Rowan University
Rowan Digital Works

Theses and Dissertations

1-8-2018

Exploring the impact of the associate degree on bachelor's degree completion for reverse transfer eligible students using propensity score matching

Justin Aaron Hull
Rowan University

Follow this and additional works at: https://rdw.rowan.edu/etd

 Part of the Higher Education Commons

Recommended Citation

Hull, Justin Aaron, "Exploring the impact of the associate degree on bachelor's degree completion for reverse transfer eligible students using propensity score matching" (2018). *Theses and Dissertations*. 2495.
https://rdw.rowan.edu/etd/2495

This Dissertation is brought to you for free and open access by Rowan Digital Works. It has been accepted for inclusion in Theses and Dissertations by an authorized administrator of Rowan Digital Works. For more information, please contact graduateresearch@rowan.edu.

EXPLORING THE IMPACT OF THE ASSOCIATE DEGREE ON BACHELOR'S DEGREE COMPLETION FOR REVERSE TRANSFER ELIGIBLE STUDENTS USING PROPENSITY SCORE MATCHING

by

Justin A. Hull

A Dissertation

Submitted to the
Department of Educational Services and Leadership
College of Education
In partial fulfillment of the requirement
For the degree of
Doctor of Education
at
Rowan University
December 6, 2017

Dissertation Chair: Dr. Monica Reid Kerrigan, Ed.D.

© 2018 Justin A. Hull

Dedications

To my family and soon-to-be wife, Amy, who supported and believed in me through every step of this journey.

Acknowledgements

I would like to thank my committee members for their time and insights, which were invaluable in helping to bring this document to completion. I could not have asked for a better group of mentors, researchers and experts. To my dissertation chair, Dr. Kerrigan, thank you for remaining patient and understanding through the many iterations and revisions of this work, for challenging my thoughts and assumptions, and pushing me to become a better researcher. To Dr. Nespoli, thank you for your leadership across the community college sector, and for providing an important policy perspective. To Dr. Cho, thank you for all of your guidance and expertise, and for helping me to understand what was at first an intimidating methodology.

Abstract

Justin A. Hull
EXPLORING THE IMPACT OF THE ASSOCIATE DEGREE ON BACHELOR'S DEGREE COMPLETION FOR REVERSE TRANSFER ELIGIBLE STUDENTS USING PROPENSITY SCORE MATCHING
2017-2018
Dr. Monica Reid Kerrigan, Ed.D.
Doctor of Education

Many students who enter a community college expect to transfer and earn a bachelor's degree, yet many are unable to do so largely because of inefficiencies in the transfer of earned credits. Prior research has shown that students who leave community college with an associate degree are more likely to complete bachelor's degrees. However, this has not been situated within the context of reverse transfer, which allows former community college students enrolled at four-year institutions to transfer their credits back in order to retroactively earn an associate degree.

This study uses propensity score matching to compare the six-year bachelor's degree completion rates of two groups of students at a single community college: associate degree completers and reverse transfer eligible students who transferred to four-year institutions after earning between 60 and 90 degree credits, but no associate degree. Reverse transfer eligible students were more likely to be enrolled in Associate of Science degree programs, and they were also lower in grit, which is a measure of persistence in achieving long-term goals. Results of this study show that associate degree completers are significantly more likely to earn bachelor's degrees in six years when compared to a matched group of reverse transfer eligible students.

Table of Contents

Table of Contents (Continued)

Table of Contents (Continued)

Table of Contents (Continued)

List of Figures

List of Tables

Chapter 1

Introduction

The vast majority of students enter a community college planning to earn a bachelor's degree, yet the reality is that only about a quarter end up transferring to a four-year institution and only 17 percent are able to complete a bachelor's degree (Horn & Skomsvold, 2011). Prior research has shown that students who transfer with a certificate or two-year degree are 16 percentage points more likely to earn a bachelor's degree than students who transfer without one (Shapiro et al., 2013). One possible reason for this may be that students with an associate degree have greater success in transferring their credits. Loss of credits is a significant barrier that inhibits community college students' bachelor's degree attainment. Many students who enter a community college expect to transfer and earn a bachelor's degree, yet many are unable to do so, largely because of inefficiencies in the transfer of earned credits (Monaghan & Attewell, 2015).

Nature of the Problem

Community colleges were originally designed to serve as the first two years of a bachelor's degree, thereby easing the burden on four-year institutions to educate entry-level students who may be unprepared for college (Cohen, Brawer, & Kisker, 2014). There has been some debate surrounding the community college transfer mission, with critics arguing that community colleges actually increase social stratification because they do not deliver on their transfer promise and divert students away from attending four-year colleges (Dougherty & Kienzl, 2006; Karabel, 1972; Rouse, 1995). Proponents have argued that community colleges democratize higher education, and that the community college transfer mission serves as perhaps the only viable avenue for upward

social mobility and achieving equity in student outcomes for low-income underrepresented students (Altstadt, Schmidt, & Couturier, 2014; Jenkins & Fink, 2016).

When working as intended, community college students who earn an associate degree are qualified to enter a university with junior standing. In reality, however, certain courses may not be transferrable, additional coursework may be required, and transfer into a student's desired program may not be guaranteed. In other words, "Students credits may *transfer,* but they do not necessarily *apply* to a university major or general education pattern; thus students must take additional, often repetitive, courses to meet the university's degree requirements" (Cohen et al., 2014, p. 284). This wastes a considerable amount of students' time and money and delays their progress toward an advanced degree.

To date, research on community college transfer patterns has focused on vertical transfer from community colleges to four-year institutions (Townsend, 2001; Wang, 2009). Very little attention has been given to the phenomenon of reverse transfer, whereby a student earns a large number of credits at a community college, transfers to a four-year institution without earning a degree, and then transfers the credits back to fulfill the requirements of the associate degree or certificate. Improving the inefficiencies in the transfer process ensures the successful transition of students and has the potential to substantially raise college attainment (Taylor, 2015a; Taylor & Bragg, 2015). One study estimated that increasing the rate at which transfer students earn associate degrees before transferring from 20 percent to 30 percent would add 37,500 associate degrees and would likely boost bachelor's degree completion rates (Poisel & Joseph, 2011).

In a similar study, Taylor (2015) utilized Credit When It's Due (CWID) baseline

data from Alaska and Hawaii to explore the difference in bachelor's degree completion rates between students who transfer with or without an associate degree. By using logistic regression, Taylor (2015) was able to control for pre-transfer factors such as race/ethnicity, gender, age, GPA, remedial education, and number of credits earned. After holding these variables constant, the author found that earning an associate degree before transfer can increase a student's odds of completing a bachelor's degree by as much as 12 percent, varying by state and type of degree earned.

Purpose

The purpose of this study is to compare the bachelor's degree outcomes of associate degree completers and community college transfer students who earned between 60 and 90 credits before transferring to a four-year institution without earning an associate degree. For the purposes of this study, the latter group of students are considered reverse transfer (RT) eligible in that they earned enough credits at the community college to satisfy the institution's residency requirement (typically between 50 and 60 degree credits) and transferred to a four-year institution before earning an associate degree (Taylor, Bishop, Makela, Bragg, & Ruud, 2013). They would therefore be eligible to transfer their credits back to the community college to fulfill the requirements of the associate degree, depending on how many credits they were able to earn at the four-year institution.

This study builds off the work of Crosta & Kopko (2014) by also exploring the impact of earning an associate degree on bachelor's degree completion by comparing the six-year bachelor's degree outcomes of associate degree completers, and community college transfer students who earned a large number of credits before transferring to a

four-year institution without earning an associate degree. However, this research differs from Crosta and Kopko's work because it includes measures of individual motivation, such as grit, as well as variables related to the transfer institution, such as affiliation and location.

Significance of the Study

There has been some debate as to whether earning an associate degree before transferring benefits students' subsequent bachelor's degree completion. Crosta & Kopko (2014) found significant positive impacts of earning an Associate of Arts or Associate of Science degree on four, five, and six-year bachelor's degree completion rates. In a study conducted within the City University of New York (CUNY) system, Crook, Chellman, & Holod (2012) found that earning an Associate of Arts or Associate of Science degree was associated with a 6.9 percent increase in the probability of obtaining a bachelor's degree. However, in a national study of transfer activity, no direct link was found between earning an associate degree before transfer and eventual bachelor's degree completion (Jenkins & Fink, 2016). Several states, such as Texas and Maryland, have very high bachelor's degree completion rates for transfer students, yet low transfer-with-award rates for community college students. This seems to suggest that the two are not directly linked, at least within certain states.

The present study differs from Crosta & Kopko (2014) in one important way. The authors acknowledge that one of the limitations of their study, and in the research literature in general, is the inability to account for students' motivation levels and goal-oriented behavior. These factors contribute greatly to students' likelihood of completing a degree, but are typically not included in multivariate analyses because they are difficult to

quantify and operationalize. Wang (2009) utilized several items from the National Education Longitudinal Study of 1988 (NELS: 88) and the Postsecondary Education Transcript Study (PETS) to create two independent variables for locus of control and self-concept and found positive effects on community college student persistence for students with an internal locus of control, even after controlling for other enrollment and demographic variables through logistic regression.

These findings suggest that students with an internal locus of control may hold themselves more accountable for their own successes and failures, and thus continue to enroll and persist in community college despite significant setbacks (Wang, 2009). Interestingly, these effects were not as apparent for the outcome of bachelor's degree attainment. However, community college transfers who started out as baccalaureate aspirants in the 12th grade had an increased chance of earning a bachelor's degree, which highlights the importance of goals and expectations in helping students to progress forward in their education.

In light of these findings, not controlling for psychological and motivational factors may bias results, especially if they are strongly associated with the outcome of interest. Therefore, the present study seeks to explore if grit, or perseverance for long-term goals, has an impact on bachelor's degree outcomes for reverse-transfer eligible students and community college associate degree completers. The grit scale consists of twelve items organized into two categories: consistency of interests and perseverance of effort. It has been shown to be strongly associated with educational attainment and the overall scale demonstrates high internal consistency and reliability ($\alpha = .85$) (Duckworth, Peterson, Matthews, & Kelly, 2007).

If it's shown that reverse transfer eligible students are less likely to earn bachelor's degrees than associate degree completers, then it could provide support for reverse transfer policies that give students the option to transfer their credits back to the community college to earn a valuable credential. The effectiveness of reverse transfer policies in improving bachelor's degree attainment levels has yet to be determined, and is worth investigating given the potential significant returns that earning an associate degree has for students, community colleges, and four-year institutions.

First, earning an associate degree may serve as a milestone for students, motivating them to persist in college and potentially increasing their likelihood of earning a bachelor's degree. Transferring more credits, and seeing the finish line closer, may encourage students to finish the degree sooner rather than later. "When students lose a lot of credits in the transition (and consequently the time and money invested in completing those credits), they may become frustrated and discouraged, which could reduce their likelihood of completing the bachelor's degree" (Roksa & Keith, 2008, p. 245). Being able to apply these earned credits towards an associate degree enables reverse transfer students to receive a return on their investment, despite arguably paying more for the same courses while at the four-year institution.

Furthermore, earning a reverse transfer associate degree en route to the bachelor's degree ensures that students have a recognized and valued credential to fall back on should they be unable to fulfill their educational goals. This benefits students in the labor market and leads to higher lifetime earnings when compared to students with only a high school diploma (Belfield & Bailey, 2011; Jepsen, Troske, & Coomes, 2014; Marcotte, Bailey, Borkoski, & Kienzl, 2005). Kane & Rouse (1995) report that associate degrees

lead to earnings increases of 24 percent for men and 31 percent for women. However, there is some evidence of differential gains in earnings by degree type and major, with vocational degrees in the applied sciences proving more valuable than general A.A. degrees and transfer A.S. degrees (Dadgar & Trimble, 2015; Jepsen et al., 2014).

Second, reverse transfer policies are beneficial for community colleges as they strive to meet the demands of the college completion agenda at the state and national levels. Despite the traditional transfer mission of community colleges, they are often criticized for low completion rates, which do not account for students who transfer out before receiving a degree. The implementation of reverse transfer policies is an opportunity for community colleges to see their students' success realized in the form of a credential as well as receive credit for their contribution to students' completion (Taylor, 2015b). However, it is unclear whether or not reverse transfer programs actually increase the first-time, full-time, three-year graduation rate, which is the standard national benchmark for measuring completion.

Awarding reverse transfer associate degrees aligns with institutional and state priorities related to college completion. Many states have established performance-based funding policies, which tie funding to an institution's completion rates. Thus, depending on how these funding models are structured, conferring more associate degrees via reverse transfer may improve institutional performance and create financial advantages under states' performance-based funding models. For example, in Hawaii, where reverse transfer policies are well-established, performance funding is based partially on the number of degrees and certificates awarded, and the number of transfers to the baccalaureate campuses (National Conference of State Legislatures, 2015). Reverse

transfer students would be considered very valuable because they would be counted in both of these funding categories. However, in states like Florida, performance funding is tied to a six-year graduation rate. Depending on how quickly a reverse transfer student is able to progress through baccalaureate level coursework, they may or may not be able to transfer their credits back and earn an associate degree within a six-year time window. Therefore, the impact of reverse transfer on funding levels is much less certain in states that use a graduation rate as opposed to the number of completions.

Third, the establishment of reverse transfer associate degree policies has potential value for the entire state education system through improvements in transfer processes and agreements. There are presently only fourteen states with formal reverse transfer state legislation, including New Jersey (Garcia, 2015). However, almost all states have some form of informal reverse transfer policy in place between individual two and four-year institutions. Research on the phenomenon of "swirling" (back and forth enrollment between two or more institutions) and "double-dipping" (concurrent attendance at multiple institutions) has shown that community college students are quite mobile and transfer in many different directions across multiple institutions (Hossler et al., 2012; McCormick, 2003). To some extent, this mobility is encouraged through policies that have eased the transfer process for students. However, these policies simultaneously dis-incentivized students from completing associate degrees.

Community college transfer students comprise a considerable proportion of students enrolled at four-year institutions, and almost half (45 percent) of the nation's baccalaureate degree holders previously attended a community college (Altstadt et al., 2014). If it can be shown that earning an associate degree has positive impacts on

bachelor's degree completion, then four-year institutions may encourage more of their students to earn an associate degree before transferring, and help build reverse transfer agreements across institutions.

Propensity Score Matching in Educational Research

Because reverse transfer is a relatively new phenomenon, there have not been any studies that utilize multivariate analyses to study the impact that these policies could have on bachelor's degree completion. However, there have been small-scale institutional level descriptive analyses conducted, which have shown that nearly 70 percent of reverse transfer students go on to earn baccalaureate degrees (Friedel & Wilson, 2015). These studies do not control for outside variables, however. The present study attempts to control for extraneous variables through propensity score matching (PSM).

In randomized experiments, individuals are randomly assigned to either a treatment or control group, and their differences in outcomes after receiving the treatment are compared. In educational settings, researchers are often interested in determining whether a certain intervention was effective. To accomplish this, two groups are often compared during or after the intervention has taken place. This introduces selection bias because individuals choosing a treatment could be different from those who do not. This bias is reduced when there is random assignment to groups, which is often not feasible or ethical in educational settings. In an extensive review of existing research on community college success reforms, Goldrick-Rab (2010) states that:

> Selection bias is a statistical problem plaguing much of higher education research, because college outcomes can be observed only for those who participate, and participants differ in important and often unobservable ways from nonparticipants. This area of research is dominated both by descriptive rather than explanatory analyses and by multivariate analyses that attempt to make causal arguments without first taking the necessary steps to minimize selection bias. This

> issue can and should be remedied by current and future generations of researchers. (p. 458).

PSM attempts to account for the threat of selection bias, and thus directly addresses the methodological gaps and limitations in higher education research.

PSM is a technique often used in the medical field to simulate a randomized experiment, and can be used to make quasi-experimental estimates of causal effects (Rosenbaum & Rubin, 1983; Rubin, 1973). In the first phase of PSM, individual treatment and control cases are matched based on a composite profile of covariates, the goal being to eliminate or minimize the differences between the two groups. In phase two of PSM, comparisons between the matched groups can be made on an outcome of interest, and these differences are aggregated to produce an overall treatment effect (Bryer, 2014). One advantage of PSM over simple regression analysis is that it allows the researcher to compare individuals who are very similar in terms of their observed characteristics and have an equal probability of receiving the treatment. This is different from regression analysis that would compare all the individuals in the treatment and control groups (Melguizo, Kienzl, & Alfonso, 2011).

Definitions of Terms

Logistic Regression- A statistical model where the dependent variable is categorical. In propensity score matching, logistic regression is one method used to estimate the propensity score (Ho, Imai, King, & Stuart, 2007).

Propensity Score Matching- A quasi-experimental technique that involves matching individuals in treatment and control groups to estimate causal treatment effects (Caliendo & Kopeinig, 2008).

Propensity Score- The conditional probability that a participant will be selected for the treatment condition given certain observable baseline characteristics (Thoemmes & Kim, 2011).

Reverse Transfer- The phenomenon that occurs when a student completes the requirements for the associate degree and transfers their credits back to the community college while simultaneously pursuing a bachelor's degree (Taylor & Bragg, 2015).

Conclusion

This study has thus far identified the problem of low completion rates amongst community college transfer students, and explained how the new phenomenon of reverse transfer has the potential to improve inefficiencies in the credit transfer process. In the chapters that follow, a synthesis of relevant research related to reverse transfer is provided, which situates this relatively new phenomenon within the broader research on community college transfer patterns. A description of the methodology for the proposed study, including research design, research questions, sampling, data collection, and data analysis will then be discussed, followed by a summary of the results, discussion of relevant findings, and implications for policy, practice and future research.

Chapter 2

Literature Review

This review begins with a discussion of the traditional transfer mission of community colleges, and explores how the new phenomenon of reverse transfer has evolved. There is an ever-growing population of 'potential completers' who left higher education with no degree, due in large part to inefficiencies in the transfer and acceptance of earned credits. This obstacle is one of the single greatest barriers facing transfer students on their journey toward a baccalaureate degree. States are beginning to enact reverse transfer policies that award credentials to students who have satisfied the credit requirements for the associate degree. The review concludes with a theoretical synthesis of variables associated with degree completion, which helped inform the construction of the statistical models used throughout this study.

History of the Community College Transfer Mission

When community colleges were first founded as junior colleges, the intent was for students to transfer from the community college to the four-year institution, and not the reverse (Townsend, 2001). Students following this non-traditional transfer pattern would later be referred to as "reverse transfer" students (Townsend & Dever, 1999). The language of "reverse", "transfer-back", and "less-than-four-year" implied that a student was losing progress by leaving a four-year institution to attend a community college.

In the original community college model, transfer and liberal arts programs were designed to act as bridges between secondary schooling and a traditional baccalaureate education. Students who entered community colleges and failed to progress into upper level coursework were considered dropouts (Cohen et al., 2014). Universities had the

power to decide which courses and programs were transferrable, and so community colleges designed their curricula in the university's image. The benchmark of a community college's success was its ability to transfer students into four-year programs.

