826| 0.607010 - 1.489282      |
| Attendance Pattern: Full-Time | 0.951357| 2.589221 | 0.297773 | 8.27   | 0.000| 2.066697 - 3.243854      |
| Representation: Race | -0.345386| 0.707947 | 0.195873 | -1.25 | 0.212| 0.411616 - 1.217612      |
| Representation: Gender | -0.282928| 0.753574 | 0.164096 | -1.30  | 0.194| 0.491780 - 1.154731      |
| Discipline: Arts and Humanities | -1.095959| 0.334219 | 0.069907 | -5.24  | 0.000| 0.221814 - 0.503585      |
| Discipline: Biological and Agricultural Sciences | -1.470823| 0.229736 | 0.049829 | -6.78  | 0.000| 0.150179 - 0.351440      |
| Discipline: Education | -0.680902| 0.506160 | 0.110550 | -3.12  | 0.002| 0.329896 - 0.776603      |
| Discipline: Engineering | -1.200996| 0.300895 | 0.054940 | -6.58  | 0.000| 0.210375 - 0.430364      |
| Discipline: Health and Medical Sciences | -0.802143| 0.448367 | 0.122517 | -2.94  | 0.003| 0.262447 - 0.765995      |
| Discipline: Mathematics and Computer Sciences | -1.341307| 0.261504 | 0.068835 | -5.10  | 0.000| 0.156106 - 0.438063      |
| Discipline: Other Fields | -0.679893| 0.506672 | 0.095880 | -3.59  | 0.000| 0.349663 - 0.734182      |
| Discipline: Physical and Earth Sciences | -1.172886| 0.309472 | 0.083838 | -4.33  | 0.000| 0.181981 - 0.526280      |
| Discipline: Public Administration and Services | -0.474067| 0.622466 | 0.150057 | -1.97  | 0.049| 0.388077 - 0.998420      |
| Discipline: Social and Behavioral Sciences | -1.052090| 0.349207 | 0.092759 | -3.96  | 0.000| 0.207483 - 0.587739      |
| Institution 1 | -0.039755| 0.961025 | 0.122953 | -0.31  | 0.756| 0.747882 - 1.234913      |
| Institution 2 | -0.287058| 0.750468 | 0.103419 | -2.08  | 0.037| 0.572838 - 0.983179      |
| Institution 5 | 0.457678| 1.580400 | 0.286919 | 2.52   | 0.012| 1.107217 - 2.255803      |
| Start Term: Spring | -0.443648| 0.641691 | 0.078412 | -3.63  | 0.000| 0.505025 - 0.815341      |
| Start Term: Summer | -0.245555| 0.782270 | 0.150985 | -1.27  | 0.203| 0.535880 - 1.141947      |
| Age | -0.034460| 0.966127 | 0.007991 | -4.17  | 0.000| 0.950590 - 0.981917      |
| Race: Unknown | -0.142340| 0.867327 | 0.208098 | -0.59  | 0.553| 0.541942 - 1.388073      |
| Race: Asian | -0.316038| 0.729032 | 0.162584 | -1.42  | 0.156| 0.470887 - 1.128694      |
| Race: Black or African American | -0.391821| 0.675825 | 0.178839 | -1.48  | 0.139| 0.402334 - 1.135224      |
| Race: Hispanic Or Puerto Rican | -0.017734| 0.982422 | 0.301085 | -0.06  | 0.954| 0.538802 - 1.791298      |
| Race: International | 0.205501| 1.228140 | 0.338706 | 0.75   | 0.456| 0.715315 - 2.108621      |
| Race: Multi/American Indian/Hawaiian Or Pacific Islander | -0.485268| 0.615533 | 0.241475 | -1.24  | 0.216| 0.285314 - 1.327942      |
| Gender: Female | 0.191670| 1.211271 | 0.126688 | 1.83   | 0.067| 0.986764 - 1.486856      |
| Residency: Out of State | -0.184520| 0.831504 | 0.100311 | -1.53  | 0.126| 0.656413 - 1.053298      |

Cons | 2.468291| 11.802260 | 6.518522 | 4.47   | 0.000| 3.997945 - 34.841230      |
Research Questions and Hypotheses

Research Question 1: Admissions-based Variables

What is the relationship between admissions-based attributes, specifically undergraduate GPA and standardized test score percentile, and master’s degree completion, while controlling for demographic- and environment-based attributes?

Undergraduate GPA (H1). In looking at the binary regression analysis in Table 6, the variable “Undergraduate GPA” has a p-value of 0.063 which is greater than the 0.05 alpha level. This suggests within this model, Undergraduate GPA is not statistically significant, net of other factors. Accordingly, we cannot reject the null hypothesis and cannot conclude that higher Undergraduate GPA is associated with greater odds of graduation than lower undergraduate GPA.

Test Score Percentile (H2). According to the binary regression analysis in Table 6, the variable “Test Score Percentile” has a p-value of 0.826 which is greater than the 0.05 alpha level. Within this model, it would suggest that Test Score Percentile is not statistically significant, net of other factors. As such, we cannot reject the null hypothesis and cannot conclude that higher test score percentile is associated with greater odds of graduation than lower test score percentile.

Research Question 2: Environment-based Variables

What is the relationship between environment-based attributes, specifically attendance pattern and representation, and master’s degree completion, while controlling for admissions-, demographic-, and environment-based attributes?

Attendance Pattern (H3). In looking at results of the binary logistic regression analysis in Table 6, the category “Full-time “ within the variable “Attendance Pattern” has a p-value of 0.000 which is less than the 0.05 alpha level. This would suggest that
Attendance Pattern is statistically significant, controlling for other factors. Furthermore, Full-time status has an odds ratio of 2.589 which indicates that students matriculating in their master’s degree program full-time have 2.589 higher odds than their peers matriculated part-time. Accordingly, we can reject the null hypothesis and can conclude that an attendance pattern of full-time is associated with greater odds of graduation than an attendance pattern of part-time.

**Representation by Race/Ethnicity (H4).** As per the binary logistic regression analysis in Table 6, the model indicates the “Representation by Race/Ethnicity” variable has a p-value of 0.212 which is greater than the 0.05 alpha level. This would suggest that Representation by Race/Ethnicity is not statistically significant within the context of this model. Accordingly, we cannot reject the null hypothesis and cannot conclude that a higher proportion of race/ethnicity representation is associated with greater odds of graduation than those with lower proportions of race/ethnicity representation.

**Representation by Gender (H5).** The results of the binary logistic regression analysis in Table 6 indicates the “Representation by Gender” variable has a p-value of 0.194 which is greater than the 0.05 alpha level. This would suggest that Representation by Gender is not statistically significant, net of other factors. Therefore, we cannot reject the null hypothesis and cannot conclude that a higher proportion of gender representation is associated with greater odds of graduation than those with lower proportions of gender representation.

**Academic discipline.** As per the binary logistic regression analysis in Table 6, all eleven academic disciplines were significant as all ten categories included within the model had p-values that were less than 0.05; Arts and Humanities (p=0.000), Biological and Agricultural Sciences (p=0.000), Education (p=0.002), Engineering (p=0.000),
Health and Medical Sciences (p=0.003), Mathematics and Computer Sciences (p=0.000), Other Fields (p=0.000), Physical and Earth Sciences (p=0.000), Public Administration and Services (p=0.049), and Social and Behavioral Sciences (p=0.000). This would suggest that, controlling for other factors, Academic discipline is statistically significant, regardless of the specific discipline. Because Business was used as the reference category, the odds ratios for each of the ten comparative categories is in reference to Business and that all ten academic disciplines have odds ratios less than 1. This means that students in each discipline are less likely to graduate than their peers matriculated in business programs; Arts and Humanities students have 0.334 lower odds, Biological and Agricultural Sciences students have 0.230 lower odds, Education students have 0.506 lower odds, Engineering students have 0.301 lower odds, Health and Medical Sciences students have 0.448 lower odds, Mathematics and Computer Sciences students have 0.262 lower odds, students in Other Fields have 0.507 lower odds, Physical and Earth Sciences students have 0.309 lower odds, Public Administration and Services students have 0.622 lower odds, and Social and Behavioral Sciences students have 0.349 lower odds.

**Institution.** The results of the binary logistic regression analysis in Table 6 indicate two of the categories within variable “Institution” have a p-value less than the 0.05 alpha level; Institution 2 (p=0.037) and Institution 5 (p=0.012). These findings indicate that, within the context of this model, the relationships between Institutions 2 and 5 and the reference category, Institution 4, are statistically significant. However, where students from Institution 2 have lower odds of graduating, an odds ratio of 0.750, students from Institution 5 have higher odds of graduating, an odds ratio of 1.580, than their peers from Institution 4. Conversely, Institution 1 has a p-value of 0.756 which is
greater than the 0.05 alpha level. This indicates that Institution 1 is not statistically significant as it relates to Institution 4, the reference category. Hence, we can conclude that the results of institutional impact are mixed. For some, institutional impact is statistically significant and not for others. As mentioned in Chapter 3, Institution 3 was omitted due to missing data and an incompatible sample.

