EXPLORING DIFFERENCES IN STUDENT ACHIEVEMENT IN ADVANCED PLACEMENT COURSEWORK IN RESPONSE TO AN ACADEMIC SUPPORT SYSTEMS GRANT IN ALASKA

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DEDICATION

To my parents, Mary and Brent Almon, who were my first and most important teachers, and who have been, and continue to be, my strongest advocates.

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CHAPTER 1

INTRODUCTION

Access to public education was separate by design and backed by law until the middle of the twentieth century (Smith, 2005). *De jure* segregation often meant that even under the best conditions, education outcomes were unequal (Gooden, 2004; Ladson-Billings, 2004). Inequity was enshrined in constitutional law when the Supreme Court, in its *Plessy v. Ferguson* (1896) decision, established that separate educational facilities met the Equal Protection clause in the 14th Amendment to the United States Constitution. However, this decision was overturned 58 years later in the Supreme Court's *Brown v. Board of Education* (1954) decision. The unanimous decision declared that educating students in separate facilities based on race was unequal and a violation of the Equal Protection Clause of the 14th Amendment to the United States Constitution. In the wake of *Brown,* a series of legislative actions in the 1960s and 1970s attempted to redress historical inequities, and signaled a further shift toward equal access to education. The Civil Rights Act of 1964, the Elementary and Secondary Education Act of 1965, containing Title I support for students living in poverty, and Section 504 of the Rehabilitation Act in 1973, all represented federal efforts to provide access to education and prevent discrimination based on race, sex, and disability (ed.gov, 2017). These federal efforts were a first step in closing the opportunity gap and giving students access to equitable resources; however, the gap in achievement between those who enjoyed access to resources and education from the start, and those who did not, is still a challenge today (Akiba, LeTendre, & Scribner, 2007; Davis, 2017; Henderson, 2004; Rothstein, 2014).

Despite the federal government's efforts and state and district-level efforts to give all students access to a high-quality education beginning in the middle of the 20th Century, the

achievement gap persists for students of different racial backgrounds and for students who are transient, have high mobility, and attend several schools throughout their K-12 education. The historical gap in access to advanced coursework, effective teachers, and the financial resources needed to fund them, which are often associated with college preparation and positive post-secondary outcomes, still influences the level at which some students achieve at the beginning of the 21st century.

The achievement gap between White, Asian and middle-class students, and their Black, Hispanic, Native American and Alaskan, Pacific Islander and working-class peers, can be seen as a residual effect of over a century of unequal access to education (Burris & Welner, 2005; Chambers, 2009; Diamond, 2006). The persistent achievement gap is reflected in the number of students taking advanced coursework, and in the achievement patterns on the National Assessment of Educational Progress (NAEP). Asian and White students experience significantly higher GPAs ($p<.05$), and score over 20 points higher in twelfth grade reading and mathematics on NAEP when compared to all other races (NCES 2011, 2017). These results illustrate the need to address how schools educate and support students who have been historically underserved and who achieve at lower levels that are statistically significant when compared to their peers.

Transience also influences the degree to which students achieve. Using a nationally representative sample of kindergarten through third grade students, Burkam, Lee, and Dwyer (2009) found that without taking account of a student's prior achievement and socioeconomic status, mobility has only a slight effect on achievement. However, their results are based on students in primary grades. Beyond third grade, these same students may be likely to experience even more mobility, which might be expected to disrupt learning more as students enter higher grades. Additionally, not all types of transience have the same effect. Rumberger (1999) defines

three kinds of transience: structural, strategic, and reactive. Structural moves are associated with a change in school based on the transition between primary and middle school or middle school and high school. Strategic changes are associated with moving to another school to accomplish a specific purpose and most often positively influence achievement. Finally, reactive moves are associated with a student's life outside of school, including parents' occupations, divorce, and financial challenges, among others. This final type of move appears to have the most negative impact on students' achievement (Anderson, Leventhal, Newman, & Dupere, 2014; Burkam, Lee, & Dwyer, 2009)

Furthermore, when considering conditional effects, like race, socioeconomic status, and learning disabilities, another pattern emerges. Students of lower socioeconomic status and Black students are more likely to move than their counterparts, and experience more achievement loss than others (Burkam, Lee, & Dwyer, 2009; Ziol-Guest & McKenna, 2013). Students with learning disabilities also experience more deleterious effects on learning ($ES = -.17$, $p<.01$) when they move when compared to their non-learning-disabled peers.

Both Mehana and Reynolds (2004) and Anderson et al. (2014) attribute the loss of achievement due to mobility with an ecological change, including shifting resources, and the need to establish new relationships every time a family with students move. For students of military mobile families, having to develop relationships at new schools is a source of stress (Bradshaw, Sudhinaraset, Mmari, & Blum, 2010). Additionally, during adolescence, transience may be associated with forming new peer relationships that encourage at-risk behavior, especially when parents are preoccupied with moving (Brown & Larson, 2009; Rubin, Bukowski, Parker, & Bowker, 2008). Similarly, transience affects parental social networks that

help support students. The more frequently a family moves, the more likely it is the family has less neighborhood-based resources to support a child's education (Gillsepie, 2013).

Collectively, student mobility tends to affect students of lower socioeconomic status, certain minority groups, special education students, and English language learners more than their counterparts (Burkam et al., 2009). It is not necessarily the move by itself that affects achievement, but the context in which it occurs, when and for what reasons it occurs. When students move, the context in which they develop changes. The ecological shift affects a student at four levels: family, neighborhood, peers, and school (Anderson et al., 2014). When a move is reactive, it is often a change in family condition that causes it, and the chances that a student moves to a stable neighborhood, forms relationships with positive peers, and enrolls in a high achieving school are not guaranteed (Rumberger, 1999).