By the 1970s, the linear relationship between community colleges and universities began to disappear. Students were taking courses at will, and dropping in and out of attendance. Transfer became much more lateral than linear. What was happening was that "students were using the institution in one way, whereas the institution's patterns of functioning suggested another" (Cohen et al., 2014, p. 40). Modern community colleges are structured in a way that complicates the transfer process. Students enter the institution without a clear idea of what major they want to pursue, and do not always receive proper advising. They are often placed on a general education track, and instructed to take courses in liberal arts and sciences. When it comes time to transfer, students are surprised to learn that many of the credits that they earned while exploring do not count toward the majors they select at the four-year institutions (Bailey, Jenkins, & Jaggars, 2015).

Unfortunately, the links between two and four year colleges are oftentimes broken, which makes curriculum alignment difficult. Many states offer a common core set of courses designed to be transferrable across institutions, but not all states offer this, and when they do, it does not guarantee that a student's credits will apply to a degree in their chosen field (Bailey et al., 2015). These structural barriers have sparked a recent movement to create a "Guided Pathways" model for students to progress through community colleges as quickly and efficiently as possible by providing proper academic, career, and transfer advising. The Guided Pathways model also involves structuring programs to reduce credit loss and prevent roadblocks in key milestone courses, as well

as aligning curricula with students' career and transfer goals.

The New Phenomenon of Reverse Transfer

The phenomenon of reverse transfer was originally used to refer to students who reverse the traditional transfer pipeline and move from a four-year college or university back to a two-year college (Townsend & Dever, 1999). Recently, policymakers and national organizations have redefined the term *reverse transfer* to mean, "the process of retroactively granting associate degrees to students who have not completed the requirements of an associate degree before they transferred from a two- to a four-year institution" (Anderson & Education Commission of the States, 2015, p. 2). The new phenomenon of reverse transfer has gained significant attention from national educational and policy organizations because of its potential to improve community college completion rates.

At the national level, the Correctly Recognizing Educational Achievements to Empower (CREATE) Graduates Act legislation, introduced in summer 2014, offers incentives for states to establish or expand reverse transfer programs (Correctly Recognizing Educational Achievements To Empower Graduates Act, 2014). More recently, the Reverse Transfer Efficiency Act of 2017 (H.R. 3774) was introduced with bipartisan support. The measure effectively streamlines the sharing of transcripts between institutions and allows students to receive notifications once they have earned the required number of credits for an associate degree. It also amends the Family Educational Rights and Privacy Act (FERPA) to make this process more efficient and transparent (Messer, 2017).

In 2012, five national foundations created the Credit When It's Due initiative to

help institutions across twelve states develop reverse transfer articulation agreements. The CWID initiative is designed to support partnerships between community colleges and universities to increase the number of associate degrees being awarded to students after they transfer (Anderson & Education Commission of the States, 2015). Initial baseline data from the CWID initiative have revealed that approximately 27,000 students in the 2008 cohort of transfer students across twelve states would be eligible to participate in reverse transfer (Taylor et al., 2013). Demographically, these students were similar to the average community college student (predominantly female, white, and between the ages of 18 and 24). The majority (65 percent) started full-time at a community college, and nearly two-thirds transferred with over 45 degree credits, which suggests that they were very close to earning an associate degree. In fact, 42 percent had earned 60 or more credits prior to transfer. When tracked over a four-year period, almost half of all reverse transfer eligible students were not able to earn a bachelor's degree, which suggests that a sizable proportion of students would stand to benefit from reverse transfer policies by having a degree to fall back on.

Potential Completers

Over two decades in the United States, more than 31 million students have enrolled in college and left without receiving a degree or certificate (Shapiro et al., 2014). Of these students, over 16 percent can be classified as "potential completers" who have two or more years' worth of progress toward a degree, but no credential. When compared to students who are able to complete a degree or certificate, potential completers are more likely to attend multiple institutions, have one or more stop-outs, and require more time along their educational pathways. When students decide to forgo

earning an associate degree and prematurely transfer to a four-year institution, they are losing out on the potential economic benefits of earning an associate degree, which has been found to yield significantly higher earnings in the labor market when compared to individuals with only a high school diploma, or some college experience but no degree (Belfield & Bailey, 2011; Marcotte et al., 2005).

Numerous studies have shown that transfer students are more likely to complete a bachelor's degree if they first complete an associate degree (Crook et al., 2012; Crosta & Kopko, 2014; Shapiro et al., 2013). Despite this perceived benefit, roughly one in eight students in the 2008 cohort of students who started at a community college transferred to a four-year institution after receiving either a certificate or associate degree (Shapiro et al., 2015). The vast majority of students transferred without a degree, and many ended up leaving higher education altogether without reaping the benefits of an associate degree.

Credit Transfer

Though current research indicates that earning an associate degree prior to transfer has positive effects on bachelor's degree completion, it does not necessarily mean that reverse transferring *credits* to retroactively earn an associate degree while still enrolled at a four-year institution will have the same effect. The extant literature on student transfer has examined factors related to students' movement from one institution to another, but few studies are available that examine the factors surrounding the transfer of credits between institutions. One such study utilized the Postsecondary Education Transcript Study of 2009 (PETS), a national NCES initiative that collects transcript information from 17,000 students across over 2,500 institutions, to examine under what circumstances institutions accept transfer credits earned by students at other institutions

(Simone, 2014).

This study found that for the subset of students who elected to move from one postsecondary institution to another, credit transfer was not guaranteed, and that "on average, students lost 13 credits as a result of their first transfer or co-enrollment. For about 39 percent of students, no credits transferred between the origin and first destination institution, with an average loss of 27 earned credits" (Simone, 2014, p. 23). For a full-time community college student, this represents a year of wasted credits, which equates to a substantial loss of both time and money. Results from the analysis by institutional level suggested that deviating from a traditional vertical transfer pattern (i.e., 2-year to 4-year) resulted in a higher likelihood of no credits transferring, and a higher number of credits lost for students who were able to transfer credit. On average, 22 credits were lost for students that were reverse transferring from a four to a two-year institution, and 15 credits were lost for students transferring laterally between two-year institutions. In contrast, students who transferred vertically from a two-year to a four-year institution lost only about eight credits, on average.

Another study also utilizing a national dataset of transcripts, the 2004/2009 Beginning Postsecondary Students Longitudinal Study (BPS), tracked a nationally representative sample of first-time freshmen for six years after their initial college enrollment (Monaghan & Attewell, 2015). Using propensity score matching, the researchers explored the mechanisms contributing to the disparity in bachelor's degree completion between similar students who start at a four-year college, or transfer in from a community college. The study examined a number of potential reasons for non-completion among community college transfer students, including lowered expectations

from attending a two-year college, the vocational focus of some community college programs, and the supposed lower level of rigor at community colleges (Jenkins & Fink, 2015).

The authors determined that none of these factors were associated with failure to complete a four-year degree. In fact, the largest impediment to bachelor's degree completion for community college students was loss of credits upon transfer. In addition, the authors concluded that "many transfer students pay a penalty, in the sense that the receiving 4-year institution does not accept all their earlier credits as counting toward the BA. Only 58% of transfers in our national sample are able to bring all or almost all of their credits with them" (Monaghan & Attewell, 2015, p. 85). Even when controlling for college GPA and credits earned, students who are able to transfer more credits are more likely to complete a bachelor's degree. This suggests that the bachelor's degree attainment rates among community college transfers would be even higher than 4-year entrants if this credit loss penalty was removed (Monaghan & Attewell, 2015).

The Reverse Transfer Policy Environment

Fortunately, in states such as New Jersey, there are state policies that mandate that all community college credits earned as part of an associate degree be transferrable toward a four-year degree in a similar program at a state college. The Lampitt Law, requires all New Jersey colleges and universities to enter into a statewide articulation agreement and provides for the full transfer of academic credits earned as part of an associate of arts or associate of science degree (Maliszewski, Crabill, & Nespoli, 2012). This law adds more value to the associate degree because students who earn the degree lose fewer credits after transferring.

A recent bill passed in the New Jersey state legislature requires all higher education institutions to enter into a statewide reverse transfer agreement (Caride, Mckeon, Jasey, & Giblin, 2017). Students who earn a cumulative total of 66 degree credits between a community college and a four-year institution will be eligible to receive an associate degree from the community college. The reverse transfer agreement also addresses developing effective communication practices between institutions around the exchange of transcripts and course equivalencies, but lacks specific details concerning how students will be notified of their eligibly and how they will be advised on the courses that they still need to take in order to qualify.

Articulation policies in general are designed not to entice students to transfer, but to preserve credits as students who have already decided to transfer move from one institution to another (Roksa & Keith, 2008). Thus, articulation policies reduce the amount of credit loss that students must incur, potentially boosting bachelor's degree attainment levels. While many states have dedicated substantial resources to improving articulation agreements between two and four-year institutions so that transfer students can seamlessly transfer their credits, several studies have shown that statewide articulation agreements and other transfer policies have not yet yielded significant improvements in student mobility and completion (Gross & Goldhaber, 2009; Handel & Williams, 2012).

One of the strengths of the higher education system in the United States is its diversity. Institutions are able to establish new programs relatively easily, but without always considering how the credits earned in these programs will transfer to other colleges. Furthermore, students have the ability to transfer to many different types of

institutions (community colleges, two-year technical schools, public or private universities etc.). While this freedom is beneficial, it has unintentionally created barriers for students looking to transfer.

Numerous qualitative studies have shown that there are inefficiencies and complexities in the transfer process, which leave students feeling lost and confused (Booth et al., 2013; Jaggars & Fletcher, 2014). Results of surveys and focus groups have shown that there are insufficient supports for students, and that transfer information is inconsistent or overwhelming due to poor communication systems between two and four-year institutions (Jenkins & Fink, 2015). No studies to date have explored students' perceptions of the reverse transfer process. Thus, little is known about the value that these types of policies have for students, or how they can be structured more effectively.

Several qualitative studies have examined the elements of successful reverse transfer policy implementation from the perspective of administrators and policy leaders, but the voice of students has been largely absent (Friedel & Wilson, 2015; Robinson, 2015; Taylor & Bragg, 2015). For example, Robinson (2015) interviewed administrators involved in the implementation of a reverse transfer policy in the Hawaii community college system. Participants felt strongly that students should "receive recognition for their work in case outside factors prevented them from obtaining a degree" (p. 547). One administrator claimed that reverse transfer policies are beneficial because they allow students to transfer at the "most appropriate time for themselves while still gaining the demonstrable benefits of a certificate or diploma" (p. 548).

Taylor & Bragg (2015) identified several important policy issues that affect potential reverse transfer students. The first relates to "opt-in" versus "opt-out" rules that

set the default option for participating in reverse transfer. For example, Hawaii uses an opt-out rule that automatically considers students for reverse transfer unless they choose not to participate. They have had much success with this approach, with no students declining to participate. However, most states in the CWID baseline study utilize an opt-in approach where students must actively decide to reverse transfer. These states have averaged between a 10 and 25 percent consent rate depending on how well the institution communicates with students. States that use multiple email messages with carefully crafted messages tend to have the highest consent rates. For example,

> Some states provided information about the purpose of reverse transfer, the value of securing a reverse transfer associate's degree in terms of employability, and the value of the associate's degree as a fallback credential should the student not complete a bachelor's degree. Some states also emphasized modest or no cost associated with securing the degree, capitalizing on student sensitivity to the cost of obtaining a higher education credential (Taylor & Bragg, 2015, p. 6)

Other strategies that states are using to improve consent rates include offering financial incentives, inviting students to participate in the commencement ceremony, and waiving graduation fees. These strategies have minimal financial cost for the institution, but may serve to communicate the importance of the reverse transfer degree and motivate students to pursue it.

Lastly, some states are actively engaging and advising near completers to transfer their credits back to receive the associate degree. This maximizes the number of potential reverse transfer students who may be within only one or two courses of earning an associate degree (Taylor & Bragg, 2015). Community colleges are writing letters and emails to students notifying them of the courses they need to fulfill their degree requirements. In a small number of cases, advisors at the universities are counseling students on the courses they need to complete in order to be eligible to reverse transfer.

However, in some cases, institutions are intentionally choosing *not* to advise students out of fear that students will become confused about whether or not they are on the right track, and veer off course.

Propensity Score Matching

The use of PSM has increased significantly in higher education research due to the lack of feasibility and ethical concerns associated with conducting randomized experiments in educational settings. Several recent studies have used PSM to examine: the financial return on completing a graduate degree (Titus, 2007); the effect of earning an associate degree before transferring on bachelor's degree completion (Crosta & Kopko, 2014); and the difference in educational attainment of community college transfers and non-transfers with junior standing (Melguizo et al., 2011).

However, a recent comprehensive review of PSM studies in the social science literature revealed that while the prevalence of these studies has increased, the methodological transparency and rigor has been inconsistent (Thoemmes & Kim, 2011). The authors concluded that well-designed and rigorous propensity studies exhibited the following characteristics: adequate sample sizes based on the number of covariates selected; a methodological discussion of covariates that reflect theoretically-bound characteristics and include more than age, race, and gender for controls; and the examination of results before and after propensity matching, including effect sizes due to large sample size influences. These factors must be taken into consideration in order to ensure the internal validity of the study by ruling out, as much as possible, any alternative explanations which could be explaining the findings (Teddlie & Tashakkori, 2009).

Since it would not be possible to randomly assign students to receive associate degrees, simply comparing the attainment levels of RT-eligible students and completers would not reflect a true difference in their outcomes. Rather, the differences may be biased by a host of demographic, environmental, and institutional variables which could be correlated both with a student's decision to pursue an associate degree, and their likelihood of completing a bachelor's degree.

In order for propensity score matching to produce an unbiased treatment effect, several conditions must hold. First, the conditional independence assumption states that individuals must be equally likely to have received the treatment. In the context of this study, there must not be a population of students who are inherently more likely to have earned an associate degree. Second, the stable unit treatment value assumption (SUTVA) requires that one individual's treatment assignment does not affect the outcome for another. In other words, students' decisions to complete an associate degree are independent and have no impact on one another.

If these assumptions hold, Rosenbaum and Rubin (1983) propose that the propensity score, defined as the conditional probability of receiving the treatment given observed pretreatment characteristics, can be used to create a comparison group that resembles the treatment group by matching on the propensity score. Through the use of logistic regression, individuals are assigned a propensity score, which in this study, is the conditional probability that a person earned an associate degree before transferring to a four-year institution given certain characteristics of the person and/or institutions in the sample.

This is done in order to identify matched pairs or clusters of similar students who

differ only in respect to the treatment. Matching can be performed in a number of different ways and there are several factors to consider including matching with or without replacement, how to assess the proximity or closeness of the match, whether and how to weight cases, and the number of comparison units to match to each treatment unit (Heinrich, Maffioli, & Vazquez, 2010). The most simple and straightforward method is to use one-to-one matching, which pairs each treated and control unit that have identical propensity scores (Ho et al., 2011). However, this is often not feasible if there are many covariates and exact matches cannot be found.

Another common matching algorithm used in PSM is known as nearest neighbors matching, where an individual from the treated group is paired with one in the comparison group based on the closeness of their propensity scores. This can be done with or without replacement. In other words, individuals can either be used more than once in determining a match, or excluded once a match is found. Another common matching method is caliper or radius matching, which involves setting a tolerance level or distance metric for determining the threshold of matches. By setting a range of propensity scores, bad matches can be avoided and the quality of the matching rises (Caliendo & Kopeinig, 2008).

Whichever matching algorithm produces the best balance in propensity scores is typically the one that is chosen. After matching, it is important to assess the balance of the covariates after matching by conducting numerical summaries such as t-tests of mean differences across the two groups (Ho et al., 2011). This can also be assessed visually using a density plot of the propensity scores in both groups. The basic idea is to compare the situation before and after matching to check if there remain any differences after

conditioning on the propensity score. If there are differences, matching on the propensity score was not completely successful and the regression model should be reevaluated or a different matching algorithm should be chosen (Caliendo & Kopeinig, 2008).

After propensity scores have been estimated and if a one-to-one matching algorithm has been chosen, the impact of the treatment on the treated (ATT) and untreated (ATU) is calculated by averaging the differences in outcomes between each treated unit and its neighbor (or neighbors) (Heinrich, Maffioli, & Vazquez, 2010). If exact matching is not used, it is not sufficient to perform a simple comparison of means (Ho, Imai, King, & Stuart, 2007). Instead, analyses that account for the matched nature of the data should be performed, such as paired samples t-tests (Austin, 2011).

Another approach is to use the matched sample to run a multiple regression of the outcomes on pretreatment covariates and an indicator of the treatment. Researchers suggest the propensity score regression approach can potentially improve the precision of the estimates by adjusting for slight covariate imbalances (Rubin, 1973, 1979). When interpreting the results, it is important to evaluate the robustness of the estimations by changing the matching algorithms or by altering the parameters of a given algorithm. Robustness checks help increase the reliability of the results by showing that the estimations do not depend on the methodology chosen.

The most important step in propensity score analysis is deciding on which variables to include. Researchers often rely on a strategy of selecting covariates that are highly correlated with both the selection into treatment and the eventual outcome. Heckman, Ichimura, and Todd (1997) show that, “omitting important variables can seriously increase bias in resulting estimates. Only variables that influence

simultaneously the participation decision and the outcome variable should be included. Hence, economic theory, a sound knowledge of previous research and also information about the institutional settings should guide the researcher in building up the model" (as cited in Caliendo & Kopeinig, 2008, p. 10).

Conceptual Framework and Relevant Literature

When using propensity score matching, it is important to control for as many covariates as possible, and the decision to do so should be theoretically-driven (Thoemmes & Kim, 2011). However, there is a tradeoff between including as many relevant variables as possible, which introduces additional variance, and "trimming" the model too much by removing too many important variables (Caliendo & Kopeinig, 2008). The main purpose of estimating the propensity score is not to predict the probability of placement into treatment as accurately as possible, but to ensure that the covariates are sufficiently balanced between the treatment and control groups. Based on these recommendations, the following sets of variables were used to construct the model.

Demographic variables. Decades of research has supported the strong impact that demographic variables such as gender and race/ethnicity have on the educational outcomes of students (Pascarella & Terenzini, 2005). For example, Wang (2009) utilized the National Education Longitudinal Study of 1988 (NELSE) to explore the contribution of demographic variables such as race/ ethnicity, socioeconomic status, and gender on the probability of community college transfer students staying in college and ultimately attaining a bachelor's degree. Utilizing a logistic regression model, the author found that after controlling for other variables, the odds for female students to attain a bachelor's degree was 2.5 times that for male students, and individuals with higher socioeconomic

status were more likely to attain a bachelor's degree than students with lower socioeconomic status.