**Start Term.** According to the results of the binary logistic regression analysis in Table 6, the categories “Spring” and “Summer” within the variable “Start Term” have p-values of 0.000 and 0.203, respectively. This suggests that starting in the Spring is statistically significant, given that its p-value is less than the 0.05 alpha level. Conversely, starting in the Summer is not statistically significant, given that its p-value is greater than the 0.05 alpha level. This suggests that a start term of Spring is statistically significant, in relation to students beginning in the fall and has an odds ratio of 0.078. This indicates that students starting in their master’s degree program in the Spring term have 0.078 lower odds than their peers starting in the Fall.

**Demographic-based Variables**

**Age.** The results of the binary logistic regression analysis in Table 6 indicate the variable “Age” has a p-value of 0.000 which is less than the 0.05 alpha level. This would suggest that Age is statistically significant within the context of this model. Furthermore, Age has an odds ratio of 0.9661 which indicates that as a student’s age increases, their odds of graduation decrease slightly, and does so linearly.

**Race/Ethnicity.** As per the binary regression analysis in Table 6, the seven categories under the variable “Race/Ethnicity” all have p-values greater than the 0.05 alpha level; Did not report/Unknown (p=0.553), Asian (p=0.156), Black or African American (p=0.139), Hispanic or Puerto Rican (p=0.954), International (p=0.456), and
Multi/American Indian/Hawaiian or Pacific Islander (p=0.216). These p-values suggest within this model, not a single category within the Race/Ethnicity variable statistically significant, including White students.

**Gender.** In looking at the binary regression analysis in Table 6, the category “Female” under the variable “Gender” has a p-value of 0.067 which is greater than the 0.05 alpha level. Within this model, it would suggest that Gender is not statistically significant, net of other factors.

**Residency.** According to the binary logistic regression analysis in Table 6 indicates the category “Out of State” within the variable “Residency” has a p-value of 0.126 which is greater than the 0.05 alpha level. This would suggest that Residency is not statistically significant within the context of this model.

**Citizenship.** Citizenship was heavily correlated with the “International” category of the Race/Ethnicity variable and was omitted from the model. However, as stated earlier, the model indicated that International students had a p-value of 0.456 which is greater than the 0.05 alpha level. This would suggest that Citizenship, via proxy, is not statistically significant, net of other factors.

**Research Question 3: Graduation Rate and Time to Degree**

*What is the graduation rate and time to degree for the 2009 master’s cohort?*

Of the 4,039 students that started their master’s journey during 2009, 3,466 persisted on to graduation. This represents a graduation rate of 85.81%. This rate is not distributed evenly across the variables and disparities manifest most dramatically by academic discipline, start term, and attendance pattern. The most disparate graduation rates by academic discipline can be found between Mathematics and Computer Science
(75.47%) and Business (89.46%). The differences in Start term were comparatively disparate between Spring (79.66%) and Summer (88.33%). Correspondingly, the range in graduation rates for attendance pattern was also dramatic as evidenced by differences in full-time (88.57%) and part-time (77.04%) status.

Differences in graduation rate also manifest across race/ethnicity and gender. The range in graduation rate for race/ethnicity was just under seven percentage points (6.97) between Multiple Races, American Indian, or Hawaiian or Pacific Islander (81.97%) and International students (88.94%). Similarly, the graduation rate for females and males was 86.87% and 84.71%, respectively. The full breakdown of graduation rates can be found in Table 7.

The mean time to completion for students within this sample was 2.41 years or just under two years and five months, the minimum time to degree was 0.27 years, and the maximum was 9.68 years. Again, completion times vary most dramatically by academic discipline, start term, and attendance pattern. Within academic discipline, the students to complete their degrees the fastest on average were in Education (1.668 years) and the slowest in Business (2.807). Students that started in the Summer completed in an average of 1.696 years, where those that started in Spring completed in an average of 3.038 years. Similarly, full-time students completed faster than part-time students; on average 2.215 and 3.448 years, respectively. Differences in graduation rates are also apparent, but less so, across race/ethnicity and gender categories. (Table 7)
Table 7. Graduation Rate and Time to Degree.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Students Started</th>
<th>Students Graduated</th>
<th>Graduation Rate</th>
<th>Min Time to Degree</th>
<th>Max Time to Degree</th>
<th>Avg Time to Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Discipline</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>330</td>
<td>272</td>
<td>82.42%</td>
<td>0.441</td>
<td>6.809</td>
<td>2.251</td>
</tr>
<tr>
<td>Biological and Agricultural Sciences</td>
<td>248</td>
<td>196</td>
<td>79.03%</td>
<td>0.977</td>
<td>6.379</td>
<td>2.506</td>
</tr>
<tr>
<td>Business</td>
<td>1290</td>
<td>1154</td>
<td>89.46%</td>
<td>0.266</td>
<td>9.388</td>
<td>2.807</td>
</tr>
<tr>
<td>Education</td>
<td>349</td>
<td>302</td>
<td>86.53%</td>
<td>0.266</td>
<td>4.999</td>
<td>1.668</td>
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<td>Engineering</td>
<td>452</td>
<td>368</td>
<td>81.42%</td>
<td>0.381</td>
<td>9.676</td>
<td>2.224</td>
</tr>
<tr>
<td>Health and Medical Sciences</td>
<td>186</td>
<td>161</td>
<td>86.56%</td>
<td>0.977</td>
<td>6.888</td>
<td>2.306</td>
</tr>
<tr>
<td>Mathematics and Computer Sciences</td>
<td>106</td>
<td>80</td>
<td>75.47%</td>
<td>0.704</td>
<td>6.965</td>
<td>2.381</td>
</tr>
<tr>
<td>Other Fields</td>
<td>521</td>
<td>453</td>
<td>86.95%</td>
<td>0.381</td>
<td>8.307</td>
<td>2.205</td>
</tr>
<tr>
<td>Physical and Earth Sciences</td>
<td>127</td>
<td>104</td>
<td>81.89%</td>
<td>0.348</td>
<td>7.398</td>
<td>2.672</td>
</tr>
<tr>
<td>Public Administration and Services</td>
<td>280</td>
<td>250</td>
<td>89.29%</td>
<td>0.611</td>
<td>7.989</td>
<td>2.260</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>150</td>
<td>126</td>
<td>84.00%</td>
<td>0.977</td>
<td>6.979</td>
<td>2.254</td>
</tr>
<tr>
<td>Start Term</td>
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<tr>
<td>Fall</td>
<td>3030</td>
<td>2631</td>
<td>86.83%</td>
<td>0.381</td>
<td>9.388</td>
<td>2.373</td>
</tr>
<tr>
<td>Spring</td>
<td>649</td>
<td>517</td>
<td>79.66%</td>
<td>0.441</td>
<td>9.676</td>
<td>3.038</td>
</tr>
<tr>
<td>Summer</td>
<td>360</td>
<td>318</td>
<td>88.33%</td>
<td>0.266</td>
<td>7.967</td>
<td>1.696</td>
</tr>
<tr>
<td>Attendance Pattern</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time</td>
<td>3072</td>
<td>2721</td>
<td>88.57%</td>
<td>0.266</td>
<td>8.307</td>
<td>2.125</td>
</tr>
<tr>
<td>Part-time</td>
<td>967</td>
<td>745</td>
<td>77.04%</td>
<td>0.348</td>
<td>9.676</td>
<td>3.448</td>
</tr>
<tr>
<td>Residency</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In State</td>
<td>2868</td>
<td>2453</td>
<td>85.53%</td>
<td>0.266</td>
<td>9.676</td>
<td>2.520</td>
</tr>
<tr>
<td>Out of State</td>
<td>1171</td>
<td>1013</td>
<td>86.51%</td>
<td>0.266</td>
<td>6.727</td>
<td>2.142</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not report</td>
<td>304</td>
<td>268</td>
<td>88.16%</td>
<td>0.972</td>
<td>9.281</td>
<td>2.767</td>
</tr>
<tr>
<td>Asian</td>
<td>326</td>
<td>275</td>
<td>84.36%</td>
<td>0.649</td>
<td>7.989</td>
<td>2.499</td>
</tr>
<tr>
<td>Black or African American</td>
<td>183</td>
<td>152</td>
<td>83.06%</td>
<td>0.704</td>
<td>7.989</td>
<td>2.442</td>
</tr>
<tr>
<td>Hispanic or Puerto Rican</td>
<td>159</td>
<td>141</td>
<td>88.68%</td>
<td>0.266</td>
<td>6.639</td>
<td>2.242</td>
</tr>
<tr>
<td>International</td>
<td>199</td>
<td>177</td>
<td>88.94%</td>
<td>0.745</td>
<td>5.996</td>
<td>2.057</td>
</tr>
<tr>
<td>Multi/American Indian/Hawaiian or Pacific Islander</td>
<td>61</td>
<td>50</td>
<td>81.97%</td>
<td>0.704</td>
<td>6.965</td>
<td>2.217</td>
</tr>
<tr>
<td>White</td>
<td>2807</td>
<td>2403</td>
<td>85.61%</td>
<td>0.266</td>
<td>9.676</td>
<td>2.397</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>2064</td>
<td>1793</td>
<td>86.87%</td>
<td>0.266</td>
<td>7.989</td>
<td>2.282</td>
</tr>
<tr>
<td>Male</td>
<td>1975</td>
<td>1673</td>
<td>84.71%</td>
<td>0.381</td>
<td>9.676</td>
<td>2.546</td>
</tr>
<tr>
<td>Institution</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Institution 1</td>
<td>1254</td>
<td>1090</td>
<td>86.92%</td>
<td>0.266</td>
<td>9.281</td>
<td>2.687</td>
</tr>
<tr>
<td>Institution 2</td>
<td>766</td>
<td>634</td>
<td>82.77%</td>
<td>0.745</td>
<td>6.992</td>
<td>2.221</td>
</tr>
<tr>
<td>Institution 4</td>
<td>1422</td>
<td>1207</td>
<td>84.88%</td>
<td>0.266</td>
<td>9.388</td>
<td>2.335</td>
</tr>
<tr>
<td>Institution 5</td>
<td>597</td>
<td>535</td>
<td>89.61%</td>
<td>0.602</td>
<td>9.676</td>
<td>2.237</td>
</tr>
<tr>
<td>Graduation Outcome</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did not graduate</td>
<td>573</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Graduated</td>
<td>3466</td>
<td>266</td>
<td>85.81%</td>
<td>0.266</td>
<td>9.676</td>
<td>2.410</td>
</tr>
<tr>
<td>Grand Total</td>
<td>4039</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Clearly, time to degree has a connection with graduation rate. Put simply, with more time, students are more likely to graduate. Students whose time to degree is within three years have a 68.46% graduation rate. By comparison, for those graduating within four years, it increases to jumps to 79.20%, and for those graduating within six years it further increases to 84.35%. (Figure 1)