Background of Problem

The number of high school students taking rigorous curriculum increased for all racial and ethnic groups between 1990 and 2009. Rigorous high school curriculum is defined by the National Center for Educational Statistics (NCES) as earning four credits in English, four mathematics credits including pre-calculus at a minimum, four credits in science including biology, chemistry, and physics, and at least three foreign language credits. NCES's High School Transcript Study (2011) sets one credit equal to 120 hours of instruction or one full school year for the purposes of comparison across schools in the United States. While the completion rates of these courses have increased for all groups, White and Asian/Pacific Islanders still earn significantly higher grade point averages once enrolled in the courses ($p<.05$) than their non-Asian minority counterparts, including Black, Hispanic, Alaskan and Hawaiian Native, and Native American students. This suggests that even though historically underserved

students may enroll in rigorous courses more frequently than in the past, their achievement outcomes still lag. Additional support may help increase the achievement of traditionally underserved students once they access more rigorous curriculum. Based on a double-digit gap in National Assessment of Educational Progress (NAEP) scores, which are addressed below, it appears access to rigor has not fundamentally changed the outcomes for certain minority groups, and that more support is needed once these students enroll in rigorous courses.

Higher GPAs are related to higher scores on the National Assessment of Educational Progress (NAEP), and with a higher level of post-secondary educational attainment (*The Nation's Report Card*, nces.ed.gov, 2011). Despite growth for all students, an achievement gap still remains and there are disparities in the educational quality students from different backgrounds experience. This disparity is reflected in the trends in NAEP scores through 2015 reported in *The Condition of Education* (2017), which reflect a 20 point or greater gap between White and Asian students and their non-Asian minority counterparts in both reading and mathematics at the twelfth-grade level. Although Asian students are frequently considered a minority, they achieve at higher rates than their non-Asian peers including Black, Hispanic, and Native students. Taken together, the long-term trends in completion of rigorous coursework in high school, GPA, test scores, and educational outcomes suggest a continued need to address the achievement gap.

National achievement trends on NAEP are also reflected at the state level. For example, in Alaska, 2015 NAEP scores reveal that White students achieve at levels four times higher than Black and Hispanic students, and a level twice that of Alaska Natives in the advanced category in Grade Eight Reading. On NAEP Grade Eight Mathematics, the gap is also noticeable. White students outperform Black and Hispanic students ten to one and ten to three, respectively, on

percentage of students achieving at the advanced level. Asian and Pacific Islanders outperform Black and Hispanic students 22 to one and 22 to three, respectively, in the advanced category in mathematics. Conversely, non-White and non-Asian minorities are overrepresented in the below basic category on the same tests (education.alaska.gov, 2015-2016 Report Card to the Public-District Level). Based on Alaska statewide trends in eighth grade mathematics and language arts achievement as measured by NAEP, it is reasonable to assume that traditionally underserved and minority students are entering high school at a disadvantage, and will need additional support to close the achievement gap to their peers. Merely enrolling undeserved students in more rigorous curriculum has not narrowed the achievement gap as reflected in NAEP scores and the High School Transcript Study (2011). Additional support systems, including extended time on task, peer and adult tutors, social support networks inside school, and emphasis on literacy may help underserved students achieve equitable outcomes with their peers who have been historically more successful (Miretsky, Chennault, & Fraynd, 2016; Pugh & Tschannen-Moran, 2016). With the gap in achievement apparent at both the national and the state level, researchers have attempted to explain and address the achievement gap using different theoretical orientations.

Researchers who have attempted to explain and suggest solutions to the achievement gap fall into two predominant disciplines: sociological and economic. Sociological research frequently attempts to explain how students' social background and outside-of-school experience influences their achievement. Theories of social and cultural capital address the systemic inequities that underlie the achievement gap (Acar, 2011; Bourdieu, 1986; Bourdieu & Passeron, 1990; Coleman, 1966, 1985, 1987, 1988; Dufur, Parcel, & Troutman, 2013; Laureu & Weininger, 2003; Putnam, 1995). Social capital is associated with how students form relationships with parents, mentors, and others and how it relates to achievement. Cultural

capital takes the form of what kind of knowledge a student brings to school, how much value is placed on that knowledge by the school, and how this relates to a student's achievement. Bourdieu (1986) explored how the differences in social and cultural capital created different levels of achievement based on a student's background. Generally, students with more capital routinely experience better educational outcomes. The solution to the achievement gap in this theoretical orientation is to acknowledge the different types of social capital students bring to school and work toward a system that builds on students' assets (Desimone, 1999; Lareau & Horvat, 1999). However, systemic disparities in the wake of school segregation have sustained the gap between those who possess the type of capital schools often favor, and those who have less favored capital and who experience less favorable outcomes (Lareau & Horvat, 1999). Furthermore, schools tend to be more receptive to the type of social and cultural capital, which the middle and professional class possess, rather than their working class and impoverished counterparts. As a result, the achievement gap is exacerbated by the type of resources different students possess and the degree to which schools respond to those resources (Lareau & Horvat, 1999; McKenzie & Scheurich, 2004; Salloum, Goddard & Larsen, 2017).

On the other hand, economic theorists focus more narrowly on inside-of-school influences on student achievement using an education production function (Hanushek, Kain, & Rivkin, 2009; Hanushek & Rivkin, 2012; Hanushek, Rivkin, & Schiman, 2016). This research addresses how teacher quality, access to resources, and peer influence relate to achievement outcomes. Their findings suggest that teacher turnover affects students from lower income schools to a greater degree than in middle-income schools, and that resources are inequitably distributed based on the fragmented nature of how schools are funded. The frequent result is that lower income students are given access to less experienced teachers, less rigorous curriculum,

and less focused peers, which widens achievement outcomes between those who have access to inside-of-school resources and those who do not (Lafortune, Rothstein, & Schanzenbach, 2016; Lankford, Loeb, & Wykoff, 2002; Milner, 2013).

Social and economic theorists have increased understanding of how different systems affect student achievement, but the connection between the two systems has received far less attention. Each system has passively referred to the other in addressing the achievement gap. However, student achievement outcomes have rarely been addressed in a manner that accounts for the interacting influences of school, community, and larger systems level effects on student achievement within a single model or framework. In particular, the degree to which inside-of-school support systems can help mitigate outside-of-school disparities has received less attention in the literature. Researchers using a sociological lens and focusing on outside-of-school influences have even suggested that students do experience school differently and it does affect their achievement (Anderson, Leventhal, Newman & Dupere, 2014; Coleman, 1966, 1987; Hanushek, Kain, & Rivkin, 2009; Kinderman, 2007; McKenzie & Scheurich, 2004; Newman, Myers, Newman, Lohman, & Smith, 2000).