Research on achievement gaps has shown that Black or African American and Hispanic/Latino students remain underrepresented in higher education, both in terms of enrollment and completion (Bailey, Jenkins, & Leinbach, 2005). When these students do earn credentials, they are less likely to be at the baccalaureate level, and more likely to be in certificate and occupational associate degree programs. This is partly a function of the social stratification both inside and outside of the institution. Minority students are more likely to enter higher education through the doors of for-profit and two-year institutions, and their representation within programs at these institutions is further stratified (Goldrick-Rab, 2010). While these demographic characteristics themselves do not fully explain the differences in outcomes, they hint at the underlying root causes and structural barriers that contribute to achievement gaps.

Environmental variables. Environmental variables such as financial need are risk factors for stopping out, and thus impact students' degree attainment levels (Simone, 2014). In a national study of over 700,000 degree-seeking community college students, Jenkins & Fink (2016) found that "lower income students who transferred to a four-year institution were 8 percentage points less likely to earn a bachelor's degree than were higher income transfer students" (p. 30). For the purposes of this study, Pell status is a used as a proxy for income level. The federal Pell grant program is currently the largest need-based financial aid program available to students, and is awarded primarily based on the student's and/or parents' income for the previous year, with awards made primarily to low-income students (Wei, Horn, & Carroll, 2002). Using data from the

Baccalaureate and Beyond Longitudinal study, Wei and Horn (2009) found that Pell Grant recipients who graduated in 1999–2000 took longer to complete a bachelor's degree than their counterparts who did not receive Pell Grants.

However, these results can be misleading because Pell grant recipients are also more likely to come from non-English speaking households and have parents with a high school education or less. A larger proportion tend to be Black, Hispanic, American Indian, or a racial/ethnic background other than White. To help account for this, multivariate regression analyses revealed that after controlling for transfer and stop out rates and several other related variables, receiving a Pell Grant was actually associated with a shorter time to degree (Wei & Horn, 2009).

Pre-Baccalaureate variables. Student experiences and enrollment patterns at the community college directly affect their eligibility and likelihood of completing a degree and transferring successfully. Depending on the type of associate degree, students may be more or less able to transfer credits seamlessly from one institution to another. For example, Crosta & Kopko (2014) found large positive impacts of earning a transfer associate degree (e.g. Associate in Arts or Associate in Science) on the probability of earning a bachelor's degree within four, five, and six years. However, this effect disappeared for students earning a career-oriented associate degree (e.g. Associate in Applied Science), which is not intended to be transferrable. Therefore, it may be harder for students to transfer credits earned from these programs and apply them towards a bachelor's degree.

Transfer timing, GPA, and credit accumulation are critical variables to account for in this study. The amount of credits earned at the community college and overall

academic performance may influence students' bachelor's degree attainment. The successful transfer of credits, "may be at least partially a function of a student's prior academic performance, as many institutions have minimum performance thresholds for transferring credits" (Simone, 2014, p. 39). Research has shown that the more credits a student accumulates towards an associate degree, the more likely they are to transfer and earn a bachelor's degree (Koker & Hendel, 2003). Therefore, students who are able to earn a substantial number of credits before transferring may differ significantly from students who transfer after earning only a small number of credits. In fact, research has shown that community college transfer students who enter as juniors have higher outcomes than students who enter as freshmen or sophomores, and perform just as well as students who start out at four-year institutions (House, 1989; Melguizo et al., 2011).

Students' enrollment intensity throughout community college may also play a role. A study conducted by the Center for Community College Student Engagement found that students who attended college as always-full-time students had higher overall engagement levels than always-part-time students. Transcript data from 28 colleges that participated in the 2016 administration of the Community College Survey of Student Engagement (CCSSE) showed that always-full-time students were significantly more likely to persist, complete gateway courses, and graduate than always part-time students. Importantly, students with fluid attendance patterns (e.g. a mixture of full-time and part-time enrollment) were more similar to always-full-time students in terms of their outcomes, which suggests that even some full-time enrollment is better than none at all (Center for Community College Student Engagement, 2017).

Community college GPA has been shown to be one of the strongest predictors of bachelor's degree attainment and persistence among community college transfer students, and is also highly correlated with continuous enrollment (Pascarella & Terenzini, 2005; Townsend, McNerny, & Arnold, 1993; Wang, 2009). When holding other predictors constant, "Students who earned better GPAs from community colleges tend to be more likely to persist. The odds of being continuously enrolled in postsecondary education increases by a factor of 3.441 for a one point increase in community college GPA" (Wang, 2009, p. 581).

Baccalaureate variables. Simone (2014) identified several institutional variables that affect the transfer of credits including institutional level (i.e., transfer direction), institutional control (public/private), accreditation status, and institutional selectivity. Community college students who transfer to public four-year institutions are more likely to earn bachelor's degree when compared to students who transfer to private institutions, and the likelihood of degree attainment also increases with selectivity (Jenkins & Fink, 2016).

Therefore, depending on the characteristics of the institution a student transfers to, they may be more or less likely to complete a bachelor's degree regardless of whether or not they earned an associate degree. Similarly, the degree and award level of students' programs both before and after transfer will impact their rates of completion (Simone, 2014). A student who transfers into a completely different program at a four-year institution will likely not have all their credits transferred, and will take longer to complete a bachelor's degree than a student who enters a similar area of study.

Psychological variables and grit. The psychological construct of grit has received increased attention in recent years. Grit is defined as, "Perseverance and passion for long term goals. It entails working strenuously toward challenges, maintaining effort and interest over years despite failure, adversity, and plateaus in progress" (Duckworth et al., 2007, p. 1087). Grit has two distinct facets – consistency of interest, or the tendency to not change one's goals or interests frequently, and perseverance of effort, or the desire to work hard despite challenges and setbacks. As a construct, grit is thought to be distinct from cognitive ability in that it explains variation in performance even when measures of intelligence are controlled for (Duckworth & Quinn, 2009).

However, a recent meta-analytical study of the grit literature found that grit might not be very different from other personality dimensions, such as conscientiousness or self-control (Credé, Tynan, & Harms, 2016). Even Duckworth et al. (2007) and Duckworth and Quinn (2009) report strong correlations between conscientiousness and overall grit scores, but still maintain that they are separate constructs. Credé et al. (2016) also found that the perseverance component of grit was a much stronger predictor of performance than either consistency of interest or overall grit. Despite these limitations, grit was shown to be a strong predictor of retention, which suggests that the grit scale may be a useful tool to use in higher education settings where interventions are targeted toward individuals at risk of dropping out.

Chapter 3

Methods

This chapter explains the methods that were used to address the central research questions of this study. The gold standard of inferential research about treatment effects is the randomized experiment. Since it would not be possible to randomly assign students to receive associate degrees, this study relies on a quasi-experimental approach called propensity score matching (PSM) to determine the impact of earning an associate degree on bachelor's degree completion. Through PSM, differences between two groups are balanced out by carefully examining covariate information, and matching similar treated and untreated cases (Rubin, 1973, 1979).

Research Questions

This study addresses the following research questions using a combination of propensity score matching and surveys:

1) What are the demographic characteristics of reverse transfer eligible students, and how do they differ from associate degree completers?
2) What impact does earning an associate degree have on bachelor's degree completion?
3) Are there significant differences in grit between reverse transfer eligible students and associate degree completers, and if so, do these differences contribute to bachelor's degree completion?
4) What are some of the reasons why students transfer before earning an associate degree?

Setting

All study data were collected from a single community college in the Northeast. This institution serves approximately 12,000 students annually, most of whom are part-time (59 percent), Hispanic or Latino (53 percent), and low-income (60 percent Pell-eligible). The three-year graduation rate for the Fall 2012 cohort of first-time, full-time, degree-seeking students was 13 percent, and the three-year transfer-out-rate for the same group was 14 percent.

Sample

In most states, students must meet minimum eligibility requirements in order to be considered eligible for reverse transfer. These include: meeting the institution's residency requirement (the number of credits that must be earned at the community college in order to qualify for an associate degree), earning a certain number of cumulative college credits (typically between 50 or 60 credits), and transferring to a four-year university without first earning an associate degree (Taylor & Bragg, 2015).

Individuals in the treated (associate degree completer) and untreated (RT-eligible) groups were selected based on the following criteria: if they had earned between 60 and 90 cumulative degree credits and had a start date at the community college between January 1, 2000 and January 1, 2011. This time window was used in order to allow enough tracking time for students to earn a bachelor's degree in six years. The population was then further confined to students with at least one enrollment record at a four-year institution after their official degree or stop-out date at the community college. This resulted in a total sample size of N = 2,859 (n = 2,154 treated; n = 705 untreated).

Finally, students with transfer credits were excluded from the analysis because

their true start date in college could not be determined, and many could have earned college degrees at previous institutions. This resulted in a final sample size of N = 2,268 students (n = 1,985 treated; n = 283 untreated). The number of individuals in the untreated group is substantially smaller because the analysis was limited to individuals who earned between 60 and 90 degree credits and had not earned any transfer credits. This was done in order to facilitate matching by comparing similar groups of associate degree completers and RT-eligible students.

Research Design

Propensity score matching was used to determine the impact of earning an associate degree on subsequent bachelor's degree completion. As mentioned previously, PSM attempts to adjust for the problem of selection bias in observational studies that occurs due to the lack of randomization. It accomplishes this by matching a treated and an untreated group on covariates thought to be associated with receiving the treatment (Rosenbaum & Rubin, 1983). PSM was performed using the *MatchIt* package in R, a free and open source statistical language and environment (Ho, Imai, King, & Stuart, 2011; R Core Team, 2014).

This study utilizes PSM to estimate the causal effect of earning an associate degree on bachelor's degree completion. The propensity score is defined as "the conditional probability of assignment to a particular treatment given a vector of observed covariates" (Rosenbaum & Rubin, 1983, p. 1). The probability of being in the treatment is defined as:

$$\pi(X_i) \equiv Pr(T_i = 1|X_i)$$

Where X_i is a matrix of observed covariates and $\pi(X_i)$ is the propensity score. The

propensity score reduces all predictors into one probability, and acts as a balancing score by ensuring that the distribution of covariates are relatively the same across treated and untreated groups (Leite, 2017). Assuming treatment assignment is strongly ignorable, matching, weighting, or stratifying based on the propensity score can provide unbiased treatment effect estimates. The average treatment effect (ATE) is defined as the difference between the expected values of the potential outcomes of all individuals in the treated and untreated individuals. Given a set of covariates, *X*, and outcomes *Y*, where 0 denotes not earning an associate degree and 1 denotes earning an associate degree, the ATE is defined as:

$$ATE = E(Y_1 - Y_0|X) = E(Y_1|X) - E(Y_0|X)$$

Or the difference in outcomes between associate degree earners and non-earners given the set of observed covariates.

Data Collection

Study variables. Administrative data were collected according to a data dictionary, which outlines the formats and definitions for the variables used in the initial regression model (see appendix A). Student ID was collected to serve as a unique identifier useful for matching. Students' first name, last name, middle initial, and date of birth were collected in order to submit an enrollment file through the National Student Clearinghouse's StudentTracker service, which tracks enrollment of students across institutions. Demographic variables such as race/ethnicity categories and gender were dummy coded (1 = Yes and 0 = No). Pell eligibility status was used as a proxy for income level and was also dummy coded.

Several institutional level variables were also collected. Students' start and end dates at the community college served as time bounds for measuring successful completion of a bachelor's degree within six years of initial enrollment at the community college. Since completion and transfer vary by program, both the degree type (A.A., A.S., or A.A.S.) and major CIP code were collected. Performance metrics, such as the number of accumulated degree credits and GPA upon transfer were also collected in order to compare students with similar academic standing. Lastly, a reverse transfer flag (dummy coded 1 and 0) was used to differentiate RT-eligible students from associate degree completers.

A third set of baccalaureate-level variables was collected once a return file was received back from the Clearinghouse. This file contains several important student and institutional level variables including: transfer institution name, state, public/private affiliation, student enrollment begin/end dates, enrollment status (full-time, half-time, less than half-time, withdrawn), class level (freshman, sophomore, etc.), enrollment major, enrollment CIP code, graduation status, graduation date, degree title, and degree major.

Survey data collection. The final sample of N = 2,268 was then administered an online survey consisting primarily of the grit scale, which is a 12 item instrument used to measure passion and perseverance in achieving long-term goals (Duckworth et al., 2007). The scale consists of two main factors, consistency of interest and perseverance of effort, which demonstrate high internal consistency and intercorrelation with one another (r = .59, p < .001). After controlling for conscientiousness and other big five personality

characteristics as well as age, grit was shown to be a strong predictor of educational attainment (Duckworth & Quinn, 2009).

The survey yielded 212 responses (n = 33 untreated; n = 178 treated). However, 22 were discarded because they were missing one or more response items, resulting in incomplete grit scores (n = 29 untreated; n = 161 treated). Each question on the scale was scored on a five-point Likert scale (1 = Not like me at all, and 5 = Very much like me). Scores were then added for each of the 12 items to compute an overall grit score with 60 being the highest possible score. An average grit score was also calculated by dividing the total score by 12, which resulted in scores from one (not at all gritty) to five (extremely gritty). Some questions, such as "new ideas and projects sometimes distract me from previous ones", were reverse coded. For example, if an individual answered "very much like me" to this question, which is a score of five, they were instead given a score of one.

Data Analysis

Data analysis in PSM is typically conducted in two phases. In phase I, the probability of placement into the treatment group is estimated based on a number of observed covariates using a logit or probit regression model with a dichotomous or binary outcome. In phase II of PSM analysis, comparisons on the dependent variable (bachelor's degree completion) can be made between matched pairs. The following sections detail the steps that were taken to conduct the propensity score analysis.

Propensity score estimation. Logistic regression was the method used to calculate propensity scores. Logistic regression involves the prediction of a binary or categorical outcome (earning an associate degree or not) based on multiple covariates or

independent variables. Covariates in a propensity score model should be true confounders. In other words, they should be related to both the probability of earning an associate degree (the treatment) and eventual bachelor's degree completion (the outcome).

A total of 15 variables were used as predictors for the study: Race/Ethnicity (coded into five separate binary categories for Hispanic/Latino, Asian, Black or African American, White, and Native Hawaiian/Pacific Islander), age at first enrollment, sex, Pell-eligibility status, developmental English or Math requirement, ESL requirement, accumulated GPA, accumulated degree credits, degree program (A.A., A.S., A.A.S), and primary attendance status (full or part-time). A final variable was included as a covariate in order to account for the variability in the timing of when students choose to transfer. Some students may earn a large number of credits spread out over many years, and thus would be less likely to be captured in a six-year graduation rate when compared to students who transfer early on. If not controlled for, these different types of transfer students could bias any comparisons. Crosta & Kopko (2014) attempt to remedy this by including a variable that counts the number of terms that students enrolled in at the community college. However, this becomes problematic if there are shortened terms that some students may enroll in more than others do. Therefore, instead of counting terms, the number of years between a student's start and end date at the community college was used to help control for the differences in transfer timing.

The *glm* function in R was used to fit a logistic regression model with the covariates above and earning an associate degree as the binary outcome. The *predict* function was used to compute a propensity score for each student. In order to avoid

compression around 0 and 1, it is advantageous to match on the linear propensity score by using the logit transformation of the propensity score itself (Leite, 2017). A preliminary evaluation of common support was performed using a histogram (Figure 1). It is important that there be sufficient overlap in propensity scores across the treated and untreated groups. Specifically, it is recommended that the distribution of the treated scores be contained almost entirely within the distribution of the untreated (Leite, 2017). This makes it more likely that there will be an adequate number of individuals with similar propensity scores in both groups when matching is performed. Figure 1 shows that the pre-matched groups are very similar to one another. With the exception of a few individuals with very high propensity scores in the treatment group, there is adequate enough common support to proceed with matching.

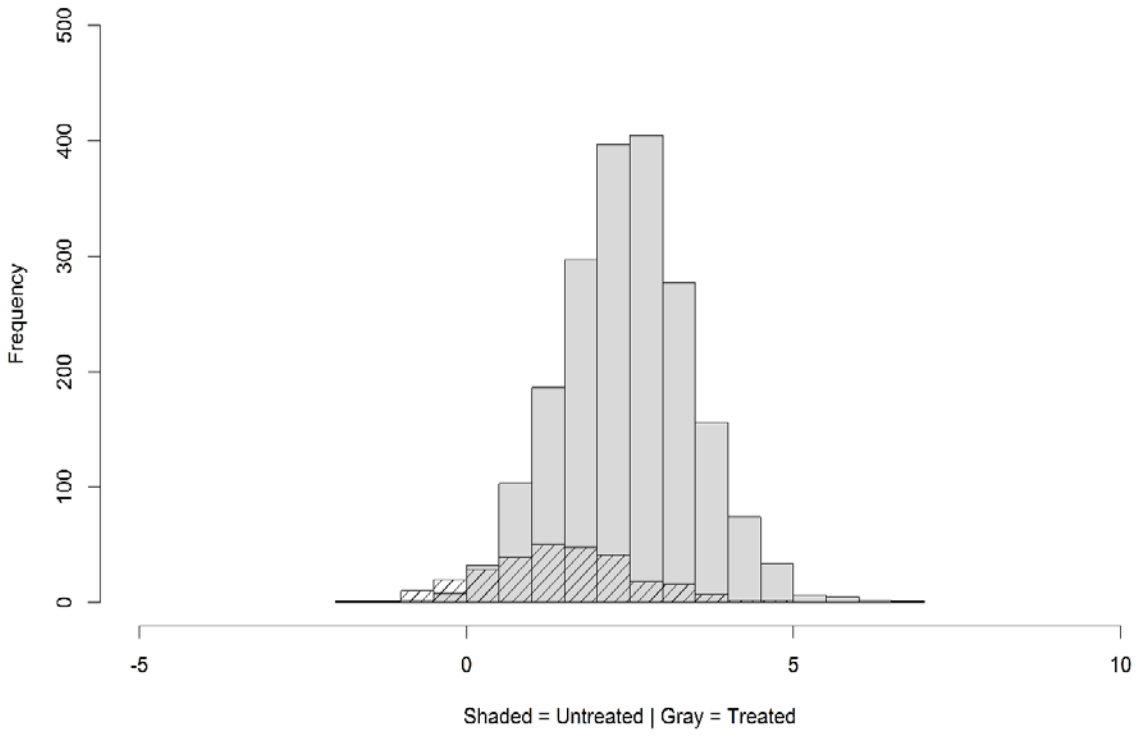

Figure 1. Evaluation of Common Support

Propensity score method implementation. There are three main methods of propensity score implementation once propensity scores have been estimated: matching, weighting, and stratification (Leite, 2017). Two of these approaches- matching and stratification- were used in this study, and each is described in the sections that follow.