Figure 1. Graduation Rate by Time to Degree by Year.
CHAPTER 5: DISCUSSION

With tuition revenue increasingly becoming a primary source of income and by extension institutional sustainability, it is imperative that colleges and universities execute a well-balanced enrollment management strategy that relies as much on retention as has been traditionally on recruitment. With master’s students making up such a large portion of revenue, the importance of properly calibrated master’s admissions policies - whose principal purpose is to predict degree completion - cannot be overstated. This calibration is particularly important as it pertains to traditional measures of success and the predictive validity of undergraduate GPA and standardized test scores on degree completion. After all, they represent the two most commonly used measures by master’s admissions decision-makers in admitting master’s students and gauging potential success.

The purpose of this dissertation was to assess the predictive validity of undergraduate GPA and standardized test scores on degree completion. In addition to these two traditional measures of student success, demographic attributes and environmental factors were also considered. This rationale for the inclusion of these additional elements was two-fold; to acknowledge the considerable gap between admissions and retention literature and to ensure the statistical method employed, binary logistic regression, controlled for their existence. The logit model included more than 4000 students, in hundreds of programs, enrolled at four large, public, American research institutions.

This chapter will serve to digest this dissertation in four sections. The first section seeks to not only address the three research questions and interpret the key findings of the subsequent statistical investigation, including a detailed investigation of completion rates and time to degree. The second section offers both practice and policy implications for
higher education administrators, master’s admissions decision-makers, and legislators. The third section provides a discussion of the limitations of the study as well as recommendations for future research. The chapter concludes with its fourth section, a brief summary.

**Interpretation of the Findings**

The research presented within this paper contributes to a growing body of literature seeking to better understand the predictive validity of undergraduate GPA and standardized test scores on master’s student success outcomes. More specifically, this section will interpret the key findings of the three research questions:

- **RQ1**: What is the relationship between admissions-based attributes, specifically undergraduate GPA and standardized test score percentile, and master’s degree completion, while controlling for demographic- and environment-based attributes?
- **RQ2**: What is the relationship between environment-based attributes, specifically attendance pattern and representation, and master’s degree completion, while controlling for admissions-, demographic-, and environment-based attributes?
- **RQ3**: What is the graduation rate and time to degree for the 2009 master’s cohort?
Research Question 1: Admissions-based Variables

The substantial amount of prior research surrounding the predictive validity of undergraduate GPA and standardized test scores, GRE and GMAT, suggests that these measures are statistically significant and can adequately predict degree completion (Broadus & Elmore, 1983; Jin et al., 2004; Kirchner et al., 2001; Kjelgaard & Guarino, 2012; Kuncel et al., 2001, 2007, 2010; Kuncel & Hezlett, 2007; Schuler et al., 1993; Schwager et al., 2015; Symons, 1999; Wamala et al., 2012). However, there is a growing body of research that contradicts these findings and suggests that these measures cannot or do not sufficiently predict degree completion (Bedsole, 2013; Bleske-Rechek & Browne, 2014; Covert & Chansky, 1975; Hansen & Pozehl, 1995; Heritage, 1977; House, 1989; Kass et al., 2019; Miller & Stassun, 2014; Newton & Moore, 2007; Rhodes et al., 1994; Swinton, 1987; Tanguma et al., 2012). The results of the binary logistic regression for RQ1, the admissions-based traditional measures of success, rest somewhere between these two definitive assertions. The model found that neither undergraduate GPA (H1) nor standardized test scores (H2) were statistically significant (p>0.063 and p>0.826, respectively). This means, within the parameters of this study, that it is not possible to conclude any statistical relationship between the traditional measures of success and master’s degree completion. Accordingly, one outcome could be for practitioners to reconsider any perpetuation of these deep-seated, educational customs in favor of possible alternative measures of success (Cortes, 2013; Fischer et al., 2013; Hagedorn & Nora, 1996; Kent & McCarthy, 2016; Michel et al., 2019; Miller & Stassun, 2014; Posselt, 2016; Zwick, 2002, 2007). Such a change in philosophy and practice would effectively initiate the first steps in the adoption of an admissions process that
seeks to incorporate these noncognitive measures, skills, and attributes in a more holistic way (Kent & McCarthy, 2016; Posselt, 2016; Okahana et al., 2018).

However, the inconclusive results of the model could be explained in part by the weak model fitness. Because master’s students graduate at rates markedly better than their undergraduate and doctoral peers, there is reason for pause. If the primary purpose of the master’s admissions process is to forecast success, there is evidence that the reliance on undergraduate GPA and standardized test scores may be effective in forecasting success considering the nearly 86% graduation rate for master’s students. As such, this finding - the lack of statistical significance - does not necessarily put this study at odds with the decades of research and professional practice that lauds the inclusion of traditional measures of success within the admissions process. Nor does it put it at odds with the growing body of research that collectively calls into question the efficacy of such measures, and thus its very place, in master’s admissions. Rather, the outcomes of this research question situate it between the extremes of the previous scholarship.

**Research Question 2: Environment- and Demographic based Variables**

The environment-based attributes investigated in RQ2 are the most prominent in terms of statistical significance across attendance pattern, academic discipline, institution, and start term. However, the results of the logit model are mixed, not only between variables, but within their respective categories.

The results of the model signal the statistical significance of attendance pattern (H3) (p-value=0.000). Full-time students have 2.589 higher odds of graduating than their part-time peers. This represents the greatest disparity between any two populations included within the statistical model. The results, though dramatic, are not unfounded and reinforce the early studies of Ott et al. (1984), Ott and Markewich (1985), and Pyke and
Sheridan (1993), and the more recent study of Barry and Matheis (2011), all of which suggest that attending full-time increases a students’ likelihood of graduation and subsequently serve to highlight the comparative disadvantage faced by part-time students.

Conversely, representation by race/ethnicity (H4) and representation by gender (H5) were not statistically significant, according to the results of the model. As such, these findings are at odds with the work of Ellis (2001) who found incongruities between the graduation rates of women of color and other students. They also conflict with the studies of Ferreira (2003) and Ostriker et al. (2011), which also found inconsistencies in graduation outcomes by gender and racial representation, respectively. Confusingly, the results regarding the attributes operationalized as representation do not speak to the importance of “critical mass” mentioned by Lott et al. (2009). Perhaps at the master’s level, racial and gender gaps fail to emerge in light of two compounding phenomena. First, is the previously mentioned front-loading of the racist and sexist policies within the admissions process that see women and students of color disproportionately excluded from being admitted (Hagedorn & Nora, 1996; Kuncel and Klieger, 2007; Michel et al., 2019; Small, 2017; Steele & Aronson, 1995; Zwick, 2002, 2007). Second, master’s students may simply be less affected by their social and environmental conditions, which would be in line with the non-traditional student findings of Metzner and Bean (1987).