There is a strand of research addressing the kinds of inside-of-school support systems that may help mediate outside-of-school influences, which negatively affect achievement. Many studies address the systems associated with the Advancement Via Individual Determination (AVID) program. AVID provides professional development for teachers, outside partnerships to monitor academic growth, and an elective course for students, which fosters the social and academic skills necessary for college success (avid.org). This research evaluates the academic outcomes of students from a wide array of social backgrounds based on the different experiences and resources they bring to school (Huerta, Watt, & Butcher, 2013; Huerta & Watt, 2015; Watt,

Huerta, & Lozano, 2007). However, less research has been conducted on the effectiveness of social and academic support systems for students who are accessing Advanced Placement curriculum for the first time or who have been traditionally excluded from AP courses, including middle achievers, transient students, and others. In particular, student cohorts whose demographic makeup is different than in most urban schools have not often been the subject of this research.

Statement of the Problem

Although more students of all backgrounds have been given access to and are taking rigorous coursework in high school, including the type of coursework associated with post-secondary success (Adelman, 2006, NCES, 2011), the achievement gap remains (NCES, 2017). While underserved students may be present in larger numbers in rigorous high school courses, their inside-of-school resources are not always adequate (Hanushek & Rivkin, 2012; Hanushek, Rivkin & Schiman, 2016) In order to begin to close the achievement gap, underserved students must be given access to rigorous curriculum in addition to academic support systems, including extended instructional time for all students, tutoring, well-trained teachers, and social support systems, including academically oriented peer networks, which are necessary to achieve at levels equitable to their peers who have had more constant access and support (Ladson-Billings, 2006; Lankford, Loeb, & Wyckoff, 2002; Miller, Ramirez, & Murdock, 2017). The gap between White and Asian students and their predominantly Black and Hispanic peers is well-documented (Diamond, 2006; ets.org, 2007; Hanushek, Kain, & Rivkin, 2009). However, the gap between White and Asian students and their peers from other racial or multi-racial backgrounds is less well understood in areas of the country where the population demographics do not align well with the contiguous 48 states where most studies have been conducted. Similarly, the

achievement gap between military mobile students and their more stable counterparts is not well understood, despite the instructional discontinuity challenges military students face (Bradshaw et al., 2010, Williams, 2013). Southcentral Alaska is one place where the student demographics do not align well with student demographics in the contiguous United States. Alaska is also home to a large percentage of military dependent students who attend three high schools surrounding the military base, two of which are included in this study (asdk12.org, 2017 Ethnicity Report). This study addressed how academic support systems influenced student populations in Southcentral Alaska that differ in demographic composition from those typically included in evaluation studies in other states and districts.

Purpose of the Study

The purpose of my study was to explore the relationship between the academic support systems associated with a National Mathematics and Science Initiative's (NMSI) College Readiness Program (CRP), a student's ethnicity, military mobility, free and reduced lunch status and gender along with when a student attended, and their academic outcomes as measured by AP exam score and letter grade in the same AP courses. Depending on the program's influence on different student groups, another purpose was to learn if the program was effective enough to be replicated at other schools throughout the district, and what might be done to implement the systems without a formal relationship with the National Math and Science Initiative.

To explore trends in achievement, I compared two grant schools and two non-grant schools comparison schools across seven years, three of which the grant was present. A student's AP exam score and letter grade were used as outcome variables to measure how students responded to attending a school where the support systems were present in relationship to student attending schools where it was not. The two types of schools allowed me to use Bronfenbrenner's (1994)

systems as a model to explore how two different approaches to supporting students in advanced courses influenced achievement. The first approach changed students' academic environment, learning process, learning context, and time spent on content. The second approach did not change the environment, process, context or time associated with advanced courses in a deliberate way.

Theoretical Framework

The outside-of-school conditions associated with sociological research and the inside-of-school resources addressed by economic theorists have been tacitly linked in the aforementioned research. However, little has been done to address how the different systems can be understood in dynamic relationship to one another. Acknowledging the interrelationship between systems may help inform policy decisions about the kind of inside-of-school processes that have the potential to close the achievement gap. This can be done by identifying the inside-of-school experiences and interactions that positively influence achievement and mediate negative outside-of-school influences on student achievement, particularly for students who are underserved or who have been excluded from advanced courses.

Bioecological Systems Theory (Bronfenbrenner, 1994, 1999; Bronfenbrenner & Morris, 1998, 2006) provides an opportunity to explore how inside-of-school systems have the potential to increase access to and success in rigorous academic programs and potentially lessen the effects of outside-of-school influences that tend to undermine achievement. This model of understanding educational development moves from microsystems containing students, peers, and teachers, all of whom most directly influence learning and achievement, to meso and exosystems, which are composed of multiple systems within the school context, including tutoring, test-taking strategy, and teacher professional development. These systems are framed

by the macrosystem associated with cultural and behavioral norms associated with school and in particular with higher academic expectations, and chronosystems associated with role expectations at different ages, including the level of responsibility and expectations of high school students.

The systems in Bronfenbrenner's theory are nested and begin with the microsystem containing the individual whose development is being addressed. Figure 1 on page 15 provides a visualization of the nested systems and the interactions within each system. The Microsystem consists of Advanced Placement classrooms, which each contain students and a teacher working on AP curriculum. Additionally, relationships with tutors, mentors and coaches also constitute a microsystem. Further, it also includes students' peer and social networks within and outside of school.