Propensity score matching. Matching involves selecting one of several algorithms (nearest neighbors, genetic, full etc.) and a matching ratio (one-to-one, fixed ratio, or variable ratio). The matching ratio determines whether to match with replacement. Matching with replacement means that an individual in one group can be matched to more than one individual in the other group. Other options for matching include setting the caliper, or the maximum distance in standard deviations within which matches are acceptable (Leite, 2017). It is advisable to experiment with many different matching algorithms and criteria in order to find the one that produces the best balance in variables across the treated and untreated groups. Each of the following matching techniques were used in this study.

Nearest neighbor matching. This method involves simply finding the untreated observation with the closest propensity score in the treated group (Leite, 2017). The *matchit* function with the method set to "nearest" was used to perform the matching, which was done with replacement using a caliper of .25. The use of a caliper has been shown to increase matching performance and enforces common support because observations that are outside of the caliper range are discarded (Leite, 2017). While there is no set standard for which caliper to choose, Rosenbaum & Rubin (1985) found that using a caliper of .25 removed 90 percent of bias. Figure 2 shows a jitter plot after nearest neighbor matching was performed. The size of each point represents the number of times

an individual was matched, with larger points reflecting more weight. It also shows the number of treated and untreated cases that were not matched, and subsequently dropped.

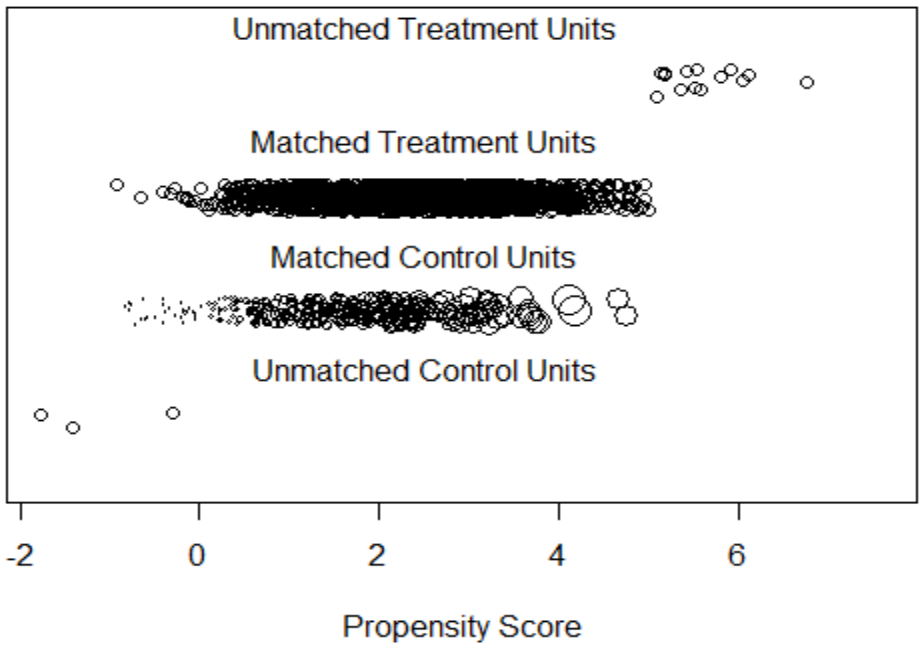

Figure 2. Comparison of Treated and Untreated Observations after Nearest Neighbor Matching

Greedy matching. Greedy matching involves matching treated and untreated cases without regard for the overall quality of matching across the entire sample (Ho et al., 2011; Leite, 2017). It works particularly well at estimating the average treatment effect on the treated (ATT) when the number of treated cases is substantially less than the number of untreated cases. As with other matching methods, greedy matching can be performed with or without replacement, with the enforcement of a maximum allowable distance, and with the option to allow multiple matches (Leite, 2017). Greedy matching

was performed using the *Matching* package with a caliper of .25, allowing for replacement. The distance metric between groups was set equal to the logit propensity score calculated previously.

Genetic matching. Genetic matching uses a genetic search algorithm to generate a set of weights for each covariate such that optimal balance is achieved after matching (Hansen, 2004; Ho et al., 2011). Matching is done with replacement and balance is determined using paired t-tests for categorical variables and Kolmogorov-Smirnov tests for continuous variables. When using genetic matching, it is important to specify a large population size (Leite, 2017). The default in the *GenMatch* package is 100 generations, which was increased to 1,000 in order to optimize balance.

Full matching. Full matching uses all individuals in the dataset by grouping them into matched sets, similar to subclassification (Hansen, 2004; Stuart & Green, 2008). Each matched set contains at least one treated and one untreated individual. Full matching is particularly useful when there are large differences in the distribution of propensity scores between treated and untreated groups (Leite, 2017). Treated individuals who have many matches are grouped with multiple comparison individuals, whereas treated individuals with fewer comparisons are matched with fewer. A discard option can also be specified that excludes cases outside of the region of common support (Ho et al., 2011).

Propensity score stratification. Propensity score stratification involves dividing up the range of propensity scores into strata that have similar propensity scores, establishing cutoffs for each strata, and assigning weights based on the number of treated and untreated cases in each (Leite, 2017). The most common approach to stratification is

to divide the propensity scores into quintiles (Thoemmes & Kim, 2011). The *MatchIt* package can automate this process using method "subclass" and dividing the data into five strata. Then, the *match.data* function creates a new dataset containing the original data, strata ids, and weights (Leite, 2017). Common support is deemed adequate if there are at least some treated and untreated observations within each stratum. Table 1 below shows the number of treated and untreated individuals within each stratum after stratifying based on the logit propensity score and discarding cases outside of the region of common support.

Table 1

Distribution of Treated and Untreated Cases After Propensity Score Stratification

	Stratum					
	1	2	3	4	5	Total
Untreated	159	53	32	22	15	281
Treated	397	397	397	397	366	1,954
Total	556	450	429	419	381	2,235

Covariate balance evaluation. The primary way to evaluate the success of matching involves comparing the distribution of each covariate in the treatment and control groups. If the two groups are well balanced after matching, then the matching has been successful. There are several ways to assess balance across covariates including graphically through the use of QQ and bar plots, or through descriptive or inferential measures such as t-tests or standardized mean differences (Leite, 2017). However, the

commonly used procedure of conducting *t*-tests of the difference in means between two groups can be misleading and should be avoided (Ho et al., 2011). Instead, Austin (2011) recommends using the standardized bias, which is defined as the weighted difference in means divided by the standard deviation of the treated group. Absolute values below 0.10 indicate that sufficient balance has been achieved. A less strict criterion is that all covariates should have a standardized mean difference, or standardized bias, below 0.25 (Stuart, 2010).

Table 2 shows the standardized biases for all covariates across each matching method. All covariates had a value below 0.25, but nearest neighbor matching and propensity score stratification had the most values below .10, which indicates that the best balance was achieved using these two methods. Figure 3 is a visual boxplot of the data presented in Table 2. The point in the middle represents the median standardized bias across all covariates, and the horizontal dashed lines indicate the minimum and maximum values.

Table 2

Comparison of Standardized Biases After Matching

	STRATA[1]	NEAREST	GREEDY	FULL	GENETIC
Hispanic/Latino	0.03	0.01	0.13	0.13	0.13
Asian	0.05	0.01	0.04	0.04	0.04
Black or African American	0.10	0.02	0.07	0.08	0.07
Native Hawaiian/ Pac. Island	0.09	0.01	0.03	0.03	0.03
White	0.06	0.08	0.11	0.11	0.11
Age	0.09	0.04	0.01	0.00	0.01
Sex	0.06	0.03	0.03	0.03	0.03
Pell-Eligible	0.07	0.05	0.02	0.02	0.02
Required Developmental	0.07	0.07	0.11	0.12	0.11
Required ESL	0.07	0.08	0.09	0.09	0.09
Accumulated GPA	0.15	0.15	0.16	0.15	0.16
Accumulated Degree Credits	0.16	0.16	0.22	0.20	0.22
Years at Community College	0.15	0.12	0.13	0.11	0.13
Degree Program (A.S.)	0.06	0.01	0.01	0.01	0.01
Degree Program (A.A.S.)	0.08	0.01	0.05	0.06	0.05
Attendance Status	0.04	0.00	0.05	0.02	0.05

[1] Stratification with five strata (standardized mean differences across strata).

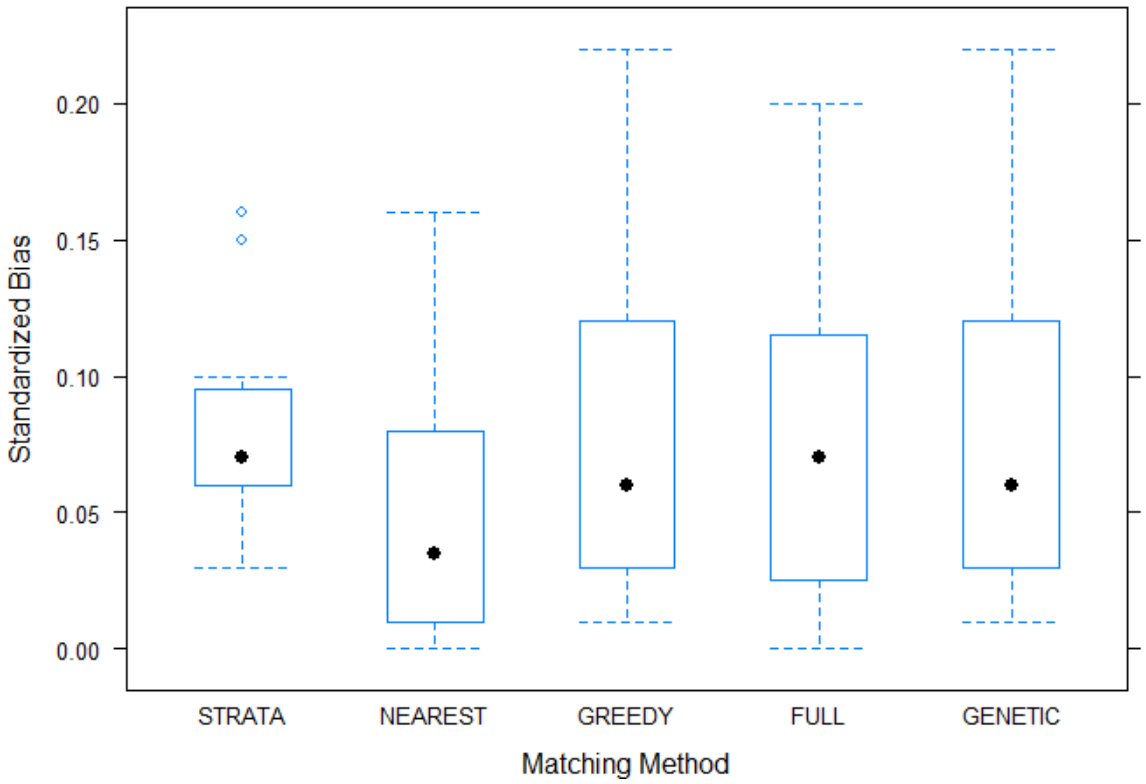

Figure 3. Boxplot of Absolute Standardized Biases for Covariates After Matching

Covariate balance evaluation differs in propensity score stratification depending on whether you are looking across all strata, or within each individual stratum (Leite, 2017). The standardized biases in Table 2 are for all five strata combined. However, if the goal is to estimate treatment effects by pooling stratum specific treatment effects, covariate balance should be evaluated and achieved within each individual stratum by examining the similarity of distributions of covariates between treated and untreated groups.

This is perhaps best accomplished visually using the *PSAgraphics* package in R (Helmreich & Pruzek, 2009). Figures 4 and 5 show the distribution of continuous and categorical covariates between treated and untreated groups and across strata. Visually,

the two groups look very similar with the exception of stratum five, which only has 15 untreated cases. If the sample sizes of the groups are small, covariate evaluation can become very sensitive to outliers (Leite, 2017). Nonetheless, it appears as though adequate balance was achieved both within and across strata.

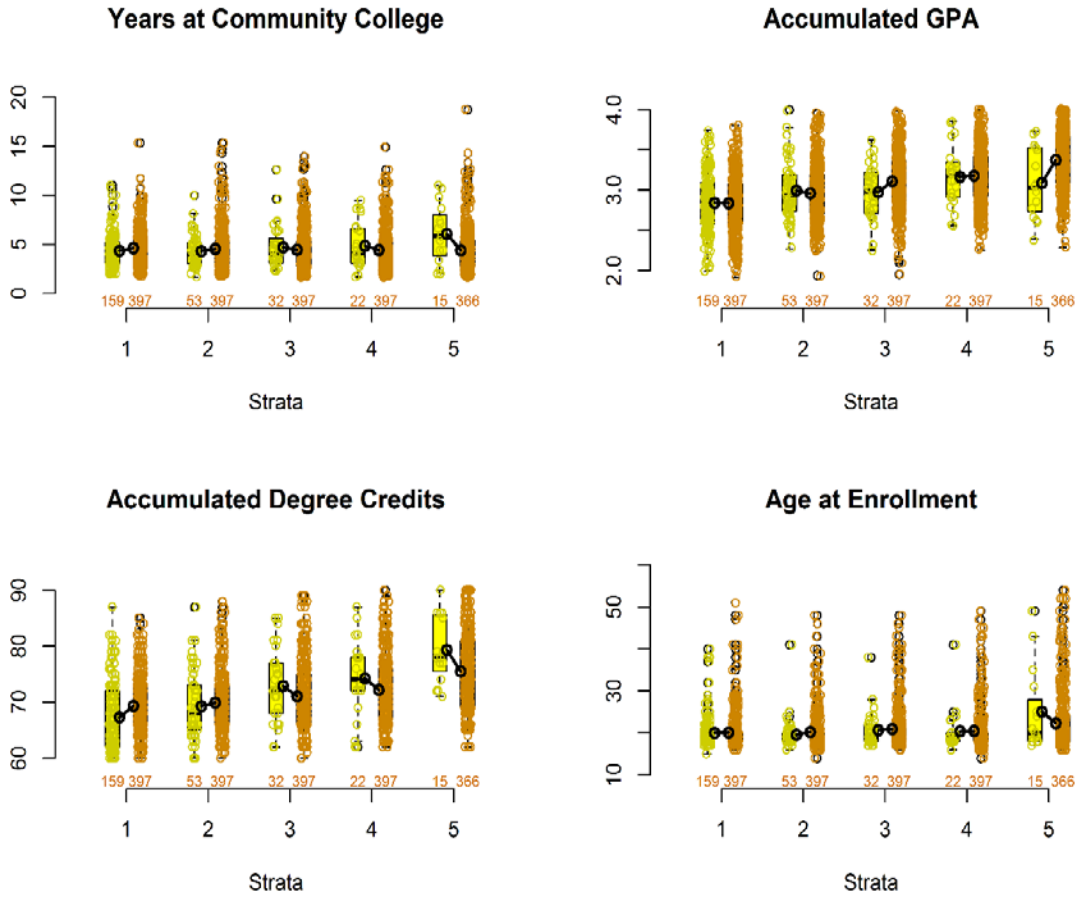

Figure 4. Boxplots of Continuous Covariates After Stratification

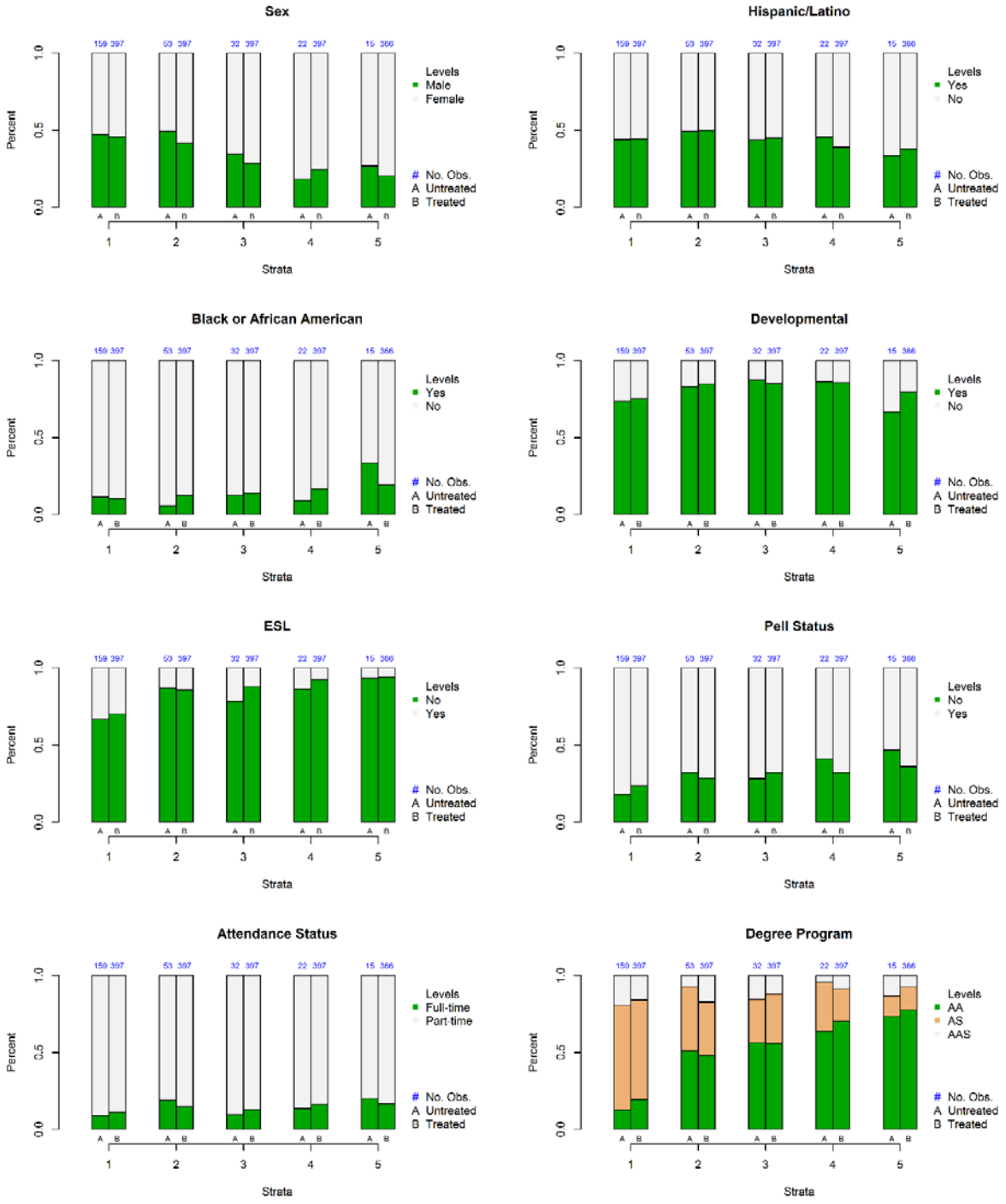

Figure 5. Barcharts of Categorical Covariates After Stratification

Threats to Validity

An important step in propensity score matching is sensitivity analysis, which involves examining the magnitude of hidden bias that exists due to the omission of covariates that could potentially impact the treatment effect (Leite, 2017). Rosenbaum (2002) proposed a method of conducting sensitivity analysis that uses the Wilcoxon signed-rank test to obtain upper and lower bounds of *p* values, which are used to determine how large the hidden bias would have to be in order for the effect to become non-significant. However, sensitivity analysis is only well-defined for one-to-one matching without replacement, which was not a matching technique used in this study (Keele, 2009).