Perhaps the most salient and interesting finding of RQ2 is the statistical significance ($p$-value$<0.05$) of every academic discipline included within the model. For example, Public Administration and Services and Biological and Agricultural Sciences disciplines have the highest and lowest odds ratios of 0.6224 and 0.2297, respectively. With Business disciplines acting as the reference category, this means that master’s students in Public Administration and Services programs have 0.6224 times the odds than
Business students to persist on to graduation and are the second most likely students to do so. Conversely, those master’s students in Biological and Agricultural Sciences programs have 0.2297 times the odds than Business students to complete their degrees and are the least likely to do so. Accordingly, this means that not only do both groups of academic disciplines have lower odds of graduating, but all academic disciplines have lower odds of graduating than master’s students in Business programs. Perhaps the financially-based motivation for students enrolled in business programs in the form of advancement, promotion, and career prospects, coupled with tuition remission benefits, the flexibility in program modality and structure (full-time, part-time, online, executive), and access to superior student services resources, particularly those identified as “concierge-level” services, foster greater rates of degree completion (Council of Graduate Schools, 2013; Gándara and Toutkoushian, 2017).

In addition, this finding may also be interpreted as a larger split between academic disciplines that prepare students for a professional career when compared to those disciplines that prepare students for an academic career, if such a clear line could be drawn between these two possible programmatic intentions regarding career preparation. In Table 8, the odds ratios of the disciplines deemed “Professional”; Business, Education, Engineering, Health and Medical Sciences, and Public Administration and Services range from 0.4483 to 1.000. Conversely, those disciplines deemed “Academic”; Arts and Humanities, Biological and Agricultural Sciences, Math and Computer Sciences, Physical and Earth Sciences, and Social and Behavioral Sciences have odds ratios that range from 0.2297 to 0.3492.
Table 8. *Academic Discipline, Odds Ratios, Professional and Academic.*

<table>
<thead>
<tr>
<th>Academic Discipline</th>
<th>Odds Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional</td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>1.0000</td>
</tr>
<tr>
<td>Education</td>
<td>0.5061</td>
</tr>
<tr>
<td>Engineering</td>
<td>0.3008</td>
</tr>
<tr>
<td>Health and Medical Sciences</td>
<td>0.4483</td>
</tr>
<tr>
<td>Public Admin and Services</td>
<td>0.6224</td>
</tr>
<tr>
<td>Academic</td>
<td></td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>0.3342</td>
</tr>
<tr>
<td>Biological and Agricultural Sciences</td>
<td>0.2297</td>
</tr>
<tr>
<td>Mathematics and Computer Sciences</td>
<td>0.2615</td>
</tr>
<tr>
<td>Physical and Earth Sciences</td>
<td>0.3094</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>0.3492</td>
</tr>
</tbody>
</table>

Clearly the impact of a student’s choice to pursue a certain degree is extraordinary and manifests in two ways; first, this finding suggests that a student’s chosen academic discipline has the power to help or to hinder degree attainment, and second, that certain academic disciplines can have a more potent impact on degree completion than others, either positively and negatively. This finding corroborates the earlier work of Ott, Markewich and Ochsner (1984), Martin et al. (2001), Canadian Association of Graduate Studies (2004), and Barry and Matheis (2011) all of which found a disparities between specific academic disciplines and graduation outcomes.

Though little is known about inter-institutional differences in master’s completion rates, they demonstrated a mixed statistical significance within the logit. Institutions 2 and 5 both indicated significance (p=0.037 and p=0.012, respectively) when compared to Institution 4; the reference category. However, where students at Institution 2 have lower odds of graduation (0.750), students at Institution 5 have higher odds (1.580). Institution 1 was not statistically significant. Nonetheless, it would seem logical that institutions would have some association with degree attainment and some would be more successful than others.
Similarly, the impact that a student’s start term has on graduation outcomes is unknown. Within the model, however, its statistical significance mixed. In comparison to a Fall start term; the reference category, a Spring start term is statistically significant (p-value=0.000), whereas a Summer start term is not (p-value=0.203). Moreover, the odds of students with Spring start terms completing their degree is 0.642 times lower than students with Fall start terms.

In exploring the demographic particulars of RQ2, the only statistically significant variable was age (p-value=0.000). Moreover, the results of the model suggested a negative relationship between age and degree completion and had an odds ratio of 0.966. Meaning; a one-year increase in a student’s age at the start of their master’s program would incur a decrease in the odds of completing that degree by 3.4% and every subsequent year increase in age means the deficit in odds is compounded. This finding is in line with the more recent findings surrounding the experiences of master’s students and analogous student populations, specifically; non-traditional students and doctoral students (Aiello, 2017; Alhassan, 2012; Barry & Matheis; 2011; Metzner & Bean, 1987; Brown, 2002; Cohen, 2012; Fairchild; 2003; Hagedorn & Doyle, 1993; Mancuso, 2001; Polson, 2003).

In contrast, the race/ethnicity and gender results of the logit model for RQ2, focusing on the relationship between demographic-based variables and degree attainment, were not statistically significant (p-values greater than 0.05). These results echo the surprising earlier findings of the admissions-based attributes included in RQ1; race/ethnicity and gender, which were also found to not be statistically significant. Like the traditional measures of success, the finding is confounding, considering the decades of research which suggests disparate outcomes when considering these two demographic
attributes. Within different racial and ethnic student populations, the disparity manifests at both the undergraduate and doctoral levels particularly for African American and Hispanic students (Council of Graduate Schools, 2008; Lott et al., 2009; Most, 2008; Shapiro et al., 2017). Likewise, the disparity emerges within gender as female master’s students were found to graduate at lower rates than their male counterparts (Wine et al., 2005).

Though citizenship was omitted from the model, it was effectively operationalized within the race/ethnicity variable as the “International” category. As such, the results of the model indicated that its presence was not statistically significant and that an association between student citizenship and master’s degree completion does not exist. This result contrasts with the work of Ott, Marewich, and Ochsner (1984), Council of Graduate Schools (2013), and King (2008), all of whom found that international students had higher rates of degree completion than their domestic colleagues for both master’s and doctoral degrees.

Comparably, residency was also not identified as statistically significant (p-value=0.126). Given this finding and the near-existent research on the impact of residency status on degree attainment, there is even less to be discussed within the context of this dissertation, unfortunately.

**Research Question 3: Graduation Rate and Time to Degree**

Within the ten-year period from 2009 to 2019, 85.81% of master’s students completed their degree. This result is considerably higher than anticipated given what is known about graduation rates for students pursuing associate’s, bachelor’s, and doctoral degrees. However, the three-year rate (68.46%) is much closer to the rates for other degree-seeking students and the four-year rate is nearly 80%. Overall the average time to
degree is 2.41 years or just under 2 years and 5 months, across all variables. The greatest differences in time to degree are by academic discipline, likely a byproduct of varying credit-hour requirements, and attendance pattern, which is to be assumed considering this variable fundamentally embodies that part-time students enroll in fewer credits per term than full-time students. Consequently, part-time students take nearly sixteen months longer than full-time students to complete their degrees (2.125 years compared to 3.448 years). Perhaps one of the great takeaways of this secondary research purpose is in identifying a possible timeframe in which master’s degree completion should be measured. An argument can be made for a standard three- or four-year graduation rate given the respective rates of 68.46% and 79.20%. As such, there is a case to be made about using either a three- or four-year timeframe as the standard when measuring master’s degree completion rates.

Disparities also emerged within academic discipline, which is to be expected. Surely students in different academic programs would graduate at different rates, given the difference in material and how it is delivered, but one of the most salient and surprising results within this variable was that Business programs held the highest graduation rate (89.46%). Considering Business-related degrees, and particularly the MBA, may require more credits than many other master’s programs, the high graduation rate runs counter to existing research which suggests that longer programs inhibit degree completion (Miller and Hosch, 2008).

This finding manifests as a small example of a larger split mentioned previously between those disciplines that prepare students for a professional career and those that prepare students for an academic career. Like the academic discipline odds ratios highlighted earlier within section, differences emerge between the dual programmatic
intentions regarding career preparation. In Table 9, we can see the graduation rates of the disciplines deemed “professional”; range from 81.42% to 89.56% and have an average ten-year graduation rate of 87.41%. Conversely, those disciplines deemed “academic” range in graduation rates from 75.47% to 84.00% and have an average ten-year graduation rate of 80.96%.