The mesosystem is made up connected microsystems, each containing the student and others in the developmental process, including distinct peer networks, sets of classrooms, College Board presenters at review sessions, other teachers in classrooms, and administrators who help support curricular programs. The interacting systems within the mesosystem in the school are aligned to support students in AP courses. The exosystem does not contain the student, but affects his or her development. This is associated with continuous professional development in which teachers engage under the NMSI Grant, and the ongoing conversations they have about teaching AP courses with one another and with College Board consultants who deliver professional development. This study did not directly account for exosystems associated with students' parents or guardians nor state-level educational policy influences on education. These influences reside outside of the scope of measurement, and are not as directly associated with classroom instruction as ongoing professional development. However, students' racial

background, degree of transiency, gender and free and reduced lunch status were included and these four student level variables are shaped by exosystems. For example, a parent's military service often leads to a student moving schools every three years, and transiency may affect achievement.

The macrosystem is the highest-level system and is made up of all systems below it, and helps define the norms of behavior and the expectations of academic work. Finally, the chronosystem addresses the changes students undergo over time, which in this study is a single school year in an AP classroom as well as the changing role expectations that are associated with advanced coursework. Additionally, within each of the nested systems, it is hypothesized that the interaction of the person, process, context and time characteristics influence the degree to which a person develops as a response to a combination of their own innate potential and their environment (Bronfenbrenner, 1994, 1999, Bronfenbrenner & Morris, 1998, 2006). More specifically, individual development is seen as a result of four interacting components. The first is a person's dispositions, resources, and demands in combination with the processes they undergo. Processes are defined by the experiences individuals have when interacting with other persons, objects, and symbols in specific contexts. Contexts are made up of the environments in which a person interacts. In this study, the principle contexts are classrooms. Finally, the time component consists of how long developmental processes last, the cycle of those processes, as well as the changing expectations of communities over time (Bronfenbrenner & Morris, 1998, 2006). In this study, students engaged in rigorous coursework surrounded by peers and teachers with differing expectations, over the course of an academic year, are synonymous with the Person-Process-Context-Time model within Bioecological Systems Theory. The particular application of this theoretical lens to this study is outlined in Figure 1 below:

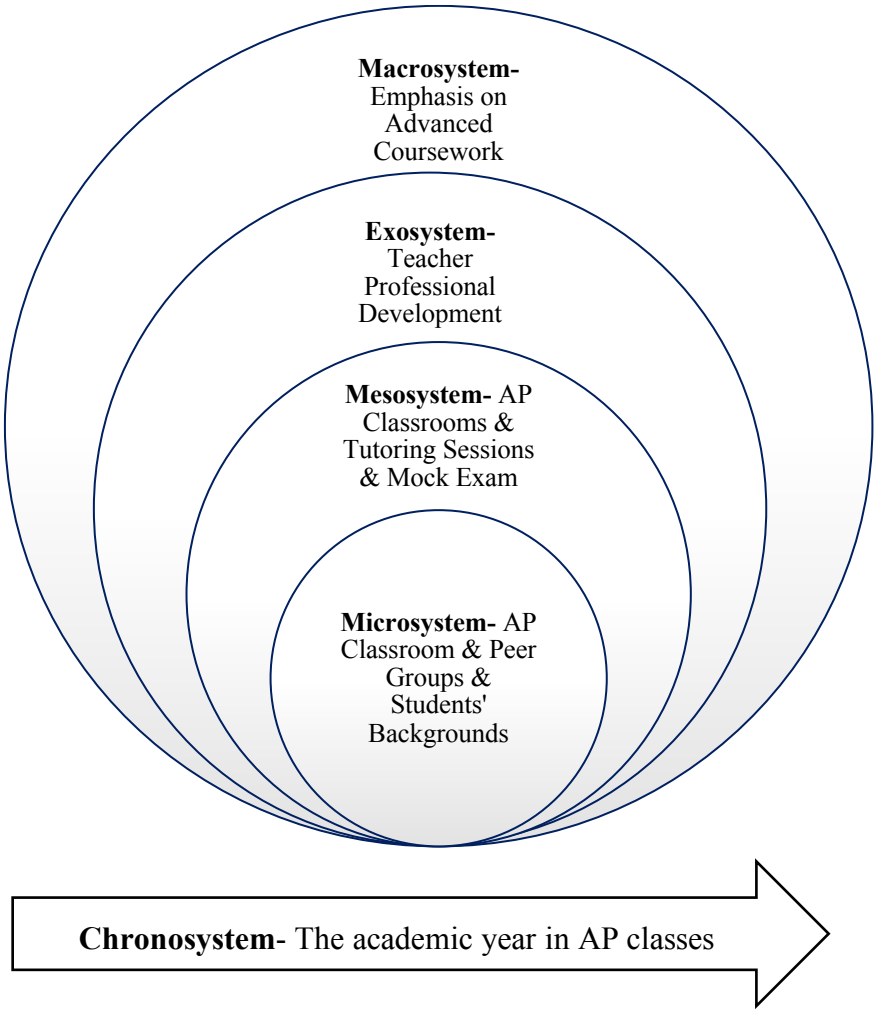

Figure 1. Nested systems within Bronfenbrenner's Bioecological Systems Theory. The person-process-context-time model (PPCT) can be used to explain how humans develop through a combination of developmental processes in different, interacting systems/contexts over time.

Bronfenbrenner's theory has been cited extensively in the literature, but some researchers suggest the system has been used too passively or at the conceptual instead of the experimental level (Mercon-Vargas, Cao, Liang, & O'Brien, 2017; Tudge, 2016; Tudge, Mokrova, Hatfield, & Karnik, 2009). Using Bronfenbrenner's theory to provide context for interpreting the effects of academic support systems on student achievement involves using the Process-Person-Context-Time (PPCT) Model to understand how academic support systems that change the nature of interactions between persons, and between persons and their environments over time, can

influence achievement outcomes for students. The support systems associated with the NMSI Grant increased access to academic rigor through AP courses while also increasing levels of support within each system in relationship to course content, which for students meant a change in the learning process, personal choice, classroom context, and amount of time spent on academic work.

My use of systems theory as an explanatory mechanism specifically relies on Bronfenbrenner's third hypothesis, which states that individuals who experience processes that encourage development in one environment, like a classroom, who have not otherwise experienced them in other environments, such as those at home, will show more development than those who have been consistently exposed to those processes in multiple environments. In this study, development was synonymous with learning as measured by a student's AP Exam score and letter grade in an AP course. The theory also holds that interactions are more influential than the environments in which the interactions occur. In other words, students who have traditionally not taken advanced coursework should show more noticeable progress in achievement in AP courses once they interact with peers and teachers in advanced courses when compared to their peers who have consistently been enrolled in advanced courses. This creates the opportunity to close the achievement gap at all types of schools so long as the necessary interactions underlying academic achievement occur.