Therefore, several other precautions were taken to help reduce the threat of hidden bias. First, careful checking of balance across treated and untreated groups was performed to help ensure that the groups were as comparable as possible. Second, multiple methods were used for matching and estimating propensity scores, including logistic regression and stratification using quintiles. Diagnostics were performed on the original logistic regression model to test for multicollinearity, which exists when there is a strong correlation between two or more predictor variables. This makes it difficult to assess the importance of individual predictors and can lead to untrustworthy regression coefficients or inaccurate R^2 values (Field, 2012).

Multicollinearity was assessed using the *vif* function in the *car* package. While there is no accepted threshold for excluding variables with high VIF (variance inflation factor), it is generally advisable to exclude variables with VIF values above five (Field,

2012). In this study, all predictors had VIF values below four, which means that the models did not suffer greatly from multicollinearity.

Limitations

This study has a number of important limitations. First, since a quasi-experimental approach with nonrandom samples is being used, causal inferences cannot and should not be made based on the results. Second, PSM is limited to observable covariates and cannot account for other unobservable variables that may be influencing the outcome. Lastly, the results are limited to a single institution and state policy environment, and may not be generalizable to other colleges in states with different articulation agreements or transfer policies.

Chapter 4

Results

The purpose of this study was to compare the bachelor's degree completion rates of associate degree completers and RT-eligible students, and explore the impact of earning an associate degree on bachelor's degree completion. Community colleges have long served an important role in facilitating degree progress for students looking to eventually transfer (Roksa & Keith, 2008). However, the average transfer-out bachelor's degree completion rate[2] across community colleges in the U.S. is only 42 percent, which indicates that there is a large population of students that have accumulated a substantial number of college credits with no degree to show for it (Jenkins & Fink, 2016). Numerous studies have shown that students are more likely to complete a bachelor's degree if they transfer with an associate degree (Crook et al., 2012; Crosta & Kopko, 2014), but the average transfer-with-award rate[3] across community colleges in the U.S. is only 29 percent (Jenkins & Fink, 2016). Reverse transfer policies that enable students to retroactively transfer their earned credits to fulfill the requirements of an associate degree may help to improve these outcomes.

The present study analyzes data from 2,268 students who enrolled at a single community college in the Northeast between 2000 and 2010 and subsequently transferred to a four-year institution. The study compares the demographic characteristics and bachelor's degree outcomes of two groups of students: associate degree completers (*n* =

[2] The rate at which a community college's students who transfer to a four-year institution earn a bachelor's degree from any four-year institution within six years of entering higher education.

[3] The rate at which a community college's transfer students earn a credential (either an occupational certificate or an associate degree) before transferring to a four-year institution.

1,985) and reverse transfer (RT) -eligible students (n = 283) who transferred to four-year institutions with between 60 and 90 community college credits, but no associate degree. The following research questions are addressed in this study:

1) What are the demographic characteristics of reverse transfer eligible students, and how do they differ from associate degree completers?
2) What impact does earning an associate degree have on bachelor's degree completion?
3) Are there significant differences in grit between reverse transfer eligible students and associate degree completers, and if so, do these differences contribute to bachelor's degree completion?
4) What are some of the reasons why students transfer before earning an associate degree?

To answer the first research question, several inferential statistics are used to compare group differences between associate degree completers and RT-eligible students. The independent sample *t*-test compares the means of a variable from two different groups provided that the data are measured at least at the interval level (Field, 2012). For categorical variables, such as race/ethnicity, it would not be possible to compare means. Therefore, the Pearson's chi-square test is used to compare the observed frequencies in each group to the frequencies one might expect to see simply by chance.

To answer the second and third research questions, multiple logistic regression is one approach that is used to predict the probability of a categorical outcome, such as bachelor's degree completion, given any number of categorical or continuous predictor

variables (Field, 2012). The outcome, *Y* is predicted from a combination of each predictor variable multiplied by its respective regression coefficient:

$$Y_i = b_0 + b_1 X_{1i} + \gamma Assoc_i + \cdots + b_n X_{ni} + \mathcal{E}_i$$

In which b_n is the regression coefficient of the corresponding variable X_n, $Assoc_i$ is an indicator equal to 1 if a student earned an associate degree before transferring, and $\mathcal{E}_i$ is the residual term. If a coefficient turns out to be significant, then one can assume that the variable is making a significant contribution to the prediction of the outcome. A similar but more robust way to answer these research questions involves propensity score matching. Given the fact that randomized trials would not be possible in this context, propensity score methods provide the best possible alternative for estimating the causal effect of earning an associate degree on bachelor's degree completion by comparing similarly matched groups of students. Finally, frequency distributions from the survey were used to answer the fourth research question.

Research Question One

The RT-eligible students in this study differed from associate degree completers in several ways (see Tables 3 and 4). When compared to completers, RT-eligible students were significantly more likely to identify as Asian χ^2 (1, N = 2,268) = 13.99, $p < .01$ and male χ^2 (1, N = 2,268) = 13.14, $p < .01$. Approximately 26 percent of RT-eligible students tested into ESL, compared to only 14 percent of completers χ^2 (1, N = 2,268) = 26.28, $p < .01$. There were also significant differences in degree type, with 53 percent of RT-eligible students enrolled in A.S. programs, compared to only 33 percent of completers χ^2 (2, N = 2,268) = 53.34, $p < .01$. It is worth noting that associate of arts (A.A.) and associate of science (A.S.) degrees are designed to be transfer-oriented, whereas associate of applied

science (A.A.S.) degrees are intended to be career-oriented. Therefore, students enrolled in A.A.S. programs would presumably be more likely to enter directly into a career, and less likely to transfer.

Table 3

Frequency Table and Chi-Square Results for Categorical Variables

	RT-Eligible (Untreated)		Completers (Treated)		Total	
Variable	*n*	%	*n*	%	*N*	%
Hispanic/Latino	126	44.5	848	42.7	974	43.0
Asian***	20	7.1	53	2.7	73	3.2
Black or African American	32	11.3	288	14.5	320	14.1
Native Hawaiian/Pac. Island***	17	6.0	46	2.3	63	2.8
White	75	26.5	572	28.8	647	28.5
Sex***						
Male	122	43.1	636	32.0	758	33.4
Female	161	56.9	1,349	68.0	1,510	66.6
Pell-Eligible*	213	75.3	1,380	69.5	1,593	70.2
Required Developmental*	219	77.4	1,628	82.0	1,847	81.4
Required ESL***	73	25.8	275	13.8	348	15.3
Degree Program***						
A.A.	90	31.8	1,081	54.5	1,171	51.6
A.S.	150	53.0	660	33.2	810	35.7
A.A.S.	43	15.2	244	12.3	287	12.6
Attendance Status						
Full-time	33	11.7	282	14.2	315	13.9
Part-time	250	88.3	1,703	85.8	1,953	86.1

Note. Chi-square test for a difference of distributions between groups (* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$).

There were also significant differences between the two groups in terms of accumulated credits. Results of an independent sample *t*-test indicated that the accumulated degree credits were significantly greater for completers (M = 71.74, SD = 6.54) than RT-eligible students (M = 69.45, SD = 7.09) $t(354) = -5.14$, $p < .05$. Associate degree completers earned an average of twelve additional credits beyond the 60 credits that are required to earn an associate degree. The results also showed that completers had significantly higher GPAs (M = 3.06, SD = 0.41) than RT-eligible students (M = 2.90, SD = 0.39) $t(376) = -6.99$, $p < .05$.

Table 4

Descriptive Statistics and Significance Tests for Continuous Variables

		N	Median	Mean	Min	Max	SD
Years at CC	RT-Eligible	283	3.99	4.52	1.63	12.63	2.02
	Completers	1,985	3.75	4.48	1.60	18.74	2.22
	Total	2,268	3.81	4.49	1.60	18.74	2.20
Age	RT-Eligible	283	19.00	20.30	15.00	49.00	4.58
	Completers	1,985	19.00	20.86	14.00	56.00	5.63
	Total	2,268	19.00	20.79	14.00	56.00	5.51
GPA***	RT-Eligible	283	2.90	2.92	1.98	4.00	0.39
	Completers	1,985	3.06	3.09	1.91	4.00	0.41
	Total	2,268	3.04	3.07	1.91	4.00	0.41
Degree Credits***	RT-Eligible	283	68.00	69.45	60.00	90.00	7.09
	Completers	1,985	70.00	71.74	60.00	90.00	6.54
	Total	2,268	70.00	71.45	60.00	90.00	6.65

Note. * p < 0.1; ** p < 0.05; *** p < 0.01

Research Question Two

Summary of completion rates. The six-year baccalaureate graduation rate for all students in the sample was approximately 25 percent. However, the rates differed considerably between the two groups and across degree types. Approximately 19 percent of RT-eligible students went on to earn a bachelor's degree within six years, whereas 26.5 percent of associate degree completers did. The overall graduation rates were the highest for students who were enrolled in an associate of arts degree program (15.2 percent), followed by the associate of science (9.5 percent), and associate of applied science (1.0 percent). A summary of these rates is shown in Table 5.

Table 5

Six-Year Bachelor's Degree Completion Rates for RT-Eligible Students and Associate Degree Completers

	RT-Eligible			Completers			Overall		
		Graduated			**Graduated**			**Graduated**	
Degree	Total	*n*	Percent	Total	*n*	Percent	Total	*N*	Percent
A.A.	90	17	18.9	1,081	327	30.2	1,171	344	15.2
A.S.	150	32	21.3	660	183	27.7	810	215	9.5
A.A.S.	43	6	13.9	244	16	6.6	287	22	1.0
TOTAL	283	55	19.4	1,985	526	26.5	2,268	581	25.7

While it appears on the surface that associate degree completers are more likely to earn bachelor's degrees, these results can be biased because they do not control for group differences. For example, there was a larger proportion of ESL students in the RT-

eligible group, and this could be what is explaining their lower completion rates, and not the fact that they did not earn an associate degree before transferring. For this reason, a logistic regression model was constructed to see if, after holding all other variables constant, associate degree completers were still more likely than RT-eligible students to complete bachelor's degrees.

Logistic regression results. Table 6 presents the results of a logistic regression model and shows that students who earned an associate degree were 57 percent more likely to earn a bachelor's degree within six years when compared to RT-eligible students (β = 0.451, *SE* = 0.218, $p < .05$). Age was negatively associated with bachelor's degree completion. That is, for every one unit decrease in age, the odds of completing a bachelor's degree within six years increased by a factor of 0.952. Students enrolled in, or graduating from, associate of applied science degree programs were significantly less likely to graduate with a bachelor's degree within six years.

Students who required at least some form of developmental math or English coursework were significantly less likely to earn bachelor's degrees (β = -0.434, *SE* = 0.170, $p < .05$), and students who took at least one ESL course were significantly more likely (β = 0.792, *SE* = 0.235, $p < .01$). Students enrolled in associate of applied science (A.A.S.) degrees were significantly less likely to graduate with a bachelor's degree in six years (β = -0.908, *SE* = 0.287, $p < .01$). Perhaps not surprisingly, the number of years spent at community college had a negative impact on timely bachelor's degree completion. For every one extra year spent at community college, the odds of completing a bachelor's degree in six years declined by a factor of 0.193.

Table 6

Logistic Regression Results of the Odds of Earning a Bachelor's Degree Within 6 Years

	Dependent Variable:	
	Earned bachelor's degree in 6 years	
	β	Odds Ratio
Earned Associate degree	0.451**	1.570
	(0.218)	
Hispanic/Latino	0.286	1.331
	(0.216)	
Asian	-0.315	0.730
	(0.379)	
Black or African American	0.196	1.217
	(0.273)	
Native Hawaiian/ Pac. Island	-0.686	0.504
	(0.408)	
White	-0.054	0.948
	(0.218)	
Sex (female)	0.013	1.013
	(0.139)	
Age	-0.049***	0.952
	(0.013)	
Pell-Eligible	-0.091	0.913
	(0.147)	
Required Developmental	-0.434**	0.648
	(0.170)	
Required ESL	0.792***	2.207
	(0.235)	
Accumulated Degree Credits	-0.006	0.994
	(0.011)	
Degree Program (A.S.)	0.135	1.145
	(0.156)	
Degree Program (A.A.S.)	-0.908***	0.404
	(0.287)	
Years at Community College	-1.645***	0.193
	(0.099)	
Accumulated GPA	0.960***	2.612
	(0.180)	
Attendance Status (Part-time)	-0.092	0.912
	(0.168)	
Public Transfer Institution	0.509**	1.664
	(0.247)	
In-State Transfer Institution	0.659**	1.933
	(0.286)	
Observations	2,268	
Log Likelihood	-757.475	
Akaike Inf. Crit	1,554.951	
Nagelkerke R^2	0.552	

Note. Standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

Two additional variables were included in the model for the affiliation (public/private) of the transfer institution, and whether it was in-state or out-of-state. Students who went on to enroll at public institutions in the state of New Jersey were significantly more likely to complete a bachelor's degree, all other variables held constant. A total of 354 students (15.6%) transferred to private institutions, but only 42 (11.9%) of them graduated in six years. In comparison, 1,914 students (84.4%) transferred to public institutions, and 539 (28.2%) graduated in six years. Only 180 students transferred out of state, but their outcomes were much lower- 15.0% versus 26.5% for students who stayed in state. RT-eligible students who transferred to private institutions had the lowest completion rates of any group. For a summary of these statistics, refer to Table 7.

Table 7

Comparison of Bachelor's Degree Completion Rates for RT-Eligible Students and Associate Degree Completers by Location and Affiliation of Transfer Institution

	RT-Eligible			Completers			Overall		
	Total	**Graduated**		Total	**Graduated**		Total	**Graduated**	
		n	Percent		*n*	Percent		*N*	Percent
Location									
In-State	239	45	18.8	1,849	509	27.5	2,088	554	26.5
Out-of-State	44	10	22.7	136	17	12.5	180	27	15.0
Affiliation									
Public	224	51	22.8	1,690	488	28.9	1,914	539	28.2
Private	59	4	6.8	295	38	12.9	354	42	11.9

Propensity score matching. The results from the logistic regression model still suffer from the issue of selection bias. It is not possible to control for every variable that may influence degree completion, and students are still choosing whether or not to earn an associate degree. Because students are not being randomly assigned to earn a degree or not, it cannot be concluded that earning an associate degree has a direct impact on bachelor's degree completion. Propensity score matching attempts to account for the threat of selection bias by matching similar treated and untreated individuals, and therefore, may provide a more accurate assessment of the impact that earning an associate degree has on subsequent degree completion.

There are three different treatment effects that can be estimated in propensity score analysis. The average treatment effect (ATE) is the difference between the expected values of the outcome for all individuals in both treated and untreated conditions. The average treatment effect on the treated (ATT) and untreated (ATU) provide the same estimate, but only for the treated and untreated conditions, respectively (Leite, 2017). Since this study focuses mainly on the impact of degree completion on those who earned an associate degree (the treatment), the average treatment effect on the treated is provided.

Since nearest neighbor matching produced the best overall balance in covariates, the results of this matching method are reported. The *MatchIt* package does not provide estimated treatment effects directly, but it does produce a matched dataset with case weights that can be used to estimate the ATT (Leite, 2017). It is important to include the weights when variable numbers of treated and untreated cases have been matched to one another, as in matching with replacement (Ho et al., 2011). These weights were used in a

weighted logistic regression model to estimate the ATT with earning a bachelor's degree in six years as the binary outcome variable (see Table 8). The model included all original matching variables as predictors in order to reduce bias by adjusting for small differences in the samples after matching (Ho et al., 2007). Using nearest neighbor matching with replacement, a ratio of 10 untreated to treated units, and a caliper of 0.25 yielded an ATT estimate of 0.055 (SE = 0.031, p = .075). These results are in the same direction as the logistic regression results presented in Table 6, but are significant only at the 0.1 level.

Table 8

Logistic Regression Results After Matching of the Odds of Earning a Bachelor's Degree Within 6 Years

	Dependent Variable:	
	Earned bachelor's degree in 6 years	
	β	Odds Ratio
Earned Associate degree	0.056*	1.057
	(0.031)	
Hispanic/Latino	0.055*	1.057
	(0.028)	
Asian	-0.048	0.953
	(0.059)	
Black or African American	-0.001	0.999
	(0.034)	
Native Hawaiian/ Pac. Island	-0.088	0.916
	(0.067)	
White	-0.004	0.996
	(0.031)	
Sex (female)	0.019	1.019
	(0.018)	
Age	-0.006***	0.994
	(0.001)	
Pell-Eligible	0.028	1.028
	(0.020)	
Required Developmental	-0.024	0.976
	(0.025)	
Required ESL	0.012	1.012
	(0.022)	
Accumulated Degree Credits	0.203***	1.225
	(0.022)	
Degree Program (A.S.)	0.013	1.013
	(0.019)	
Degree Program (A.A.S.)	-0.127***	0.881
	(0.022)	
Years at Community College	-0.068***	0.934
	(0.004)	
Accumulated GPA	0.203***	1.225
	(0.022)	
Attendance Status (Part-time)	-0.153***	0.858
	(0.031)	
Observations	2,251	
Log Likelihood	-1,023.416	
Akaike Inf. Crit	2,082.832	
Nagelkerke R^2	0.303	

Note. Standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

Propensity score stratification. The *MatchIt* package with the method set to subclass was used to subdivide the sample into five strata. For estimating the ATT, the first step is to calculate stratum weights, which is the treated sample size within each stratum divided by the total treated sample size (Leite, 2017). Since all five stratum were divided equally for the treatment group, the weights were the same for each stratum. The matched dataset was then extracted with the stratum numbers and weights appended to it. Then, a comparison using mean differences between the treated and untreated groups was made, and an overall result was pooled from those individual comparisons (Bryer, 2014). In R, this can be accomplished using the *survey* package. The *svymean* function was used to compute the mean proportion of bachelor's degree completers in each group and the *svycontrast* function was used to apply the stratum weights to obtain the ATE and ATT by pooling the stratum-specific effects (Leite, 2017).