### Table 9. Academic Discipline, Graduation Rate Professional and Academic.

<table>
<thead>
<tr>
<th>Academic Discipline</th>
<th>Students Started</th>
<th>Students Graduated</th>
<th>Graduation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business</td>
<td>1290</td>
<td>1154</td>
<td>89.46%</td>
</tr>
<tr>
<td>Education</td>
<td>349</td>
<td>302</td>
<td>86.53%</td>
</tr>
<tr>
<td>Engineering</td>
<td>452</td>
<td>368</td>
<td>81.42%</td>
</tr>
<tr>
<td>Health and Medical Sciences</td>
<td>186</td>
<td>161</td>
<td>86.56%</td>
</tr>
<tr>
<td>Public Admin and Services</td>
<td>280</td>
<td>250</td>
<td>89.29%</td>
</tr>
<tr>
<td>Academic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arts and Humanities</td>
<td>330</td>
<td>272</td>
<td>82.42%</td>
</tr>
<tr>
<td>Biological and Agricultural Sciences</td>
<td>248</td>
<td>196</td>
<td>79.03%</td>
</tr>
<tr>
<td>Mathematics and Computer Sciences</td>
<td>106</td>
<td>80</td>
<td>75.47%</td>
</tr>
<tr>
<td>Physical and Earth Sciences</td>
<td>127</td>
<td>104</td>
<td>81.89%</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>150</td>
<td>126</td>
<td>84.00%</td>
</tr>
</tbody>
</table>

In addition to the findings within academic discipline, is concern around the overt incongruity between full-time and part-time students, where 88.57% and 77.04% graduate, respectively. This finding, which highlights an inequity endemic to these experiences, is in line with the earlier findings of the logit model where full-time students have 2.589 time higher odds of graduating, is in line with previous degree completion research (Metzner & Bean, 1987; O’Toole, Stratton, & Wetzel, 2003; Tinto, 1975, 1987, 2012), and rouses further questions around the adversity faced by part-time students and how institutions can seek to counter it.

To recap, neither of the admissions-based attributes (RQ1) were found to be statistically significant. Within the environment-based attributes (RQ2), however,
institution, academic discipline, attendance pattern, and start term all had at least one category that emerged as statistically significant within the model and only age emerged as significant within the group of demographic-based attributes.

Perhaps the most salient findings of the logit (RQ1 and RQ2) are best represented within four critical areas; undergraduate GPA, standardized test scores, race/ethnicity, and gender. Their results - the lack of statistical significance - are in direct conflict with many important studies of the past and with what is widely accepted given the history and practice of master’s admissions. Perhaps the wicked problems affixed to the master’s admissions process are attributable to the traditional measures of success particularly as they pertain to issues of equity, diversity, and inclusiveness (Churchman, 1967).

Effectively, an over-dependence on the predictive validity of undergraduate GPA and standardized test scores could effectively front-load systemic racism and sexism that manifests within differences in socio-economic status, is compounded by phenomena such as stereotype threat, range restriction, and implicit bias, and can be found ingrained in the fabric of higher education, let alone specifically to the master’s degree-earning experience (Hagedorn & Nora, 1996; Kuncel and Klieger, 2007; Michel, et al., 2019; Small, 2017; Steele & Aronson, 1995; Zwick, 2002, 2007). Though the findings are in conflict with prior research that has touted the predictive power of undergraduate GPA and test score percentile, these findings offer a minor repudiation of the troublesome disparities in degree attainment for women and people of color (Barry and Matheis, 2011; Cominole, Shepherd, & Siegel, 2015; Council of Graduate Schools, 2013).

Unfortunately, these findings do not address any possible connections between prior research on representation (Griffith, 2010), student sense of belonging (Hurtado and Carter, 1997; Kuh et al., 2005), or the role of socialization in persistence and degree
Regarding graduation rates and time to degree (RQ3), master’s students outperformed all other degree-seeking students. Upon taking a step back, the picture becomes clearer when considering the critical role a university plays in designing and deploying a master’s student education and experience from admissions to graduation. Moreover, the results beg three key questions (a) should universities continue to use undergraduate GPA as the most heavily weighted measures within the master’s admissions process, (b) in what meaningful ways can universities mitigate the effects of environment- and demographic-based attributes that may serve to detract from student success, and (c) in what ways can a broader understanding of master’s completion rates and time to degree effectuate positive changes for students and institutions? An investigation into the three of these questions would have far-reaching practice and policy implications on graduation admissions and will be explored further in the “Implications” section below.

Implications

The findings of the binary logistic regression make it clear that universities need to systemically and strategically contribute to master’s student degree completion at every phase of the student lifecycle. As such, there are clear implications for both professional practice and national policy as they pertain to the admissions-, environment-, and demographic-based attributes examined within the research questions. Derived from the findings of this dissertation, what follows within this section are the practice- and policy-based recommendations and considerations regarding the master’s student
educational experience which should not be limited solely to master’s admissions decision-makers, but must be embraced at all levels, embedded into the fabric of the university mission, and encouraged by Presidents, Chancellors, and all those who hold great influence over the student experience, including legislators.

For Practice

The conflicted findings of this study - the lack of statistical significance of undergraduate GPA and standardized test scores in contrast to the impressive graduation rates of the master’s students within the sample dataset - are cause for concern when considering the predictive validity of these measures in forecasting degree completion. This is of particular importance because these traditional measures of success represent the two of the most commonly used components by university administrators in making master’s admissions decisions (Okahana et al., 2018). As such, their use must be further explored to ensure their inclusion within the master’s admissions process is achieving the desired results and not unnecessarily limiting entry into master’s programs and thus access to master’s education and the long term benefits it can offer. The recommendations and considerations regarding the admissions process are threefold; possible changes to the admissions process itself, a consideration of special populations, and a focus on institutional deficiencies.

First, university administrators must determine the efficacy of such measures for their institutions and academic programs in consideration of a more holistic admissions process. A primary goal of the master’s admissions process, and specifically undergraduate GPA and standardized test scores, is to adequately predict student success (Okahana et al., 2018). If these components, and by extension the process, are inconclusive in doing so, administrators should consider de-emphasizing their importance
within the admission decision-making process if not eliminating them from the process altogether. This would entail a dramatic shift in how admission decisions are made and would necessitate the development of, and reliance on, other forms of cognitive and noncognitive measures to either compliment or supplant undergraduate GPA and standardized test scores in accomplishing the goals of the master’s admissions process. Okahana and his associates (2018) advocate for “an admission process that provides a framework for considering noncognitive attributes as equally important to an applicant’s future success as traditional cognitive measures” (p. 2). Accordingly, researchers and policy advocates over the past two decades have continually undergirded such an alternative method of evaluating master’s applicants and have suggested the assessment of noncognitive attributes including habits, motivation, knowledge, skills, abilities, persistence, grit, resilience, time management, ethics, life experience, work experience, leadership experience, community involvement, long-term goals, drive, diligence, and the willingness to take scientific risks (Cortes, 2013; Fischer et al., 2013; Hagedorn & Nora, 1996; Kent & McCarthy, 2016; Michel et al., 2019; Miller & Stassun, 2014; Posselt, 2016; Zwick, 2002, 2007).

To move further toward a holistic admissions process and for each academic program to be able to tailor its admissions requirements for their unique programmatic needs, the decentralized nature of graduate admissions must be addressed. Kent and McCarthy (2016) suggest that the majority of master’s admissions decisions are derived from the academic units. As such, these units must not only have the resources to identify appropriate admissions criteria, but also that those committees and the individuals responsible for admitting students are adequately trained to do so. Michel and colleagues (2019) synthesize the recommendations of Kent and McCarthy (2016) and Posselt (2016)
regarding the kind of training to be made available to admissions evaluators to ensure equitable consideration of application materials and counter implicit bias. These steps would be instrumental in offering applicants a truer holistic process that embraces “looking beyond applicants’ GRE scores and undergraduate institutions” (Griffin, Muniz, & Espinosa, 2012, p. 562).

In the time shortly before 2009, when the students within the sample of this study were engaging in the admissions process and applying to their respective programs, each participant institution maintained a centralized “graduate” website that offered information and resources general to their institutional practices, despite the decentralized nature of their programs and decision-making. In looking over these resources, made possible by the Internet Archive’s “Wayback Machine”, a tool that allows users to view the archived content of websites of the past, three themes emerge; (1) there was little to no emphasis on “holistic admissions” or “holistic review”, (2) a stress on traditional measures of success including posted minimums for GPAs and standardized test scores, and (3) an intimated, if not overt, acknowledgement of the decentralized nature of the admissions process (Internet Archive: Wayback Machine, n.d.). In the more than twelve years that has passed since these students were applicants, little has changed. Applicants of today who embark on the master’s admissions process and seek out these resources will be confronted with similar themes. That said, in more recent years, and most notably effectuated by COVID-19, there has been a considerable decline in the reliance of standardized test scores, but these tests have not been replaced by other noncognitive assessments. In spite of decades of research encouraging the adoption of nontraditional measures and thus a holistic admissions process, the realities of implementing such changes represent such administrative challenges that it is no wonder why the participant
institutions have not done so. Nevertheless, these changes represent an opportunity to embrace more predictive admissions practices.

Second, institutions must ensure that the students that are admitted are poised for success. The results of this dissertation suggest that older students are less likely (have lower odds) to persist on to graduation than younger students. This is not to suggest that older students should not be admitted. In no way should university administrators use their individual institutional assessment and the subsequent findings to exclude student populations from being admitted to their institutions. Rather, the findings should encourage each academic discipline, department, program, or unit to assess and calibrate their unique admissions process to not only elucidate areas for improvement, but to offer additional resources to those student groups, or students possessing specific attributes, exhibiting need.