Research Question

The research question which guided my study includes one part that addresses achievement in terms of AP Exam Score and one part that includes a student's letter grade in an AP course. The question addressed the relationship between a student's background, the school

he or she attended, the years in which it was attended and the odds of receiving a passing score (3-5) on an AP exam, and a higher letter grade (A or B) in an AP course:

> How do student demographics and exposure to academic support systems predict achievement outcomes in terms of AP course grade and AP exam score?

Significance of the Study

Using Bronfenbrenner's Person Process Context Time (PPCT) Model to contextualize educational interventions presents the opportunity to improve educational decision-making by giving policymakers a method for understanding how systems interact with one another in relationship to a student's academic outcomes. It may also lead to greater understanding of how teachers and peers influence achievement in the classroom and school, as well as how the support systems associated with the grant, are all part of a higher order model of understanding how to improve student achievement by organizing systems that align well with one another. Educational interventions that address the different systems in cohesion with one another rather than in artificial isolation may provide insight into how systems can be built to help close the achievement gap for underserved students, as well as benefitting all students. This more nuanced understanding may give educational decision-makers and policymakers information that allows them to design educational processes that are more responsive to all student groups and especially those who come from social backgrounds that have not historically had equal access and support when engaging in Advanced Placement coursework.

My research also contributes to existing research on programs that are designed to close the achievement gap by supporting academic achievement for students who have traditionally lacked access to rigorous programs or who have been excluded from taking advanced courses based on past achievement. The Advancement Via Individual Determination (AVID) program is

the most frequently cited program in the literature (Huerta, Watt, & Butcher, 2013; Lozano, Watt, & Huerta, 2009; Llamas, Lopez, & Quirk, 2014; Watt, Huerta, & Lozano, 2007). However, other lesser known programs without national prominence have also been evaluated based on their ability to increase achievement outcomes for underserved students. These include an International Baccalaureate program at an urban school (Mayer, 2008), increasing access to advanced classes and offering additional support in another urban school (Miretsky, Chennault, & Fraynd, 2016), as well as programs to improve writing, literacy, and the transition to high school for urban students (Newman, Myers, Newman, Lohman, & Smith, 2000; Olson, Matuchniak, Chung, Stumpf, & Farkas, 2016).

The National Math and Science Initiative's College Readiness Program (CRP) shares many features of these programs, including tutoring, extended instructional time, and professional development; however, it differs in its administration. The NSMI grant, unlike the AVID program, does not place students in AP courses and an elective to support their work in AP courses concurrently. As such, the support systems are built around and in addition to the school day and not integrated into it, which for certain schools with scheduling and financial limitations, may prove easier to implement than more integrated programs. In context of previous research, the results of my study have the potential to help guide further research on what kinds of academic support systems work best for students who may not have been exposed to advanced coursework before entering high school. Considering the demographic differences between Southcentral Alaska and the Lower 48 United States, my results may also help understand how different groups of students respond to academic support and increase understanding of what systems work for what types of students.

Definition of Terms

The focus of this study is on student achievement, the achievement gap, and how systems interact to influence achievement. Some terms may not be self-defining or may be used in many different contexts. For the purposes of this study, the definitions below help narrow their meaning to the interests in this study. All systems definitions are based on the work of Bronfenbrenner and Morris (2006)

Achievement Gap - When an outcome—for example, average test score—is higher for one group than for another group, and the difference is statistically significant (*The Condition of Education 2017* Glossary). In this study, the achievement gap is based on gaps associated with a student's ethnicity, military mobility, gender and free and reduced lunch status.

Chronosystem – Transitions that occur throughout the time a person develops which are associated with changes in role expectations placed on people at different stages of life. In this study, the higher expectations for independence and self-advocacy associated with advanced coursework as well as demands associated with adolescence.

Education Production Function – Measuring student academic achievement, usually in terms of a test score, based on educational inputs, including parents, teachers, other students and school characteristics (Hanushek, 1979).

Enrollment – All students who were enrolled in an Advanced Placement mathematics, science, or English course and/or who took the end of year AP exam in those subjects at the four Alaska high schools.

Exosystem – A system not containing a student that still influences a student's development. For instance, a parent's workplace demands, a teacher's professional development experience or dialogue with other teachers that does not include the student, or financial restrictions on schools.

Macrosystem – A system which is defined by the cultural in which a person lives. In my study this is defined as the expectations, norms, and behavior of advanced coursework.

Mesosystem – The interrelationship between two microsystems. In my study, the connection between the classroom and school environment containing the student, and a student's experiences at home or in other settings outside of school that influence on another.

Microsystem – A system which contains the individual and the most direct impacts to his or her development. In my study, a classroom, a school-based peer group, and tutoring and study sessions associated with teaching.

National Math and Science Initiative (NMSI) – An organization that partners with high schools to increase access to and success in Advanced Placement courses through funded professional development, tutoring and extended instructional time, and monetary incentives for students and teachers (nms.org).

Opportunity Gap – The disparity in access to high quality teachers and other educational resources necessary to receive an adequate education.

Student Achievement – Defined by the composite score (one through five) on an end-of-year Advanced Placement exam in mathematics, science, or English supported by the NMSI Grant as well a student's letter grade in an AP course, A through F.

Transience – The type of transience in this study is military transiency. Military transiency is defined by moving between schools and states at least every three years and the move may not coincide with a school year, which means some students may attend more than one school within a school year (Williams, 2013). Promotions within the military are often accompanied by a PCS, which means that students whose parents have frequently accepted promotions may attend a school for one or two years and then move to a new school. Moves are often between states, and

military personnel are given different time periods to report to their new duty station (Bradshaw, Sudhinaraset, Mmari, & Blum, 2010; Engel Gallagher, & Lyle, 2010). Military personnel reporting to Alaska for service are given a month or more to report, during which time their students may not be enrolled in school, which results in a loss of instructional time.