Outcome analysis after stratification can be assessed visually using the *circ.psa* function in the *PSAgraphics* package (Helmreich & Pruzek, 2009). Figure 6 displays the contribution of each stratum to the overall treatment effect, which is plotted as a blue dashed diagonal line. The circles above the solid black diagonal line correspond to strata that have larger outcome means for the treated group than the untreated group. The overall weighted outcome mean for the untreated group was .184 and .259 for the treated group, which yielded an ATE of 0.075 (SE = 0.031, $p < .05$) and an ATT of 0.085 (SE = 0.030, $p < .05$). This result is more significant when compared to the results achieved through matching, and shows that associate degree completers were significantly more likely to complete bachelor's degrees when compared to matched groups of RT-eligible students.

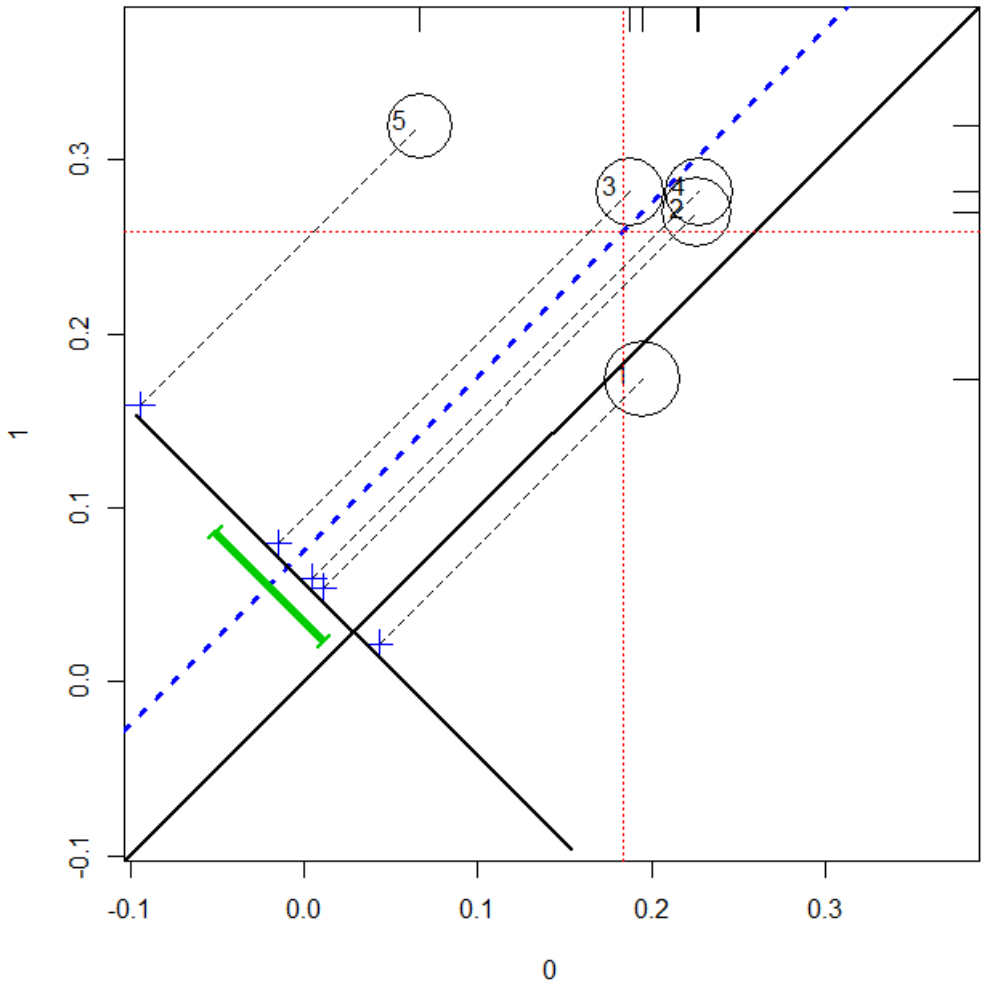

Figure 6. Propensity Score Stratification Assessment Plot[4]

Research Question Three

As shown in Table 9, associate degree completers had significantly higher overall grit scores (M = 3.99, SD = 0.48) than RT-Eligible students (M = 3.70, SD = 0.42) $t(42)$ =

[4] Circles represent each stratum and the size varies depending on the number of individuals in each stratum. The center of each circle represents the mean outcome for treated and untreated groups. The red lines represent the weighted means for the control and treatment groups. The green brackets show the 95% confidence interval. The fact that the brackets do not cross the unit line indicates a significant effect in favor of associate degree completers.

-3.24, $p < .05$, $d = 0.65$. This was consistent across the two subscales for perseverance of effort $t(39) = -2.09$, $p < .05$, $d = 0.42$ and consistency of interests $t(51) = -3.17$, $p < .05$, $d = 0.64$. Few studies have tested the reliability of the Grit scale when used with community college students. VanderHeiden Guney (2016) used the Grit scale to study developmental math students and found the internal consistency of the items to be very high ($\alpha = .79$). The present study achieved similar Chronbach's alpha levels of .76 for the Grit scale as a whole, .77 for the consistency of interest subscale, and .70 for the perseverance of effort subscale.

Table 9

Group Differences in Grit Between Associate Degree Completers and Reverse Transfer Eligible Students

	RT-Eligible		Completers			
	M	*SD*	*M*	*SD*	*df*	*t*
Consistency of Interest	3.34	0.49	3.68	0.70	51	−3.17 **
Perseverance of Effort	4.08	0.53	4.30	0.53	39	−2.09 **
Total Grit Score	3.70	0.42	3.99	0.48	42	−3.24 **

Note. *p*-values of an independent samples t-test are given (* p < 0.1; ** p < 0.05; *** p < 0.01). All questions on the consistency of interest subscale were reverse-coded.

To determine if grit was associated with degree attainment, two separate logistic regression models were run – one with earning an associate degree as the outcome, and the other with earning a bachelor's degree in six years as the outcome (see Table 10). The overall grit score was included as a predictor in both models. In model 1, for every one unit increase in grit, the odds of completing an associate degree improved by a factor of 1.13 (β = 0.12, *OR* = 1.13, p = .07). In model 2, grit was negatively associated with the odds of completing a bachelor's degree in six years (β = -.06, *OR* = 0.95, p = .31). The average overall grit score was lower for students who earned a bachelor's degree in six years (M = 3.89, SD = 0.50) and higher for those who did not (M = 3.97, SD = 0.47), but this effect was not statistically significant $t(72) = 1.33$, p = .19, d = .65.

Both models achieved relatively large effect sizes (0.69 and 0.74), which means that they fit the data well and explained more of the variance in the dependent variable (Field, 2012). However, the more predictors that are included in the models, the higher the R^2 values tend to be. Thus, it is important to assess the overall power, which is the ability of a statistical test or model to detect an effect of a particular size. A power value of 0.8 is considered good. In order to achieve this level of power in the logistic regression models, it requires a minimum sample size based on the proportion of treatment to control cases (0.85), the minimum detectable effect size (0.25 would be a moderate effect size for this type of model), and the number of covariates used (16). These values were entered into a sample size calculator, which showed that the minimum sample size needed to achieve a power level of 0.8 was 390 (Dong & Maynard, 2013). There were only 190 observations included in each model, which indicates that they are underpowered due to the small sample size and larger ratio of treatment to control cases.

Table 10

Logistic Regression Results for the Odds of Earning an Associate or Bachelor's Degree While Controlling for Grit

	Dependent Variable:			
	Earned Associate		Earned Bachelor's	
	β	Odds Ratio	β	Odds Ratio
Total Grit	0.124*	1.132	-0.055	0.946
	(0.068)		(0.055)	
Hispanic/Latino	-1.191	0.304	0.344	1.410
	(1.338)		(0.831)	
Black or African American	0.819	2.268	-0.299	0.742
	(1.385)		(1.229)	
White	-0.416	0.659	-1.107	0.331
	(1.225)		(0.929)	
Sex (female)	0.738	2.091	-0.409	0.664
	(1.008)		(0.666)	
Age	0.031	1.032	-0.099*	0.906
	(0.079)		(0.057)	
Pell-Eligible	-1.059	0.347	0.751	2.118
	(1.012)		(0.741)	
Required Developmental	0.408	1.504	-0.404	0.668
	(0.984)		(0.637)	
Required ESL	0.109	1.115	-0.017	0.983
	(1.557)		(0.859)	
Accumulated Degree Credits	0.288***	1.334	-0.028	0.973
	(0.065)		(0.028)	
Degree Program (A.S.)	-2.738**	0.065	0.649	1.914
	(1.091)		(0.664)	
Degree Program (A.A.S.)	-0.557	0.573	-1.575	0.207
	(1.140)		(1.311)	
Years at Community College	-0.065	0.937	-1.551***	0.212
	(0.109)		(0.348)	
Accumulated GPA	1.057	2.877	1.459*	4.302
	(0.831)		(0.749)	
Attendance Status (Part-time)	-0.267	0.765	0.627	1.873
	(1.342)		(0.807)	
Public Transfer Institution	1.936*	6.931	-0.648	0.523
	(1.110)		(0.880)	
In-State Transfer Institution	1.433	4.190	3.228**	25.231
	(0.914)		(1.410)	
Observations	190		190	
Log Likelihood	-28.790		-46.264	
Akaike Inf. Crit	93.581		128.528	
Nagelkerke R^2	0.74		0.69	

Note. Standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

Research Question Four

The most common reason why RT-eligible students in this study chose to forego earning an associate degree was because they were able to transfer the credits they earned at the community college and achieve junior standing at a four-year school. Nearly half (47.1%) of RT-eligible respondents cited this as one of their reasons for not earning an associate degree. Twelve percent indicated that they felt the quality of education was better at four-year schools, and 8.8 percent preferred the college experience at a baccalaureate-granting institution. Approximately one-third of respondents selected the 'other' option and provided their own responses, which included scheduling of courses, inconvenient location, time constraints, and dissatisfaction with the College's academic program offerings (see Table 11).

When asked how likely they would be to transfer their credits back to the community college to earn an associate degree, 44.8 percent of RT-eligible students indicated that they would be either extremely likely or somewhat likely to do so. This varied by degree type, with 50 percent of AAS and AS students responding positively (n = 10; n = 12 respectively), but only 29 percent of AA students (n = 7).

Table 11

Reasons RT-Eligible Students Decided to Transfer Before Earning an Associate Degree

Answer	*n*	%
I was able to transfer my credits and achieve junior standing at a four-year school.	16	47.1
The quality of education is better at four-year schools	4	11.8
I prefer the college experience (campus life, activities, etc.) at a four-year school	3	8.8
I did not want to take the College's Graduate Writing Exam.	1	2.9
Time. It would have taken me some more time to get an associate's.	1	2.9
I transferred my credits to get a pharmD as planned.	1	2.9
The College deceived me into thinking I was going to obtain a degree when the only gave me a certificate.	1	2.9
I would have needed to take physics 3, the classes i needed weren't offered every semester and the campus feels cramped. I would have stayed but may of needed to wait 9 months to take a class.	1	2.9
Nursing program did not accept me, so I went to another school.	1	2.9
It would have been another year of study at the College to obtain my Associate's for little reward.	1	2.9
The College did not have the major I was pursuing.	1	2.9
Attended a design school.	1	2.9
Enrolled at another CC due to location.	1	2.9
The College did not have enough online classes in what I was interested in taking.	1	2.9
TOTAL	34	100.0

Summary of Findings

The propensity score methods used in this study found a statistically significant difference in bachelor's degree outcomes in favor of associate degree completers when compared to RT-eligible students. Both matching and stratification procedures yielded an ATT of 0.055 and 0.085, respectively. In other words, the graduation rates for individuals in the treatment group would be between six and nine percentage points lower had they not earned an associate degree before transferring. Similarly, logistic regression results showed a 57 percent greater likelihood of bachelor's degree completion given the completion of an associate degree.

There were several significant distinctions between RT-eligible students and associate degree completers including GPA, credits accumulated, sex, ESL placement, and program type. Associate degree completers were also significantly grittier than RT-eligible students, but these differences contributed only moderately to associate degree completion and not to bachelor's degree completion. The RT-eligible students surveyed in this study indicated that they transferred without earning an associate degree in order to achieve junior standing at a four-year institution, and almost half indicated that they would be interested in taking advantage of a reverse transfer option.

Chapter 5

Discussion

The primary aims of this study were: 1) to examine differences in six-year bachelor's degree completion rates between associate degree completers and RT-eligible students and; 2) to determine the impact of earning an associate degree on subsequent bachelor's degree completion. The second goal was to compare and contrast the demographic and enrollment characteristics of RT-eligible students and associate degree completers. The third goal was to determine if there were any significant differences in grit between the two groups, and explore the relationship between grit and degree attainment. Grit, or passion and perseverance to achieve long-term goals, could be an important mediator that explains the relationship between earning an associate degree and continuing on to earn a bachelor's degree. Finally, this study sought to examine the reasons why students forego earning an associate degree, as well as gauge interest in reverse transfer policies designed to award more associate degrees.

Discussion of Research Questions

This study set out to address the following research questions. The results of each question are discussed separately in the sections that follow.

1) What are the demographic characteristics of reverse transfer eligible students, and how do they differ from associate degree completers?
2) What impact does earning an associate degree have on bachelor's degree completion?

3) Are there significant differences in grit between reverse transfer eligible students and associate degree completers, and if so, do these differences contribute to bachelor's degree completion?
4) What are some of the reasons why students transfer before earning an associate degree?

Research question one. RT-eligible students in this study were similar in some ways to the RT-eligible students in the CWID baseline study, which collected data on approximately 27,000 students across 12 states. The CWID baseline study defined an RT-eligible student as one who (a) transferred from a CWID-participating community college to a CWID-participating university, (b) whose credits earned prior to transferring were greater than or equal to the states' residency requirement, which was at least 15 credits, and (c) who did not earn a degree prior to transferring (Taylor et al., 2013). The present study only included students who transferred with between 60 and 90 degree credits. However, results from the CWID study showed that nearly two-thirds of RT-eligible students transferred with more than 45 degree credits, and the largest group (42%) earned 60 or more credits, suggesting that the populations across the two studies are comparable.

Taylor et al. (2013) found that, on average, RT-eligible students tended to be female (53%) and younger (74% were between the ages of 18 and 24). A larger proportion of RT-eligible students in this study were female (56.9%), but compared to completers and the overall population, they were significantly more likely to be male. The average age for RT-eligible students in this study was 20 with a standard deviation of 4.5, which means that approximately 68 percent of RT-eligible students were between the ages of 16 and 24, which is consistent with data in the CWID baseline study.

Results also showed that RT-eligible students were significantly more likely to be enrolled in associate of science (A.S.) degree programs. These programs are offered to students who intend to transfer to four-year colleges. Each degree program requires a core of 30 credits in general education, which are courses designed at the state level to fit the curricula of programs at four-year colleges and universities. Over half of all RT-eligible students were enrolled in A.S. programs. The way these programs are designed can dissuade students from earning an associate degree because there is incentive to transfer after completing general education requirements. Furthermore, because there are stronger articulation agreements in A.S. programs, it enables students to transfer their credits much more seamlessly.

Research question two. The second research question was designed to determine if earning an associate degree has any impact on bachelor's degree completion. RT-eligible students and associate degree completers were compared and their outcomes were assessed using several different methods. First, descriptive findings revealed that about a quarter of first-time community college students at the institution earned a bachelor's degree within six years. The vast majority of these students (88%) earned an associate degree before transferring. A smaller proportion (19.4%) of RT-eligible students went on to earn a bachelor's degree in six years, despite earning roughly the same number of credits as completers, who had an overall graduation rate of 26.5 percent. The average amount of time spent at community college was nearly equal for both groups (4.5 years), which suggests that the relatively short time window in which the graduation rates were calculated did not disproportionately affect one group over the other.

The fact that RT-eligible students had lower bachelor's degree outcomes than associate degree completers has a number of important implications for both two and four-year institutions. Because RT-eligible students transfer before earning an associate degree, and are less likely to complete a bachelor's degree within six years, most are only ever counted as community college transfer-out students and never as completers. With IPEDS beginning to track the long-term outcomes of non-first-time students, RT-eligible students that are picked up in the transfer cohorts at four-year institutions could negatively affect completion rates. This is somewhat surprising since the RT-eligible students transfer with enough credits to achieve junior standing and should theoretically finish in the same amount of time as associate degree completers.

Secondly, the outcome of bachelor's degree completion was used in a logistic regression model with earning an associate degree as one of several predictors. Results showed that earning an associate degree before transfer was associated with a significant increase in the probability of completing a bachelor's degree. Associate degree completers were about 57 percent more likely to earn a bachelor's degree than RT-eligible students. These results are nearly identical to those of Crosta & Kopko (2014), who estimated a similar logistic regression model and found that associate degree completers were about 50 percent more likely to complete a bachelor's degree in six years when compared to students who earned between 50 and 90 degree credits and transferred without graduating. This is even after controlling for the location and affiliation (public/private) of the transfer institution, variables that were not accounted for in the aforementioned study. Students who transferred to public four-year institutions in the same state had higher bachelor's degree completion rates, which is consistent with

national trends (Jenkins & Fink, 2016; Shapiro et al., 2013). This further supports the value of statewide transfer agreements between public two and four year institutions that help to reduce students' credit loss.

Crosta & Kopko (2014) estimated separate logistic regression models for A.A., A.S., and A.A.S. programs and found that earning an A.A.S. degree did not have any significant effect on the likelihood of earning a bachelor's degree. While it was not possible to estimate separate models in this study due to the small sample size, the inclusion of the type of degree as a predictor showed a significantly negative association between enrollment in an A.A.S. program and the outcome of bachelor's degree completion in six years. These findings again highlight the importance of statewide articulation agreements between community colleges and public four-year institutions that align curricula more closely and facilitate the transition of pre-transfer credit coursework. The differences in outcomes also suggest that statewide articulation agreements may be working as intended by providing a structured pathway toward completion for students in transfer-oriented degree programs.

The third method used to answer this research question utilized a quasi-experimental technique known as propensity score matching. This procedure involved calculating a predicted probability that a transfer student receives an associate degree before transferring. The probability, otherwise known as a propensity score, was then used to match degree-earners with non-degree-earners so that comparisons between the matched groups could be made on the outcome of interest (bachelor's degree completion). PSM was implemented using two different procedures, matching and stratification, which both produced similar treatment effect estimates indicating that

associate degree completers were significantly more likely than RT-eligible students to graduate with a bachelor's degree in six years.

Research question three. The purpose of the third research question was to examine differences in grit between completers and RT-eligible students, and determine whether grit is associated with degree attainment. Results of an independent samples *t*-test revealed that associate degree completers had significantly higher overall grit scores than RT-eligible students. This was consistent across both subscales for consistency of interest and perseverance of effort. However, the overall effect size (d = .65) would be considered moderate (Cohen, 1988).