Accordingly, the findings reinforce the conviction that institutions must provide resources and opportunities that foster an environment to counter the phenomena of inequity unique to their campuses and their student populations. The work of Mancuso (2001), Brown (2002), Fairchild (2003), Polson (2003), and Alhassan (2012) suggest that older students thrive in environments that are thoughtfully adapted to their lived experiences. Cohen (2012) connects students' age with their responsibilities and suggests institutions “implement services that support master’s students who have a variety of non-institutional influences such as family, employment, and other commitments that may impact their persistence.” (p. 32). Some of these types of services involve a focus on academic support as well as non-academic support such as the integration and encouragement of family presence and participation in campus events and activities. Cohen (2012) also recommends aligning professional and academic goals and activities,
such as conferences, research with faculty, and practica and internships, to ensure students connect the value of their educational experiences with their current and future careers. Gigliotti (2017) expands on the alignment of educational and professional goals and touts the impact student involvement in leadership education can have on student success outcomes for at-risk students, albeit for undergraduate students. Gigliotti (2017) suggests the meaningful connection between these goals creates conditions for student empowerment, including improving self-confidence, discovering leadership potential, and developing communication skills, which can assist in cultivating student success. Similarly, Gigliotti, Dwyer, Brescia, Gergus, and Stefanelli (2020), whose work focuses on doctoral students, echo the importance of aligning leadership education and professional development opportunities. They stress the value and impact mentorships between students and university leaderships can have on fostering a meaningful connection to their educational and professional pursuits. Aiello (2017), whose work focuses on female master’s students, compliments the work of Cohen and Gigliotti et al. and suggests a number of strategies aimed at master’s students; including peer mentor programs, workshops that acknowledge the concerns of older students, in-person and virtual support groups, access to amenable campus facilities, and simply to make their experience the norm by proudly and regularly showing these students in advertisements and promotional materials. Though these strategies are specific to accommodating the needs of older master’s students, the impetus for institutions to be cognizant of their students’ needs transcends age; the singular statistically significant demographic finding of this dissertation.

Finally, in addition to implications regarding the admissions process and accommodating specific student populations, recommendations and considerations are in
order regarding areas of institutional shortcomings. The logit model within this
dissertation found statistical significance across four variables; institution, academic
discipline, attendance pattern, and start term. As such, those will be the areas of
discussion, but they cannot be assumed to be generalizable for all institutions nation-
wide. Nevertheless, the previously mentioned variables will be addressed specifically, in
what follows here.

Just as institutions must strive to identify and accommodate populations in need
of additional resources, they must ensure the educational experience for master’s students
is being accessed equitably. Moreover, institutions would be well-served to acknowledge
the manner in which the long-established language of “student mortality” describes,
inform, and impacts their institutional approach to retention. The language, which
situates blameworthiness of student departure on the student must be challenged in favor
of the social constructionist approach of Kuh and his associates (2007). This approach,
which broadens institutional focus to consider issues of environment, context, and lived
experience, is critical in combating attrition, encouraging persistence, and fostering
degree completion because it acknowledges that these phenomena are shared jointly
between both institution and student.

Given that every single academic discipline category and three of four institutions
exhibited statistical significance, there is a clear need for institutional and academic
discipline-specific policy and programmatic changes regarding the time after a student is
admitted through to graduation. Institutions, specifically, may be well served to
encourage academic units to take account of their population and design and implement
retention strategies that speak directly to the unique needs and experiences of their
students, if not already engaged in these types of activities. Academic units would also be
well-served to respond accordingly. Unfortunately, research around this topic is limited at the master’s level. As such, I will defer to the programmatic recommendations for countering comparable retention and degree completion issues albeit for a different population; doctoral students. Departmental efforts to stave off student attrition must be embedded in the culture of the institution and the academic unit (Ziskin, Hossler, Rabourn, Cekic, & Hwang, 2014). Bowen, Chingos, and McPherson (2011) suggest that “embedding an emphasis on retention in the fabric of the institution is essential” (p. 222). To do so, the following must be considered; formalizing the socialization process (Gardner, 2008a, 2008b, 2008c, 2009a, 2009b, 2010; Turner & Thompson, 1993; Weidman & Stein, 2003; Weidman et al., 2001), bolstering and emphasizing the student-advisor relationship (Baird, 1969; Golde, 2000; Maddox, 2017), ensuring a supportive and non-competitive environment (de Valero, 2001), and formalizing the expectations for both the department or discipline and the student (Golde, 2005).

Similarly, the disparity in graduation outcomes between full-time and part-time students must be addressed. This finding, which showcases the disadvantage experienced by part-time students, is likely related to the age of the student at the start of their program. Simply, as students age, responsibilities grow, and the likelihood of a part-time attendance pattern increases (Metzner & Bean, 1987; O’Toole et al., 2003; Tinto, 1975, 1987, 2012). As such, many of the recommendations and considerations mentioned earlier for older students are particularly relevant for part-time students as well.

Finally, in addition to being mindful regarding the rate and cadence in which students complete their coursework, institutions must be mindful of the time of year when a student starts their education. Students starting in the Spring term were significantly less likely to complete their degrees than students that started in the Fall. Unfortunately,
research around start term is scant which makes developing recommendations to counter its effects difficult. Perhaps students that start in the Spring term are less prepared than students in the Fall or that fewer resources are offered to students that begin their studies in the Spring. Whatever the cause, institutions would be well-served to address this as a possible barrier for degree completion.

*For Policy*

Just as the findings have identified potential changes for professional practice at the institutional level, they also highlight areas for possible national policy reform. Despite the high graduation rates of master’s students, the logit model did not find statistical significance for undergraduate GPA or standardized test scores. In some ways these results cast doubt on the predictive validity of the traditional measures and thus the prominent role these measures play in the master’s admissions process. If faculty and staff evaluators are to rely on alternative measures of success, with a particular focus on noncognitive attributes, they need to be confident in the ability of these measures to adequately forecast student success. For such changes to be widely adopted by both institutions and students, it is critical that the identification and development of these types of assessments are coordinated, vetted, standardized, readily available, easily administered, and properly applied and interpreted by such evaluators. Such an initiative is a monumental task and likely one that requires the thrust of a national effort for it to come to fruition.

Without a greater understanding of the master’s experience and master’s completion rates, such a thrust is unlikely. Accordingly, there is a need for a supplementary initiative with the goal to more comprehensively collect master’s completion data; across graduation rates and time to degree. If implemented via the
National Center for Educational Statistics (NCES), for example, such an initiative could act as the impetus, as well as a national resource, for reporting, tracking, and benchmarking master’s completion data. Moreover, it could serve to qualify a greater focus on the master’s experience and thus areas for improvement, including the master’s admissions process.

**Limitations and Recommendations for Future Research**

This study, like all studies, has a number of limitations. In addition to exploring these limitations, this section will also provide directions for future researchers to counter their effects. These limitations and future research opportunities are explored in five broader, and in some ways, inter-related topics; generalizability, conceptual framework, sample and dataset, statistical impediments, and finally limitations outside of the researcher’s control.

First, given that this study investigates the master’s student outcomes of four large, public research institutions, its findings may be questioned in terms of their generalizability to other institution types and the students that comprise them. It is a fair criticism considering the relative homogeneity of these institutions in comparison to the diversity of the hundreds of other master’s degree-granting institutions not included. To counter such a limitation, future researchers should seek to include additional institution types or focus on an entirely different, but intra-homogenous institution type, such as private institutions or traditional liberal arts colleges, to determine whether the findings are reinforced or contradicted.

Second, considering the intent of this study and the disconnect in the available scholarship between admissions and retention makes the application of any one conceptual framework troublesome. This dissertation uses Hagedorn and Nora’s (1996)
three-phase model of graduate student success as a primary framework, but focuses primarily on the first and third phases; admissions criteria and success outcomes. Given the lack of availability of certain data points, the second phase of the Hagedorn-Nora model, comprising graduate skills, behaviors, and attitudes, has not been included. This effectively eliminates the entire student experience after being admitted; including orientation and onboarding, course-taking patterns, use of campus resources, at-risk intervention programs, etc. To offset the absence of this type of information and account for the readily available demographic and environmental information, this study incorporates decades of retention scholarship that touts the critical role the university plays in fostering student success after the student is admitted. Nevertheless, a secondary limitation emerges within the context of the framework limitation - lack of a mixed methods or qualitative approach. Such an assessment could have provided substantial background regarding the participant institutions, specifically their admissions processes and environmental conditions. Without a qualitative approach, future research of this type can only be as effective as the admissions criteria used for decision-making. Furthermore, this criteria is entirely contingent upon available data and the types of alternative measures of success; cognitive and noncognitive skills, behaviors, and attitudes, being collected and prioritized during the admissions process. Put simply, practitioners are limited in their ability to predict or forecast student success by the readily available data. Accordingly, future researchers need a more comprehensive theoretical or conceptual framework that integrates the admissions and retention models, addresses the lack of variables used in forecasting and thus decision-making, acknowledges the continuum of the student experience from application to graduation, and incorporates a qualitative approach within the study itself. It is simply not possible to predict the success outcomes
of a student within an environment without considering the attributes of both the student and the environment, and their interplay and mutual reinforcement of one another. As such, additional challenges emerge for future offices of institutional research who will be charged with collecting and making readily available the type of information that fosters a better understanding of the student experience and identifying students in need.