Underserved Students – Students who do not receive equitable resources compared to other students in schools. The group is often made up of economically disadvantaged students, racial minorities, and first-generation immigrant students who have traditionally not been well-represented in rigorous courses in high schools nor attended college at rates comparable to their more affluent peers who possess more social and cultural capital of the kind often valued by schools (Kuh, Kenzie, Buckley, Bridges, & Hayek, 2006).

Delimitations

This study is limited to four Alaska high schools, which served 3,289 students who were enrolled in mathematics, science, and English AP courses and took AP exams in those subject areas from 2011 through 2017 in a large Alaska school district. The grant and comparison schools were selected based on their close geographical proximity in two different areas within a large school district, their demographically similar student populations, and their AP course offerings, which were similar or the same as the grant schools from 2011-2017. Therefore, student samples are not precisely matched, but do reside in a similar urban or suburban area.

The student population who took AP courses at four high schools is intended to represent the larger district population who took the same AP courses, but are not included in the population. For the purposes of educational decision and policy-making, the results of this program evaluation, which explored differences in achievement outcomes between different student cohorts based on academic support mechanisms and student demographics, may be

generalized to the other high schools in the district in order to attempt to increase achievement outcomes for all eight district high schools through targeted academic intervention.

Summary

I opened this chapter with a brief discussion of the historical inequities in access to education and how inequitable access still affects achievement outcomes for students over a half a century later. Following a discussion of national achievement trends, I placed Alaska's achievement trends in context of national trends to highlight the need to address the same problem at the state level. Next, I reviewed different theoretical orientations for understanding the achievement gap, including how these were limited in their comprehensive understanding of the interacting systems' influence on students. Following a review of the two social and economic theoretical orientations, I presented a third theoretical lens. Ecological Systems Theory holds the potential for addressing achievement by looking at interacting systems, which was limited in prior research in the two other theoretical traditions. Next, the two-part research question was presented followed by the significance of this study to educational decision-makers who may be able to use the results to enact policy that provides more positive influence on student achievement outcomes. I concluded with a definition of terms and delimitations and assumptions.

I organize the remainder of this dissertation into four chapters, references, and appendices. Chapter 2 presents a review of the literature on the achievement gap, its causes, and what has been done to address it. It includes a discussion of the two predominate theoretical orientations to the achievement gap, and what can be done to reconcile them into a more effective theoretical model. In Chapter 3, I outline the research design and methodological approach of this study. It includes a discussion of the research design, the population under

study, how data were collected, and the statistical analyses employed to answer the research question in this study. Chapter 4 will present analysis of the data, and a discussion of the findings. Finally, Chapter 5 will present a summary of the study, a discussion of the findings and how they relate to prior research and national AP achievement outcomes, recommendations for future research and practice, as well as policy and theoretical implications. I conclude by providing a call to action for educational decision makers who have the potential to change the way students are supported in academic courses, and how their initiative holds the possibility of allowing more students to fulfill their academic potential. References and an appendix including the tables in this study follows the text of the dissertation.

CHAPTER 2

LITERATURE REVIEW

The National Math and Science Initiative's (NMSI) College Readiness Program's (CRP) goal is to increase enrollment and achievement in advanced coursework for students who would not typically take Advanced Placement (AP) courses. In particular, the support systems associated with the grant attempt to increase enrollment and achievement for minority students, transient students, and middle achievers who have traditionally been underserved by these programs. The grant provides weekly after school tutorials, three Saturday study sessions, a mock exam, financial incentives for students and teachers, as well as attendance at an AP Summer Institute, and follow up professional development for teachers in mathematics, science, and English AP courses. In short, the NMSI grant provides resources to students and teachers in an attempt to increase enrollment of minority and underserved students and to close the achievement gap in Advanced Placement coursework by providing more opportunities for all students to enroll. In order to address the need for such programs, I address the origins of the achievement gap and the opportunity gap, how they are currently understood, and the social and economic research on it. I conclude by suggesting that the socio-economic research has neglected the interrelationships between the outside-of-school factors and the inside-of-school factors influencing achievement, and how Bioecological Systems Theory may be used to reconcile them.

In this literature review, I first address the achievement gap in terms of where students attend school and at what rates they achieve on the National Assessment of Educational Progress (NAEP) (ets.org, 2007; nces.ed.gov, 2017). I then move on to explore how different groups conceptualize and understand the achievement gap based on the language that is used to label it

(Chambers, 2009; James, 2012; Ladson-Billings, 2006, 2007; McKenzie & Scheurich, 2004; Milner, 2013). Following conceptualization of the achievement gap, the review establishes its historical origins and highlights key court decisions that influenced education and how *de jure* and *de facto* segregation were strong precursors to the current achievement gaps (Denton, 2001; Diamond, 2006; Gooden, 2004; Henderson, 2004; Ladson-Billings, 2004; Ramirez & Carpenter, 2005; Skrla & Scheurich, 2001; Smith, 2005; Ullucci & Howard, 2015).

I then place the historical origins in context of the outside-of-school factors that influence student achievement. Much of the research on outside-of-school factors originates with The Coleman Report (1966), which attributed the disparities in achievement largely to outside-of-school factors, including students' social, human and cultural capital (Coleman, 1985, 1987, 1988; Coleman & Hoffer, 1987; Desimone, 1999; Horvat, Weininger & Lareau, 2003; Lareau & Horvat, 1999; Lareau & Weininger, 2003; Marsden, 2005). Next, I review the research on inside-of-school factors influencing achievement, including peer influence (Criss, Pettit, Bates, Dodge & Lapp, 2002; Fletcher, 1995; Hanushek, Kain & Rivkin, 2009; Kinderman, 2007; Maynard, Beaver, Vaughn, DeLisi & Roberts, 2014), teacher quality (Lankford, Loeb, & Wyckoff, 2002; Miller, Ramirez & Murdoch, 2017; Riconscente, 2014; Rivkin, Hanushek & Kain, 2005; Vega, Moore & Miranda, 2015) and professional development, including ongoing assessment, content, and tutoring (Desimone, 2009; Dufour, 2004; Hirsh, 2015; Kennedy, 2010; Meissel, Parr, & Timperley, 2016; Olson, Matuchniak, Chung, Stumpf & Farkas, 2016; Opfer & Pedder, 2011; Stoll, Bolam, McMahon, Wallace & Thomas, 2006). These inside-of-school factors have often been addressed by economic theorists and researchers using an education production function, which attempts to tie inputs to student achievement (Clotfelter, Ladd & Vigdor, 2007; Hanushek,

Kain, & Rivkin, 2004; Hanushek & Rivkin, 2012; Hanushek, Rivkin & Schiman, 2016; Jackson, Johnson & Persico, 2016; Lafortune, Rothstein & Schanzenbach, 2016).