Results of a logistic regression model revealed that grit positively contributed to associate degree completion. The associate degree completers in this study had significantly higher overall grit scores while controlling for other factors such as age, degree program, and GPA. However, this effect did not persist when the same model was used to estimate the odds of completing a bachelor's degree in six years. In fact, students who completed a bachelor's degree had lower overall grit scores than those who did not, although this difference failed to reach significance. These results mirror those of Duckworth et al. (2007) who found that, "participants with an Associate's degree were significantly higher in grit than those with less education, and, interestingly, also higher in grit than those with a bachelor's degree" (p. 1091).

Research question four. Survey results showed that most RT-eligible students transferred without earning a degree because they were able to achieve junior standing at a four-year institution. The majority of RT-eligible students were enrolled in Associate of Science degree programs, which are offered to students who wish to transfer to four-year

colleges. It could be that the primary goal of these students is to transfer as soon as possible, with or without earning a degree. The associate degree may not be the primary goal for these students, or perhaps the way A.S. programs are structured and communicated overemphasizes the transfer component rather than prioritizing the value of earning an associate degree.

There could also be structural barriers preventing students from completing their degrees. Several students indicated on the survey that it was simply not time-efficient for them to earn an associate degree. One student commented that, “I would have needed to take physics 3, the classes I needed weren't offered every semester and the campus feels cramped. I would have stayed but may have needed to wait 9 months to take a class”. Another student stated that, “It would have been another year of study to obtain my Associate's for little reward”. These statements clearly emphasize the need for greater structure and efficiency, as illustrated in the Guided Pathways Model (Bailey et al., 2015), which relies on structured academic programs with clear and predictable course schedules and sequences. According to the model, community college students who are offered efficient pathways are less wasteful — they take fewer excess credits, are less likely to deviate from their chosen field of study, and if they do, it is done in a way that minimizes lost progress. Because they are accurately advised and monitored, students in structured career and transfer pathways are less likely to experience bureaucratic structural barriers and be deterred by them (Crosta & Kopko, 2014).

Discussion of Research Methods and Validity

In experimental and quasi-experimental studies, researchers are mainly concerned with internal validity threats, or the goodness of their causal inferences (Teddlie &

Tashakkori, 2009). These threats constitute extraneous factors outside of the intervention or treatment that may be affecting the outcome. The main threat in this study is selection bias, which PSM addresses. Through matching, certain attributes that differ between groups can be balanced out to make the groups more similar, and so that they differ only in respect to receiving the treatment. It is very important to conduct balance checks before and after matching to reduce the threat of selection as much as possible (Thoemmes & Kim, 2011). Examining the region of common support, or the degree of overlap between treatment and control groups based on propensity scores, is critical in achieving balance. In this study, there were more individuals outside the region of common support in the treatment group, which when estimating the ATT, may change the group for which the results apply (Stuart, 2010). Individuals with very large propensity scores who had a high probability of completing an associate degree were dropped from the analysis, which could have under-reported the size of the treatment effect.

A second threat relevant to this study relates to statistical conclusion validity, or the degree to which inferences about relationships between variables can be made based on the results of the statistical analyses performed (Teddlie & Tashakkori, 2009). Depending on which matching algorithm is used, and the size of the pool being drawn from, the number of cases being discarded can increase, which may lead to reduced statistical power (Stuart, 2010). To improve matching and increase statistical power, there should be many more individuals in the control group from which to match individuals in the treatment group. In this study, potential completers who earned between 60 and 90 degree credits and transferred without graduating comprised a much smaller control

group than the treatment group of associate degree completers. This is mainly due to the credit restrictions required to achieve balance across the groups.

Third, any survey is prone to response bias, or the tendency for responders and non-responders to be fundamentally different from the population being surveyed (Dillman, 2011). The overall response rate for the survey was only nine percent, which increases the possibility of respondents being different from non-respondents. Thus, the results are less likely to be representative of the population as a whole. The survey in this study was administered online to students who left the institution, but had a personal email address in the student information system. Some students may have left the institution a decade ago, while others much more recently. Students with a consistent email address might be different from students who change their email addresses more often. This is known as unintended coverage bias (e.g., fewer good addresses for older members), which can skew results. Lastly, the Grit scale, while a valid and reliable instrument, is prone to social desirability bias (Dillman, 2011). For example, respondents are more likely to agree with the statement "I am diligent" because they perceive diligence to be a socially desirable trait to possess.

Implications for Policy and Practice

The results of this study have shown that students who transfer with an award are more likely to complete bachelor's degrees than students who do not. This suggests that community colleges should be encouraging students to graduate *before* transferring, but this is not always realistic or practical for students. Therefore, encouraging students to graduate *after* they transfer via reverse articulation offers a way for institutions to award degrees without disrupting students' mobility. The fact that the RT-eligible

students in this study were less likely to complete their degrees on time lends further support for the need for reverse transfer policies. Taylor & Bragg (2015) identified several key elements that are critical to successful reverse transfer policy implementation and optimization including student identification, transcript exchange, consent, degree audit, and degree conferral and advising. Each of these elements will be discussed within the findings of this study.

Student identification. In order to successfully design and implement a reverse transfer program, it is important to understand the population who would be eligible to participate. The results of this study showed that RT-eligible students at one institution were more likely to be enrolled in associate of science degree programs when compared to associate degree completers. They were also more like to be male, Asian, and to require remedial and ESL coursework. The vast majority also transferred to public colleges or universities within the same state. These are important distinctions to consider when determining which groups to target these programs to, or when deciding on which four-year institutions to partner with.

The results of this study showed that RT-eligible students were significantly lower in grit when compared to completers. This has a number of important implications. First, institutions should consider collecting grit scores as predictors for retention and completion. Numerous predictive analytic platforms enable this type of information to be collected and combined with other important variables to predict which students could be at risk of stopping out before completing a degree. Institutions can then target interventions to less gritty students and discourage them from leaving. Secondly,

individuals who score high on the grit scale may be more likely to participate in reverse transfer if it means fulfilling an important goal for them.

Transcript exchange. This study was limited to students with at least 60 degree credits, but lowering the credit eligibility threshold would substantially increase the number of RT-eligible students. However, careful examination of transcripts and tracking of students' progress is needed before these decisions can be made. Most states lack the ability to share transcripts across institutions automatically, which makes the conferral of reverse transfer associate degrees much more arduous. Currently, the National Student Clearinghouse (NSC) is piloting a reverse transfer transcript exchange program between participating two and four-year institutions. The NSC is already being used by the vast majority of institutions in higher education, but this new program offers a way to streamline the transfer of credits between institutions much more efficiently, securely, and accurately. Participation is free to colleges and states, and offers a high-impact solution to award more associate degrees. However, it requires buy-in from four-year partnering institutions, so making the case for why reverse transfer programs will benefit them is crucial. The results of this study have shown that associate degree completers are more likely to complete bachelor's degrees. Improving inefficiencies in the transfer credit process is beneficial to the entire higher education system through improved completion outcomes for both two and four-year institutions.

Consent. In order for reverse transfer policies to be successful, community college and university personnel should advise eligible students about the option of reverse transfer. Most states and institutions utilize an opt-in approach that requires students to self-enroll in reverse transfer programs (Taylor & Bragg, 2015). However,

opt-out approaches that automatically award students associate degrees without consent would undoubtedly lead to conferral of more degrees, though this raises concerns regarding FERPA compliance. Auto graduation, or automatically awarding credentials to students who have met the degree requirements, is a growing phenomenon and may facilitate the reverse transfer consent process in the future.

Degree audit. A recent initiative spearheaded by The Institute for Higher Education Policy (IHEP) known as Project Win-Win, recruited 61 institutions across nine states to identify and contact students whose records indicated that they were within striking distance of earning an associate degree (Adelman, 2013). The degree audit process was the most laborious, time-consuming, and critical step in the project. A total of 128,614 students were identified, but this was reduced to 41,000 after state and National Student Clearinghouse matches were performed. Of these, 6,733 were eligible for the degree and 4,550 (4 percent of the original population) were awarded degrees. Numerous issues arose during the project including which catalog years to use, identifying course equivalencies, determining which non-academic degree requirements could be ignored, and deciding on whether students who attended multiple institutions met each institution's residency requirements. This was an immensely complex undertaking, and one that could not be solved by improvements in technology and software systems alone.

Much of the work had to be done by individuals working on the front lines. Community colleges must do a better job of auditing degrees and contacting students through call back programs if they are very close to completing a degree, but have not enrolled for some time. Too often this process is performed manually, which is inefficient

and time-consuming. Triggers can be set up so that students can be notified of their degree progress at critical credit milestones. Furthermore, students should be notified early on of their eligibility to graduate, and this process should be made as simple as possible. Barriers that prevent students from graduating, such as fees, holds, or residency and recency requirements should be re-evaluated. Colleges have started to take notice and address these issues, but more work needs to be done to streamline the process.

Degree conferral and advising. Creating a greater awareness of the reverse transfer option across campus personnel, specifically academic advisors, faculty, and transfer student support staff, would bring the message of reverse transfer to a greater audience (Geyer, 2016). Formally recognizing reverse transfer associate degrees at community college commencement ceremonies would legitimize the degree in the minds of students, and help commemorate an important milestone for them (Taylor & Bragg, 2015).

Implications for Leadership

Many of the recommendations to expand and improve reverse transfer policies require changes to systems and processes, what Weick & Quinn (1999) refer to as first order or episodic changes. These types of changes tend to be infrequent and incremental improvements to existing systems brought on purposefully in response to a failure of some sort. Typically, episodic changes are precipitated by an external event, such as a technology change, that leaders must adapt to in the short-term. The change process tends to be viewed linearly through a process of unfreezing the old system, transitioning to a new one, and refreezing the new change into the existing culture. This requires transactional leaders who are the "prime movers" in bringing about change. Transactional

leaders are task-oriented and focus on the proper exchange of resources between leaders and followers (Burns, 1979).

There is perhaps a greater need for transformational leaders who can bring about second order change. Second order change involves creating a whole new culture by changing the way people think and learn (Weick & Quinn, 1999). This requires leaders who can plan long-term, create a compelling vision, and inspire others to follow that vision. Leaders of state systems and institutions must understand how reverse transfer policies and processes impact potentially eligible students and how system changes will affect the entire transfer student population. Numerous policies and processes, such as leveraging technology to facilitate the flow of transcripts between institutions or changing institutional residency requirements, are related to the optimization of reverse transfer policies and affect the entire transfer system. Should these changes associated with reverse transfer take hold, they may improve the transfer process for all students.

Perhaps a bigger challenge is changing the attitude and mindset surrounding the value of the associate degree. Unfortunately, the associate degree is often viewed as a "drive by" degree on the way to a bachelor's degree, and not as a key milestone or important achievement (Adelman, 2013). The results of this study show that the associate degree does indeed matter, and has far greater value for 'potential completers' who transfer and end up leaving college empty handed.

Community college leaders can use the findings from this study in several ways. First, this information can prove useful in discussions with senior leaders at four-year institutions to help make the case that reverse transfer benefits them as well. Students who are reverse-transfer eligible are less likely to complete bachelor's degrees within

normal time. These students tend to be less gritty and goal-driven on average, and may require special advisement or recognition in order to succeed in college. Second, the results of this study can help leaders design effective reverse transfer policies and target them to the students most likely to benefit. For example, focusing on students who previously enrolled in A.S. programs and transferred to public universities could have the most impact.

Areas for Future Research

This study did not explore the potential influence of a number of important variables. For example, students' majors both before and after transfer could not be matched due to missing data in the National Student Clearinghouse database. If a student changed majors, it is possible that fewer of their credits would be transferrable, thus lengthening their time to completion. This variable can and should be controlled for in future research, perhaps by matching groups based on two-digit CIP code. Additionally, unobserved differences in motivation or academic focus between RT-eligible students and completers could be explaining some of the differences in bachelor's degree completion rates. These variables are difficult to measure and operationalize, but would add greater merit to this body of research.

Future research should also track completion and retention outcomes for students who have already received reverse transfer degrees. Since students are only transferring their credits back to the community college, and not physically changing institutions, it is unclear what effect this would have on bachelor's degree completion. In the end, this study calls attention to a particular subset of transfer students, those who are reverse transfer eligible. The results of this study show that when comparing similar students,

those who receive associate degrees are more likely to earn bachelor's degrees. The exact mechanism for this is not entirely clear, but retaining credits in the transfer process is most likely a contributing factor. Would retroactively earning the associate degree allow students to have their transcripts re-evaluated, thereby enabling them to transfer more of their credits to the four-year institution? If so, we might assume that this would shorten students' time to completion. On the other hand, if the courses are equivalent across institutions, they would effectively cancel each other out and students might not see a net gain in their accumulated credits.

More importantly, this research sheds light on a population of RT-eligible students who accumulate an abundance of credits, yet never finish a degree. This is not in the students' best interests. Further qualitative studies could explore students course taking behaviors to determine if they are taking courses sporadically, accumulating excess credits, changing majors, or if there are other structural barriers such as scheduling or program offerings that are encouraging students to transfer before completing a degree.

This study found that students were more likely to earn bachelor's degrees if they transferred to public institutions within the same state. There could be other factors related to the transfer institution, such as selectivity, size, urbanicity, or faculty composition that could explain the higher outcomes. Researchers looking to explore these variables could map IPEDS data to the NSC data by using the institutions' unique Office of Postsecondary Education (OPE) ID. IPEDS variables could then be used as additional predictors to help control for the different institutional characteristics of four-year institutions.

Conclusion

The main finding of this study highlights the importance of earning associate of arts and science degrees before transfer in order to increase the odds of bachelor's degree completion. It is the responsibility of both two and four-year institutions to motivate and guide students along their chosen pathways. While reverse transfer programs primarily benefit community colleges in the form of increased completion rates, four-year institutions would also benefit by understanding that RT-eligible students as a group are less likely to graduate than associate degree completers. Therefore, four-year institutions might consider focusing on advisement to improve completion outcomes for this unique population of transfer students. As states move toward performance-based funding models, reverse transfer provides a way for community colleges to receive credit for their contribution to students' completion, while at the same time rewarding students for the credentials they have rightfully earned.

References

Adelman, C. (2013). Searching for our lost associate's degrees: Project Win-Win at the finish line. *Institute for Higher Education Policy*.

Altstadt, D., Schmidt, G., & Couturier, L. K. (2014). *Driving the direction of transfer pathways reform*. Jobs for the Future.

Anderson, L., & Education Commission of the States. (2015). *Reverse Transfer: The Path Less Traveled. ECS Education Trends*. Education Commission of the States.

Austin, P. C. (2011). Comparing paired vs non-paired statistical methods of analyses when making inferences about absolute risk reductions in propensity-score matched samples. *Statistics in Medicine*, *30*(11), 1292–1301. https://doi.org/10.1002/sim.4200

Bailey, T., Jenkins, D., & Leinbach, T. (2005). *What We Know about Community College Low-Income and Minority Student Outcomes: Descriptive Statistics from National Surveys*.

Bailey, T. R., Jenkins, D., & Jaggars, S. S. (2015). *Redesigning America's Community Colleges*. Harvard University Press.

Belfield, C. R., & Bailey, T. (2011). The Benefits of Attending Community College: A Review of the Evidence. *Community College Review*, *39*(1), 46–68.

Booth, K., Cooper, D., Karandjeff, K., Large, M., Pellegrin, N., Purnell, R., … Willett, T. (2013). Using Student Voices to Redefine Success: What Community College Students Say Institutions, Instructors and Others Can Do to Help Them Succeed. *Research and Planning Group for California Community Colleges (RP Group)*.

Bryer, J. M. (2014). *A national study comparing charter and traditional public schools using propensity score analysis*. State University of New York at Albany.

Burns, J. M. (1979). *Leadership*. New York: Harper & Row.

Caliendo, M., & Kopeinig, S. (2008). Some practical guidance for the implementation of propensity score matching. *Journal of Economic Surveys*, *22*(1), 31–72.

Caride, M., Mckeon, J., Jasey, M., & Giblin, T. Statewide Reverse Transfer Agreement, Pub. L. No. 4691 (2017). Retrieved from http://www.njleg.state.nj.us/2016/Bills/A5000/4691_I1.HTM

Center for Community College Student Engagement. (2017). *Even one semester: Full-time enrollment and student success.* Austin, TX: The University of Texas at Austin, College of Education.

Cohen, A. M., Brawer, F. B., & Kisker, C. B. (2014). *The American Community College*. San Francisco, CA: Jossey-Bass.

Cohen, J. (1988). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Routledge.

Correctly Recognizing Educational Achievements To Empower Graduates Act, S. 2506 § (2014).

Credé, M., Tynan, M. C., & Harms, P. D. (2016). Much Ado About Grit: A Meta-Analytic Synthesis of the Grit Literature. *Journal of Personality and Social Psychology*. https://doi.org/10.1037/pspp0000102

Crook, D., Chellman, C. C., & Holod, A. (2012). Does Earning an Associate Degree Lead to Better Baccalaureate Outcomes for Transfer Students? *City University of New York, Office of Policy Research.*

Crosta, P. M., & Kopko, E. M. (2014). Should community college students earn an associate degree before transferring to a four-year institution?

Dadgar, M., & Trimble, M. J. (2015). Labor Market Returns to Sub-Baccalaureate Credentials How Much Does a Community College Degree or Certificate Pay? *Educational Evaluation and Policy Analysis*, *37*(4), 399–418.

Dillman, D. A. (2011). *Mail and Internet surveys: The tailored design method–2007 Update with new Internet, visual, and mixed-mode guide*. John Wiley & Sons.

Dong, N., & Maynard, R. (2013). PowerUp!: A tool for calculating minimum detectable effect sizes and minimum required sample sizes for experimental and quasi-experimental design studies. *Journal of Research on Educational Effectiveness, 6*(1), 24–67.

Dougherty, K., & Kienzl, G. (2006). It's not enough to get through the open door: Inequalities by social background in transfer from community colleges to four-year colleges. *The Teachers College Record*, *108*(3), 452–487.

Duckworth, A. L., Peterson, C., Matthews, M. D., & Kelly, D. R. (2007). Grit: perseverance and passion for long-term goals. *Journal of Personality and Social Psychology*, *92*(6), 1087.

Duckworth, A., & Quinn, P. (2009). Development and validation of the Short Grit Scale (GRIT–S). *Journal of Personality Assessment*, *91*(2), 166–174.

Field, A. (2012). *Discovering Statistics Using R*. London: SAGE.

Friedel, J. N., & Wilson, S. L. (2015). The new reverse transfer: a national landscape. *Community College Journal of Research and Practice*, *39*(1), 70–86.

Garcia, S. A. (2015). CWID DATA NOTE: Reverse Transfer: The National Landscape.

Geyer, M. S. (2016). *Recognizing Earned Credit: Student Motivations for Reverse Transfer Programs and Concurrently Earning Two Post-Secondary Degrees*.

Goldrick-Rab, S. (2010). Challenges and Opportunities for Improving Community College Student Success. *Review of Educational Research*, *80*(3), 437–469.