Third, in addition to the limitations of the type of data collected during the admissions process, are limitations posed by the sample of this study. These limitations manifest in two ways; missing data, and the age of the dataset. The primary sample-based limitation is the lack of available data pertaining to undergraduate GPA and standardized test scores. Simply, because institutions were unable to provide consistently reported data points for these two variables across all student observations, not only were students eliminated from being included within the model, an entire institution was excluded. Thus, the sample dwindled from 10,704 students to only 4,039, suitable for executing a binary logistic regression model, but undoubtedly diminishing the power of the statistical analysis. The age of the dataset emerged as the primary cause for institutions being unable to consistently report variables. Because the requested cohort was from 2009, enough time had transpired that institutions were no longer operating on the same information systems and were unable to retrieve the requested data completely. The age of the requested dataset also limited the availability of the instructional modality; in-person, online, hybrid, of the master’s programs in which the students were enrolled. In 2009, few academic programs that were fully online and those that were not coded as such. To ensure the inclusion of the requested data points, future researchers would be well-served to seek more recent cohorts, and be cognizant of the availability of specific information, given its novelty. Undoubtedly, future research employing binary logistic
regression to analyze the association between specific student and programmatic attributes should include instructional modality within the model.

Fourth, the resulting culmination of the previous two limitations around the conceptual framework and available data result in two subsequent and related statistical impediments, including the statistical phenomenon known as range restriction and a weak overall model fitness. The analysis performed within this study focuses exclusively on a sample of students admitted to master’s programs and excludes those not admitted, either by way of rejection or through enrollment by way of non-degree or non-matriculated status. Unfortunately, in addition to the sample excluding those students who were rejected, the sample also excludes the reasons for rejection and whether those reasons were associated with undergraduate GPA or standardized test scores. As noted throughout this dissertation, the students of this sample had statistically equal chances of graduating regardless of their undergraduate GPA or standardized test scores, but those potential students who were not included may have had statistically different chances contingent upon their excluded undergraduate GPA or standardized test scores. As such, the effects of range restriction may be evident in that the measurement of student performance has inherently been restricted to only the students that were admitted and does speak to the unlived performance of those applicants who were not. Unfortunately, the effects of the incomplete framework coupled with limited availability of relevant data, further exacerbated by range restriction, are evident in the overall weaker fit of the model. Both greater than the alpha level of 0.05, the p-values of the Pearson chi-square and Hosmer-Lemeshow goodness-of-fit tests indicate that there is simply not enough evidence to conclude that the model does not fit the data. However, the comparatively low p-value of the Hosmer-Lemeshow test suggests a weaker overall model fitness.
Perhaps this model weakness and the lack of significance within the traditional measures of success, when contrasted with the decentralized nature of graduate admissions, the consequential disparate graduation rates between academic disciplines, and the clear statistical significance of all eleven academic disciplines collectively suppose that undergraduate GPA and standardized test scores are not necessarily universally poor indicators of student success. For these reasons, future researchers should seek to address and expose any possible statistical relationship between undergraduate GPA, standardized test scores, and academic discipline, despite the lack of conclusive evidence within this sample.

Finally, in addition to limitations with regard to generalizability, the conceptual framework, lack of mixed methods, the sample, and statistical impediments are those limitations out of the researcher’s control. Many of these limitations were simply due to dramatically shifting priorities of the data custodians due to COVID-19. Accordingly, the limitations rested in the inability to retrieve additional data, including alternative student success outcomes; first year GPA and post-graduation job placement, date of last enrollment, student financial information, and faculty racial and gender composition. Inclusion of some of the aforementioned additional information would have undoubtedly impacted the outcomes of this study just as the undeniable impact of COVID-19 on higher education will have on future studies. As such, future researchers need to be more mindful of, and deliberate about, the information requested at the onset of the data collection phase. Similarly, future researchers will also need to navigate the massive, historical implications of COVID-19 on the full spectrum of the master’s student experience. Nevertheless, there are research opportunities ripe for quantitative and qualitative researchers as well as mixed methodologists; including simply reperforming
this study with additional variables or alternative institution types, employing a survival analysis to look at retention and time to degree more comprehensively, focusing qualitatively on why certain variables emerged as statistically significant, the changes in admissions processes and graduation outcomes wrought by COVID-19, or a combination of these opportunities.

**Conclusion**

College and university enrollment has grown dramatically over the past six decades and master’s students have outpaced all other degree-seeking populations in that time (Digest of Education Statistics, 2017a). Every year, thousands of students are recruited and admitted to master’s programs causing master’s degree attainment to grow at a remarkable rate. Unfortunately, unlike undergraduates and doctoral students, little attention is paid to the master’s student experience. This has contributed to a dearth of information regarding the efficacy of the admissions process in adequately predicting master’s degree completion, let alone information regarding master’s completion rates. As such, master’s degree completion has remained a mystery, not out of the difficulty to obtain this information, but out of indifference and the lack of an impetus to collect and report it. The hope is that this study, and the findings within, will modestly contribute to addressing the aforementioned gap in research between undergraduate and doctoral student experiences by raising awareness to the endemic problems inherent in the master’s admissions process and educational experience. Through the employment of a binary logistic regression model, four critical findings were unearthed within this study. First, admission-based attributes, specifically undergraduate GPA and standardized test scores do not have a statistical relationship with degree completion. Second,
pattern, and start term are associated with degree completion. Third, demographic-based attributes, with the exception of age, are similarly unassociated with degree completion. Fourth, master’s students have four- and ten-year graduation rates of 78.20% and 85.81%, respectively, suggesting they graduate at rates significantly higher than their undergraduate and doctoral peers.

The admissions-based findings are important in that they contradict a significant portion of the body of literature surrounding the predictive validity of traditional measures of success in predicting master’s degree completion. Accordingly, it would be reasonable for practitioners to question the inclusion and weight of these measures within the admissions process in favor of the incorporation of alternative measures to be employed in their place. That said, the historic reliance on the traditional measures by admissions decision-makers coupled with the high master’s graduation rates among the students within this sample make it difficult to rule out their predictive validity completely. Similarly, given that environmental and demographic variables play a role in predicting master’s degree completion, it is important to be clear that the results from this study do not suggest that such variables should be used to make admission decisions. Such decisions would be unethical, immoral, and illegal. Rather, the results presented here suggest the need for practice- and policy-based programmatic changes regarding the admissions process and educational experience that ensures the safe-guarding of student populations that may be the most vulnerable to succumbing to student attrition.

Institutions and academic units are well served to take account of their population and design and implement strategies that speak directly to the unique needs and experiences of their students and address institutional shortcomings. As it stands, there is still considerable work to be done to elucidate areas of student, institutional, and global need,
and rouse the kind of admissions- and retention-improvement initiatives that will benefit master’s degree-seeking populations.
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APPENDICES

Appendix 1. Recruitment Letter

“Dear [University representative],

I am advising Mr. Jay Stefanelli, a PhD student in our Higher Education program here at Rutgers. Jay is interested in researching master's student completion rates and the factors that contribute to completion. Jay would like to gather data from Big Ten institutions because they are large, (mostly) public, research universities that have a large, diverse population and offer an abundance of master's programs. I’ve already shared with Jay there is an abundance of data on PhD students, but there is no central repository of data on master’s students. So I’m writing to you directly to see if you – or someone in your graduate school – might collect data on your master’s students. And if so, would you be willing to assist Jay with his data-gathering on master’s students?

Just so you have a bit more specific information about Jay’s project, he plans to ask 1.) What is the graduation rate for master's students in the 2010 cohort? 2.) How long does it take this cohort to complete their degree (total and by program/discipline)? 3.) What demographic, admissions, student factors and attributes contribute to, or detract from, master’s degree completion

Jay plans to look at several de-identified variables that are known to impact degree completion within a binary logistic regression model (graduated = 1, did not = 0). He intends to include the following variables in the model:
1. demographic data (gender, race, ethnicity, age)
2. admissions data (undergraduate GPA, undergraduate program)
3. academic program/discipline
4. modality (online, on-campus, hybrid)
5. start term (Fall, Spring, Summer)
6. attendance pattern (full-time, part-time)
7. residency status (in-state, out-of-state)
8. citizenship (domestic, international).