After addressing the socio-economic research on the achievement gap, I discuss Advancement Via Individual Determination (AVID) programs that include inside-of-school factors and that aim to increase achievement among underserved students, including overarching studies of the AVID program (Adelman, 2006; Contreras, 2011; Gandara & Bial, 2001; Mehan, Hubbard, Lintz, & Villanueva, 1997), as well as more specific studies investigating scaffolded peer and adult support systems, academic content, and temporal features of the program (Black, Little, McCoach, Purcell, & Siegle, 2008; Huerta & Watt, 2015; Huerta, Watt, & Butcher, 2013; Mayer, 2008; Miretsky, Chennault, & Fraynd, 2016; Radcliffe, & Stephens, 2008; Stanton-Salazar, & Spina, 2005). Finally, I make a case that a Bioecological Systems Theory approach (Bronfenbrenner, 1990, 1994, 1999; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006) to exploring how inside-of-school factors relate to the achievement gap, and mediate outside-of-school influence, may lead to a more comprehensive understanding of the influences on student achievement, which may allow for closing the achievement gap that has not been fully considered by narrower sociological or economic understandings of student achievement.

Purpose

The issue this study addresses is the achievement gaps between White and non-White students, military mobile and non-mobile students, male and female students, as well as students who receive free and reduced lunch and those who do not, in terms of achievement in Advanced Placement (AP) high school coursework. The purpose of the study is to explore the differences in achievement at four Alaska high schools in terms of student demographics in response to the academic support systems associated with the National Math and Science Initiative Grant's

College Readiness Program, which provided systematic academic support over a three-year period from 2013 to 2015 at two Alaska high schools to encourage more middle achievers and underrepresented students to enroll in Advanced Placement courses in mathematics, science, and English.

The research addresses how the academic support systems associated with the NMSI grant implementation influenced achievement and might be used to increase underserved students' academic outcomes and begin to close the achievement gaps that exists between different student groups. The NMSI grant, about which there is little research, is placed in context of the Advancement Via Individual Determination (AVID) program and others, which also support AP coursework and aim to increase enrollment of underserved students as well as increasing achievement. There are four student-level demographic variables and three, school-level independent variables, including whether a student was exposed to the academic support systems grant or not, the location of the school, either urban or suburban, and the years a student was enrolled and took an AP exam. The grant implementation included monetary incentives for qualifying scores on exams for students and teachers, additional academic tutoring and review in AP subjects for students, and additional professional development for teachers of AP mathematics, science, and English courses. The dependent variables in this study are AP Scores and AP Grades in mathematics, science, and English AP courses supported by the NMSI Grant.

Method

The sources cited in this literature review were located based on searches for academic journals using Academic Search Premier, JSTOR, ERIC, Web of Science, PsycARTICLES, PsycINFO, and Google Scholar. The primary keywords used in this search were: achievement gap, opportunity gap, academic achievement, AVID, underserved students, Bioecological

Systems Theory, social capital, cultural capital, education production function, value added, peer influence, professional development, teacher quality, and academic rigor. The chronological presentation of theory and its relationship to the achievement gap mean the sources cited in this review reach back to 1966, although most of the articles are far more contemporary. The independent variables in this study, including the systems associated with the NMSI Grant implementation were used to identify research that pertained to the achievement gaps or academic achievement, the dependent variables in this study. In many instances, the reference lists of seminal research studies were used to identify sources, which built on them. This was particularly the case with researchers who were vital to the three major theoretical orientations presented in this literature review, which include Social Capital Theory, Economic Production Function, and Bioecological Systems Theory. The first two theories cast the achievement gap in terms of inside-of-school and outside-of-school influences respectively, whereas the third theory, Bioecological Systems Theory, which is used as the theoretical lens for this study, bridges the strengths of the previous two theoretical orientations and provides a way to understand the influence of the NMSI Grant on achievement in a more holistic manner.

Theoretical Orientations

This review employs three major theoretical orientations in order to demonstrate how achievement gaps have been understood and addressed by sociological and economic researchers in the past, and how the gaps in the two approaches can be reconciled by a third theory, which addresses the interrelationships between inside-of-school and outside-of-school influences on achievement. To accomplish this, I start by synthesizing the sociological research that addresses mostly outside-of-school factors on achievement starting with the Coleman Report (1966), then move on to review the economic models that addressed mostly inside-of-school factors

(Clotfelter, 2007; Hanushek & Rivkin, 2012), before suggesting Bioecological Systems Theory (Bronfenbrenner, 1994, 1999; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006) as a more appropriate theoretical orientation to the achievement gap.

I begin with Social Capital Theory, which James Coleman contributed to in his findings in the Coleman Report (1966). The theory has been used to tie students' social backgrounds to their achievement in school. The theory hypothesizes that the more connected students are to a stable social network, which enables them to increase their own human capital, the higher their potential achievement. Applied to the achievement gap, this would appear to explain why middle and upper class White students achieve at rates higher than their minority and working-class peers based on their relative stability at home, their connection to social networks that can influence favorable outcomes at school, and their access to more resources, including high-performing teachers and peers, and the time and content to drive achievement. Coleman's theory largely addresses the outside-of-school influences on achievement.