Gross, B., & Goldhaber, D. (2009). Community College Transfer and Articulation Policies: Looking Beneath the Surface. CRPE Working Paper 2009-1. *Center on Reinventing Public Education*.

Handel, S. J., & Williams, R. A. (2012). The Promise of the Transfer Pathway: Opportunity and Challenge for Community College Students Seeking the Baccalaureate Degree. Summary of Empirical Analyses, Policy Reflections and Recommendations. *College Board Advocacy & Policy Center*.

Hansen, B. B. (2004). Full matching in an observational study of coaching for the SAT. *Journal of the American Statistical Association*, *99*(467), 609–618.

Heinrich, C., Maffioli, A., & Vazquez, G. (2010). *A primer for applying propensity-score matching*. Inter-American Development Bank.

Helmreich, J. E., & Pruzek, R. M. (2009). PSAgraphics: An R package to support propensity score analysis. *Journal of Statistical Software*, *29*(6), 1–23.

Ho, D. E., Imai, K., King, G., & Stuart, E. A. (2007). Matching as nonparametric preprocessing for reducing model dependence in parametric causal inference. *Political Analysis*, *15*(3), 199–236.

Ho, D., Imai, K., King, G., & Stuart, E. A. (2011). MatchIt: Nonparametric Preprocessing for Parametric Causal Inference. *Journal of Statistical Software*, *42*(8).

Horn, L., & Skomsvold, P. (2011). *Community college student outcomes: 1994-2009* (No. NCES 2012-253). Washington D.C.: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics.

Hossler, D., Shapiro, D., Dundar, A., Ziskin, M., Chen, J., Zerquera, D., & Torres, V. (2012). Transfer and Mobility: A National View of Pre-Degree Student Movement in Postsecondary Institutions. Signature Report 2. *National Student Clearinghouse*.

House, J. D. (1989). The Effect of Time of Transfer on Academic Performance of Community College Transfer Students. *Journal of College Student Development*, *30*(2), 144–47.

Jaggars, S., & Fletcher, J. (2014). Redesigning the student intake and information provision processes at a large comprehensive community college.

Jenkins, D., & Fink, J. (2016). *Tracking transfer: New measures of institutional and state effectiveness in helping community college students attain bachelor's degrees*. New York, NY: Columbia University, Teachers College, Community College Research Center.

Jenkins, P. D., & Fink, J. (2015). *What we know about transfer*. New York, NY: Columbia University, Teachers College, Community College Research Center.

Jepsen, C., Troske, K., & Coomes, P. (2014). The labor-market returns to community college degrees, diplomas, and certificates. *Journal of Labor Economics*, *32*(1), 95–121.

Kane, T. J., & Rouse, C. E. (1995). Labor-market returns to two-and four-year college. *The American Economic Review*, *85*(3), 600–614.

Karabel, J. (1972). Community colleges and social stratification. *Harvard Educational Review*, *42*(4), 521–562.

Keele, L. (2009). An Overview of rbounds: An R Package for Rosenbaum Bounds Sensitivity Analysis with Matched Data, *35*.

Koker, M., & Hendel, D. D. (2003). Predicting graduation rates for three groups of new advanced-standing cohorts. *Community College Journal of Research &Practice*, *27*(2), 131–146.

Leite, W. (2017). *Practical Propensity Score Methods Using R*. Thousand Oaks, CA: SAGE.

Maliszewski, C., Crabill, K., & Nespoli, L. (2012). The Role of Presidential Leadership in Improving New Jersey's Community College Transfer Experience. *New Directions for Community Colleges*, *2012*(160), 69–78. https://doi.org/10.1002/cc.20039

Marcotte, D. E., Bailey, T., Borkoski, C., & Kienzl, G. S. (2005). The returns of a community college education: Evidence from the National Education Longitudinal Survey. *Educational Evaluation and Policy Analysis*, *27*(2), 157–175.

McCormick, A. C. (2003). Swirling and Double-Dipping: New Patterns of Student Attendance and Their Implications for Higher Education. *New Directions for Higher Education, 2003*(121), 13–24. https://doi.org/10.1002/he.98

Melguizo, T., Kienzl, G. S., & Alfonso, M. (2011). Comparing the educational attainment of community college transfer students and four-year college rising juniors using propensity score matching methods. *The Journal of Higher Education*, *82*(3), 265–291.

Messer, L. Reverse Transfer Efficiency Act of 2017, Pub. L. No. H.R. 3774 (2017).

Monaghan, D. B., & Attewell, P. (2015). The Community College Route to the Bachelor's Degree. *Educational Evaluation and Policy Analysis*, *37*(1), 70–91.

National Conference of State Legislatures. (2015). *Performance-based funding for higher education*.

Pascarella, E. T., & Terenzini, P. T. (2005). *How college affects students* (Vol. 2). Jossey-Bass San Francisco, CA.

Poisel, M. A., & Joseph, S. (2011). *Transfer Students in Higher Education: Building Foundations for Policies, Programs, and Services that Foster Student Success. The First-Year Experience Monograph Series No. 54.*

R Core Team. (2014). *R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, 2012*. Retrieved from http://www.R-project.org/

Robinson, R. R. (2015). Giving "Credit When It's Due": A Case Study of Reverse Transfer Policy Implementation. *Community College Journal of Research and Practice*, *39*(6), 542–554.

Roksa, J., & Keith, B. (2008). Credits, Time, and Attainment: Articulation Policies and Success after Transfer. *Educational Evaluation and Policy Analysis*, *30*(3), 236–254.

Rosenbaum, P. R. (2002). Observational studies. In *Observational studies* (pp. 1–17). Springer.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*(1), 41–55.

Rosenbaum, P. R., & Rubin, D. B. (1985). Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician*, *39*(1), 33–38.

Rouse, C. E. (1995). Democratization or diversion? The effect of community colleges on educational attainment. *Journal of Business & Economic Statistics*, *13*(2), 217–224.

Rubin, D. B. (1973). The Use of Matched Sampling and Regression Adjustment to Remove Bias in Observational Studies. *Biometrics*, *29*(1), 185–203. https://doi.org/10.2307/2529685

Rubin, D. B. (1979). Using Multivariate Matched Sampling and Regression Adjustment to Control Bias in Observational Studies. *Journal of the American Statistical Association*, *74*(366), 318–328. https://doi.org/10.2307/2286330

Shapiro, D., Dundar, A., Yuan, X., Harrell, A. T., Wild, J. C., & Ziskin, M. B. (2015). *Transfer and Mobility: A National View of Student Movement in Postsecondary Institutions, Fall 2008 Cohort (Signature Report No. 9)*. National Student Clearinghouse.

Shapiro, D., Dundar, A., Yuan, X., Harrell, A. T., Wild, J. C., Ziskin, M. B., & National Student Clearinghouse Research Center. (2014). *Some College, No Degree: A National View of Students with Some College Enrollment, but No Completion (Signature Report No. 7)*. National Student Clearinghouse.

Shapiro, D., Dundar, A., Ziskin, M., Chiang, Y.-C., Chen, J., Harrell, A., & Torres, V. (2013). Baccalaureate attainment: A national view of the postsecondary outcomes of students who transfer from two-year to four-year institutions.

Simone, S. A. (2014). Transferability of Postsecondary Credit Following Student Transfer or Coenrollment. Statistical Analysis Report. NCES 2014-163. *National Center for Education Statistics*.

Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical Science: A Review Journal of the Institute of Mathematical Statistics*, *25*(1), 1.

Stuart, E. A., & Green, K. M. (2008). Using full matching to estimate causal effects in nonexperimental studies: examining the relationship between adolescent marijuana use and adult outcomes. *Developmental Psychology*, *44*(2), 395.

Taylor, J. L. (2015a). CWID DATA NOTE. Retrieved from occrl.illinois.edu/files/Projects/CWID/cwid-data-note-4.pdf

Taylor, J. L. (2015b). The Potential Value of a Reverse Transfer Associate Degree: Diverse Values and Perspectives. Retrieved September 13, 2015, from http://occrl.illinois.edu/articles/the-potential-value-of-a-reverse-transfer-associate-degree-diverse-values-and-perspectives/

Taylor, J. L., Bishop, C., Makela, J. P., Bragg, D. D., & Ruud, C. M. (2013). *Credit when it's due: Results from the baseline study*. Champaign, IL: Office of Community College Research and Leadership, University of Illinois at Urbana-Champaign.

Taylor, J. L., & Bragg, D. D. (2015). Optimizing Reverse Transfer Policies and Processes: Lessons from Twelve CWID States.

Teddlie, C., & Tashakkori, A. (2009). *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*. Thousand Oaks, CA: SAGE.

Thoemmes, F. J., & Kim, E. S. (2011). A systematic review of propensity score methods in the social sciences. *Multivariate Behavioral Research*, *46*(1), 90–118.

Titus, M. A. (2007). Detecting selection bias, using propensity score matching, and estimating treatment effects: an application to the private returns to a master's degree. *Research in Higher Education*, *48*(4), 487–521.

Townsend, B. K. (2001). Redefining the community college transfer mission. *Community College Review*, *29*(2), 29–42.

Townsend, B. K., & Dever, J. T. (1999). What do we know about reverse transfer students? *New Directions for Community Colleges*, *1999*(106), 5–14.

Townsend, B. K., McNerny, N., & Arnold, A. (1993). Will This Community College Transfer Student Succeed? Factors Affecting Transfer Student Performance. *Community College Journal of Research and Practice*, *17*(5), 433–433. https://doi.org/10.1080/0361697930170504

VanderHeiden Guney, S. L. (2016). *The relationship of motivated strategies for learning, mental toughness, and grit to developmental math student success in an adaptive learning technology environment* (Ph.D.). University of North Texas, United States -- Texas.

Wang, X. (2009). Baccalaureate attainment and college persistence of community college transfer students at four-year institutions. *Research in Higher Education*, *50*(6), 570–588.

Wei, C. C., & Horn, L. (2009). A Profile of Successful Pell Grant Recipients: Time to Bachelor's Degree and Early Graduate School Enrollment. Statistical Analysis Report. NCES 2009-156. *National Center for Education Statistics*.

Wei, C. C., Horn, L., & Carroll, C. D. (2002). *Persistence and attainment of beginning students with Pell Grants*. US Department of Education, Office of Educational Research and Improvement, National Center for Education Statistics.

Weick, K. E., & Quinn, R. E. (1999). Organizational change and development. *Annual Review of Psychology, 50*(1), 361–386.

Appendix A

Data Dictionary

The population of interest is all students who earned 45+ degree credits and transferred to a four-year institution. This includes two groups of students: those who earned an associate degree before transferring, and those who did not.

Category	Field #	Variable Name	Variable Label	Field Type	Format	Codes	General Notes, Definitions, Questions
Demographic	1	ETHHISP	Hispanic Origin	Numeric		0 - No 1 - Yes	
	2	RACEAI	Race American Indian/Alaska Native	Numeric		0 - No 1 - Yes	
	3	RACEAS	Race Asian	Numeric		0 - No 1 - Yes	
	4	RACEB	Race Black	Numeric		0 - No 1 - Yes	
	5	RACEPI	Race Pacific Islander	Numeric		0 - No 1 - Yes	
	6	RACEW	Race White	Numeric		0 - No 1 - Yes	
	7	SEX	Sex	Numeric		0 - Not Reported 1 - Male 2 - Female	
	8	DOB	Date of Birth	Numeric	YYYYMMDD		
	9	PELL	Pell Status	Numeric		0 - Not Pell-Eligible 1 - Pell Eligible	Student was ever Pell eligible during their time at the institution.
Enrollment	10	START	Start Date	Date	YYYYMMDD		This is the date of the student's first term at your institution.
	11	END	End Date	Date	YYYYMMDD		End Date of student's last enrolled term at your institution.
	12	DEVANY	Developmental Status	Numeric		1 - Developmental 2 - College Ready	1= Student placed into any level of developmental Math or English. 2= Placed college level in both Math and English.
	13	PROG	Academic Program Title	String			e.g. Accounting. This is the students last known major if declared more than one.
	14	DEGPROG	Degree Program	Numeric		1 - < 1 year cert 2 - < 2 year cert 4 - A.A. degree 5 - A.S. degree 6 - A.A.S. degree	
	15	CIP	CIP Code	Numeric	XXXXXX		
	16	ACCGPA	Accumulated GPA	Numeric	X.XX		The accumulated GPA earned by the student.
	17	ACCDEGCR	Accumualted Degree Credits	Numeric	XX.X		The total number of college-level credits awarded at your institution.
	18	TRANSCRED	Transfer Credits	Numeric	XX.X		The total number of transfer credits accepted by your institution. This includes credits which were reverse transferred.
	19	ATTSTAT	Attendance Status	Numeric		1 - Full-time 2 - Part-time	The student's attendance status in the first term.
	20	REVTRELG	Reverse Transfer Eligible	String		1= Completer 2= RT eligible	
	21	ASSOCDEGDATE	Associate Degree Date	Date	YYYYMMDD		Date the reverse trasfer associate degree was awarded
	22	DEGTITLE	Title of Associate Degree Earned	String			e.g. Accounting
	23	ASSOCDEGTYPE	Type of Associate Degree Earned	Numeric		1 - A.A. degree 2 - A.S. degree 3 - A.A.S. degree	
	24	DEGCIP	CIP Code of Associate Degree Earned	Numeric	XXXXXX		

The population of interest is all students who earned 45+ degree credits and transferred to a four-year institution. This includes two groups of students: those who earned an associate degree before transferring, and those who did not.

Category	Field #	Variable Name	Variable Label	Field Type	Format	Codes	General Notes, Definitions, Questions
Degree	**Below are the fields which conform to the National Student Clearinghouse StudentTracker return file format. For students who earned a bachelor's degree, report the degree record. For students who have not earned a bachelor's degree, report the first record of enrollment at the 4-year institution the student transferred to.**						
	25	RECFOUND	Record Found Y/N	String		Y= Record Found N= Record Not Found	
	26	SEARCHDATE	Search Date	Date	YYYYMMDD		Search date that you provided in your request file.
	27	COLCODE	College Code/ Branch	Numeric			OPE/FICE code of the college that the student attended.
	28	COLNAME	College Name	String			Name of the college that the student attended.
	29	COLSTATE	College State	String			State in which the college that the student attended is located
	30	INSTLEVEL	2 year/ 4 year	String		4 = 4 year or higher institution 2 = 2 year institution L = less than 2 year institution	Type of college that the student attended:
	31	INSTAFFIL	Public/ Private	String			Indicates whether the college that the student attended is a "Public" or "Private" institution.
	32	INSTBEGIN	Enrollment Begin	Date	YYYYMMDD		Begin date for the student's period of attendance.
	33	INSTEND	Enrollment End	Date	YYYYMMDD		End date for the student's period of attendance.
	34	INSTSTATUS	Enrollment Status	String		F = Full time Q = Three quarter time H = Half time L = Less than half time A = Leave of absence W = Withdrawn	The last enrollment status reported for the student:
	35	INSTLEVEL	Class Level	String		F = Freshman S = Sophomore J = Junior R = Senior C = Certificate (Undergraduate) N = Unspecified (Undergraduate) B = Bachelor's M = Master's D = Doctoral P = Postdoctorate L = First Professional G = Unspecified A = Associate's T = Post Baccalaureate Certificate	If available, the Class level associated with the student as provided by the reporting college
	36	INSTMAJOR1	Enrollment Major 1	String			If available, the major associated with the student's enrollment record as provided by the reporting college
	37	INSTCIP1	Enrollment CIP 1	Numeric	XXXXXX		If available, appropriate NCES CIP code for major 1.

The population of interest is all students who earned 45+ degree credits and transferred to a four-year institution. This includes two groups of students: those who earned an associate degree before transferring, and those who did not.							
Category	**Field #**	**Variable Name**	**Variable Label**	**Field Type**	**Format**	**Codes**	**General Notes, Definitions, Questions**
	38	INSTMAJOR2	Enrollment Major 2	String			If available, the major associated with the student's enrollment record as provided by the reporting college
	39	INSTCIP2	Enrollment CIP 2	Numeric	XXXXXX		If available, appropriate NCES CIP code for major 2.
	40	INSTGRAD	Graduated?	String		Y = College reported the student as graduated N = College did NOT report the student as graduated	Graduation status information available from the reporting college.
	41	INSTGRADDATE	Graduation Date	Date	YYYYMMDD		Date of student's graduation or degree achievement as provided by reporting college.
	42	INSTDEGTITLE	Degree Title	String			If available, the title of the degree the student received as provided by the reporting college.
	43	INSTDEGMAJ1	Degree Major 1	String			If available, the major associated with the student's degree as provided by the reporting college.
	44	INSTDEGCIP1	Degree CIP 1	Numeric	XXXXXX		If available, appropriate NCES CIP code for major 1.
	45	INSTDEGMAJ2	Degree Major 2	String			
	46	INSTDEGCIP2	Degree CIP 2	Numeric	XXXXXX		
	47	INSTDEGMAJ3	Degree Major 3	String			
	48	INSTDEGCIP3	Degree CIP 3	Numeric	XXXXXX		
	49	INSTDEGMAJ4	Degree Major 4	String			
	50	INSTDEGCIP4	Degree CIP 4	Numeric	XXXXXX		
	51	COLLSEQ	College Sequence	Numeric			The sequential order of each school that the student attended. The first record from the first school that the student attended will have a "1" in this field, the first record from the second school that the student attended will have a "2" in this field, and so on.

Appendix B

Survey Instrument

1. I have overcome setbacks to conquer an important challenge.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

2. New ideas and projects sometimes distract me from previous ones.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

3. My interests change from year to year.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

4. Setbacks don’t discourage me.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

5. I have been obsessed with a certain idea or project for a short time but later lost interest.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

6. I am a hard worker.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

7. I often set a goal but later choose to pursue a different one.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

8. I have difficulty maintaining my focus on projects that take more than a few months to complete.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

9. I finish whatever I begin.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

10. I have achieved a goal that took years of work.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

11. I become interested in new pursuits every few months.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

12. I am diligent.

- ❑ Very much like me
- ❑ Mostly like me
- ❑ Somewhat like me
- ❑ Not much like me
- ❑ Not like me at all

13. If you were given the opportunity to transfer credits back to ____ to earn your Associate degree, how likely would you be to do so?

- ❑ Extremely likely
- ❑ Somewhat likely
- ❑ Neither likely nor unlikely
- ❑ Somewhat unlikely
- ❑ Extremely unlikely

14. What were some of reasons that you decided to transfer before earning your Associate degree? (select all that apply)

- ❑ I did not want to take the Graduate Writing Exam
- ❑ I did not want a degree from a community college on my transcript
- ❑ I was able to transfer my credits and achieve junior standing at a four-year school
- ❑ The quality of education is better at four-year schools
- ❑ I prefer the college experience (campus life, activities, etc.) at a four-year school
- ❑ I was enrolled in a dual-degree program between ____ and another four-year school
- ❑ Other (please specify): _____