Jay intends to publish the results of the study in aggregate and will not identify individual institutions in his dissertation or any future publications. However, for those BTAA universities that do participate, Jay will provide institution-specific results.

Is there a contact person in your graduate school with whom Jay might be able to work as he sets out on this very ambitious project?

Let me know, and I will make introductions between Jay and the contact person at your university.

Thanks very much for your assistance.

Regards,

[Researcher agent]”
Appendix 2. Master's Completion Study Data Collection Template

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<tr>
<td>Modality</td>
<td>On-campus/online/hybrid</td>
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<td>Age at Start of Program</td>
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</tr>
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Appendix 3. Taxonomy

Academic Discipline Taxonomy

- Arts and Humanities
  - African Languages and Literature
  - Applied Behavior Analysis
  - Applied Clinical Psychology
  - Applied Psychology Research
  - Art
  - Art History
  - Community Psychology and Social Change
  - Comparative Literature
  - Composition Theory
  - Counseling
  - Counseling Psychology
  - Creative Writing
  - Design
  - Educational Psychology
  - English
  - English as a Second Language
  - French
  - Hebrew and Semitic Studies
  - Hispanic and Lusophone Literature, Cultures and Linguistics
  - History
  - History of Science
- Humanities
- Italian
- Jazz History and Research
- Languages and Cultures of Asia
- Learning Cognition and Development
- Linguistics
- Music Theory
- Music Performance
- Musicology
- Performance
- Portuguese
- Psychology
- Stage Management
- Theatre and Drama
- Visual Arts
- Voice Performance and Pedagogy

- Biological and Agricultural Sciences
  - Agricultural, Environmental, and Resource Economics
  - Agricultural Extension and Education
  - Agricultural and Applied Economics
  - Agriculture
  - Agroecology
  - Agronomy
  - Anatomy
○ Animal Science
○ Applied Kinesiology
○ Applied Plant Sciences
○ Bacteriology
○ Biochemistry, Molecular Biology, and Biophysics
○ Bioinformatics and Computational Biology
○ Biological Sciences
○ Biology
○ Biostatistics
○ Cell and Developmental Biology
○ Comparative Biomedical Sciences
○ Conservation Biology and Sustainable Development
○ Dairy Science
○ Ecology
○ Ecology and Evolution
○ Entomology
○ Epidemiology
○ Food Science
○ Genetics
○ Horticulture
○ Human Ecology
○ Integrated Biosciences
○ Kinesiology
○ Literacy Education
- Master of Biomedical Sciences
- Medical Genetics
- Medical Microbiology and Immunology
- Microbial Engineering
- Microbiology and Molecular Genetics
- Molecular and Environmental Toxicology
- Molecular Medicine
- Molecular, Cellular, Developmental Biology and Genetics
- Music
- Neuroscience
- Oceanography
- Pharmacology
- Plant Biology
- Plant Breeding and Plant Genetics
- Plant Pathology
- Reading
- Recreation, Parks, Tourism Management
- Soil Science
- Stem Cell Biology
- Toxicology
- Zoology

• Business

- Accounting and Taxation
- Business Administration
- Finance
  - Financial Accounting
  - Governmental Accounting
  - Hospitality Management
  - Human Resource Development
  - Human Resource Management
  - Human Resources and Industrial Relations
  - Human Resources and Employee Relations
  - Information Systems
  - Joint Undergraduate Degree Program
  - Labor Studies and Employment Relations
  - Leadership Development
  - Management
  - Marketing
  - Medical School Joint Degree Program
  - Nonprofit and Public Management
  - Organizational Leadership, Policy, and Development
  - Professional Accounting
  - Professional Accounting
  - Work and Human Resource Education

- Education
  - Art Education
  - College Student Affairs

- College Student Affairs
○ Counselor Education
○ Curriculum and Instruction
○ Early Childhood Education
○ Education, Curriculum & Instruction, Teaching Licensure
○ Education and Mathematics
○ Education, Curriculum and Instruction
○ Educational Administration and Supervision
○ Educational Leadership and Policy Analysis
○ Educational Leadership
○ Elementary/Early Childhood Education
○ English (MAT)
○ English/Language Arts
○ Family Social Science
○ Higher Education
○ Instructional Systems
○ Language Education
○ Mathematics Education
○ Music Education
○ Science Education
○ Social Studies Education
○ Spanish (MAT)
○ Special Education
○ Teaching and Curriculum
○ Teaching English Second Language
- Engineering
  - Aerospace Engineering and Mechanics
  - Aerospace Engineering
  - Agricultural and Biological Engineering
  - Architectural Engineering
  - Biological Systems Engineering
  - Biomedical Engineering
  - Biotechnology
  - Chemical and Biochemical Engineering
  - Chemical Engineering
  - Civil and Environmental Engineering
  - Civil Engineering
  - Electrical and Computer Engineering
  - Electrical Engineering
  - Energy and Mineral Engineering
  - Engineering
  - Engineering Mechanics
  - Engineering Management
  - Engineering Science
  - Environmental Pollution Control
  - Environmental Engineering
  - Geological Engineering
  - Industrial and Systems Engineering
  - Industrial Engineering
○ Infrastructure Systems Management and Engineering
○ Manufacturing Systems Engineering
○ Materials Engineering
○ Materials Science
○ Materials Science and Engineering
○ Mechanical and Aerospace Engineering
○ Mechanical Engineering
○ Mechanical Engineering
○ Nuclear Engineering
○ Nuclear Engineering and Engineering Physics
○ Operations Research
○ Quality and Manufacturing Management
○ Software Engineering

● Health and Medical Sciences

○ Bioethics
○ Clinical Laboratory Science
○ Communication Science and Disorders
○ Communicative Disorders
○ Community Health Education
○ Dentistry
○ Endocrinology
○ Environmental Health
○ Health Administration
○ Health Education
○ Health Informatics
○ Health Services Research, Policy, and Administration
○ Healthcare Administration
○ Maternal and Child Health
○ Medical Physics
○ Nursing
○ Occupational Therapy
○ Pharmaceutical Science
○ Pharmacy
○ Population Health
○ Public Health Admin and Policy
○ Public Health
○ Public Health Nutrition
○ Public Health Sciences
○ Rehabilitation Psychology
○ Speech-Language-Hearing Sciences

● Mathematics and Computer Sciences
○ Applied Statistics
○ Computer Science and Engineering
○ Computer Science
○ Computer Sciences
○ Financial Mathematics
○ Information Science
○ Information Technology
○ Mathematical Finance
○ Mathematical Sciences
○ Mathematics
○ Quantitative Finance
○ Statistics
○ Statistics and Biostatistics

● Other Fields
○ Architecture
○ Atmospheric and Oceanic Sciences
○ Classical and Near Eastern Studies
○ Classics
○ Communication Arts and Sciences
○ Communication and Information Studies
○ Communication Arts
○ Communication Studies
○ Criminal Justice
○ Dual JD/MBA Program
○ Environmental Geology
○ Forensic Science
○ Global Affairs
○ Health Journalism and Communication
○ Human Development/Family Studies
○ Journalism and Mass Communication
○ Landscape Architecture
○ Liberal Studies
○ Library and Information Studies
○ Life Sciences Communication
○ Mass Communication
○ Media Studies
○ Nutrition
○ Nutritional Sciences
○ Rhetoric and Scientific and Technical Communication
○ Scientific and Technical Communication
○ Strategic Communication
○ Urban and Regional Planning
○ Urban Planning and Policy Development

● Physical and Earth Sciences
  ○ Acoustics
  ○ Chemistry
  ○ Conservation Sciences
  ○ Earth Sciences
  ○ Environment and Resources
  ○ Environmental Chemistry and Technology
  ○ Environmental Sciences
  ○ Forest Resources
  ○ Geological Sciences
  ○ Geology
  ○ Geophysics
○ Geosciences
○ Land and Atmospheric Science
○ Meteorology
○ Natural Resources Science & Management
○ Physics
○ Physics and Astronomy
○ Science, Technology, and Environmental Policy
○ Water Resources Management
○ Water Resources Science
○ Wildlife Ecology
○ Wildlife/Fish Science

● Public Administration and Services
○ Educational Theory and Policy
○ Educational Policy Studies
○ Health Policy/Administration
○ Public Administration
○ Public Affairs
○ Public Policy
○ Social and Philosophical Foundations
○ Social Work
○ Youth and Family Education

● Social and Behavioral Sciences
○ Afro-American Studies
○ American Studies
○ Anthropology
○ Applied Economics
○ Cartography and Geographic Information Systems
○ Chinese
○ Economics
○ French
○ French Studies
○ Geographic Information Science
○ Geography
○ International Affairs
○ International Public Affairs
○ Japanese
○ Latin American, Caribbean, and Iberian Studies
○ Political Science
○ Rural Sociology
○ Scandinavian Studies
○ Sociology
○ Southeast Asian Studies
○ Spanish
○ Women's and Gender Studies