After reviewing Social Capital Theory, I discuss economic theories of education, including the application of the education production function used by Hanushek and Rivkin (2012) and Clotfelter et al. (2007) to explore how teacher quality as measured by experience and education as well as value-added on standardized tests, and teacher turnover, affect student achievement. Applied to the achievement gap, the education production function helps explain why as teacher quality and stability rise, student achievement follows. The theory has been used to explain how the unequal distribution of high performing teachers has affected student outcomes, and argues that more consistent and uniform access to high performing teachers would help start to close the achievement gap.

Finally, I use Bronfenbrenner's Bioecological Systems Theory (1977, 1979, 1994, 1999; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006) to reconcile Social Capital and economic theories of education and to suggest a more appropriate theoretical approach to the complex interrelationships that underlie students' academic achievement. Applied to the achievement gap, the Ecological Systems approach helps understand how outside-of-school and inside-of-school systems interact to influence achievement. For instance, microsystems, like classrooms, schools and homes are nested in larger mesosystems, exosystems, macrosystems, and chronosystems. In theory, the degree and intensity of interactions between individuals (proximal processes between students, teachers and peers) in an environment (classroom or school) over time relate to the degree to of learning. Using this logic, students who have high quality teachers, motivated peers, high quality content and tutoring will exhibit higher rates of achievement than their peers who have less of these interactions.

Furthermore, Bronfenbrenner's third hypothesis states that when individuals who have not been exposed to proximal processes that underlie academic achievement outside of school begin to be exposed to these processes to a greater degree, their potential for growth in achievement is larger than those who have been exposed to processes in other environments. Applied to the achievement gap, this means that if underserved students can be placed in programs, which expose them to high performing teachers, motivated peers, viable content and tutoring, then hypothetically, their achievement should increase at a greater rate than their peers who have had longer access to these resources. Bronfenbrenner's third hypothesis can be used to understand how the support systems associated with NMSI grant influenced outcomes for students who would not normally be exposed to AP programs nor the content, teachers, and tutoring associated with it.

The Achievement Gap, Current Understandings, Historical Origins

The National Center for Education Statistics (NCES) defines the achievement gap as occurring "when an outcome—for example, average test score—is higher for one group than for another group, and the difference is statistically significant" (Glossary section, para. G). In its *Condition of Education 2017* report, NCES noted that generally, Black and minority students attend higher poverty schools and achieve at lower rates than their counterparts. During the 2014-2015 school year, almost half of all Hispanic and Black students in the United States and one-third of all American Indian or Alaska Native students attended high poverty schools. By comparison, White, Asian, and students of two or more races attended high poverty schools at a rate under 20% collectively, with White students attending at just an 8% rate, a fraction of the rate of their minority peers. Achievement also lags. The gap between White and Black NAEP reading scores was 26 points in 2013 and in 2015 in eighth grade, and 29 points in 12th grade. This is notable because the gap increased over time rather than closing, which would be expected with more instruction. The gap in NAEP mathematics scores was 31 points in 2013 and 32 points in 2013 and 2015 in eighth grade mathematics, and 30 points in 12th grade in both years (nces.ed.gov).

In terms of both access to well-resourced schools and literacy and mathematics achievement, minority students do not experience equitable outcomes. NCES highlights this disparity in their analysis of reading scores when they point out that from 1992 to 2015, White fourth and eighth graders' reading scores were higher than their Black and Hispanic peers, and at 12th grade, the White-Black gap in reading widened from 24 points in 1992 to 30 points in 2015. There is a similar gap in twelfth grade scores in schools based on the poverty level. Those attending a high poverty school scored 266 compared to their counterparts in low poverty

schools who scored 298, a similar gap to the White-Black gap overall. This connection appears to mirror the finding that almost 50% of all Black students attend a high poverty school whereas their White counterparts attend at only an 8% rate (nces.ed.gov).

Although the achievement gaps based on race and poverty are well-established in the literature, the achievement gap for military transient students is less well understood, but there are some clear trends that may indirectly affect achievement. Williams (2013) noted that in 2010 there were over one million military dependent students, and 144,609 of them were adolescents aged 12-14. Since adolescents experience rapid physical, emotional, and psychological changes, the added stress of military mobility and deployment may magnify achievement gaps. In Bradshaw et al.'s (2010) qualitative study of the stressors on military families, both students and parents noted the inconsistencies that result from making up to nine moves throughout a student's school years. These include differing credit requirements and curriculum by state, which may result in the need to repeat or take additional classes, inconsistent support for special needs, school size, and knowledge gaps that are difficult to fill. In a study of Nebraska schools, Isernhagen and Bulkin (2011) found a negative correlation between achievement and high rates of mobility associated with military service. Furthermore, the last twenty years has been marked by ongoing war overseas, which is likely to add stress to students with deployed parents (Lasser & Adams, 2007), and in some cases deployment has shown to magnify learning loss (Engel, Gallagher, & Lyle, 2010), and that students who experience loss find it more difficult to catch up to their non-mobile peers.

At the same time, the demographics in the United States are changing. The population is generally growing more diverse while the economy is beginning to value higher order thinking skills for which public education is most students' best resource. This is happening while the

gap between those with and without twenty-first century literacy and numeracy skills is widening. Of all adults, only 13% fall in the highest literacy category, and by race the differences are noticeable: 17% of White, 3% of Hispanics, 3% of Blacks, and 9% of Asian students fall within the highest category with the largest numbers of the lowest category distributed among Hispanic and Black students at 33%. This suggests that in order to close the achievement gap, and ensure the general population can be productively employed, we must find ways of improving education for everyone (ets.org). Although the achievement gap is well documented, the understanding of it and its causes remain inconsistent based on which theoretical orientation is adopted to explain the causes of achievement disparities.

Understanding the Achievement Gap

As an illustration of this inconsistency, students and teachers come to different conclusions about the underlying causes of the achievement gap. Students believe their achievement barriers are the people, including teachers, counselors, and other school-based personnel; policies, including discipline procedures; and places, including the neighborhoods in which schools are located. Students believe the leading barrier is teachers who either do not care or who are overwhelmed and underprepared to teach students, or who simply do not believe students in urban environments are capable of learning at levels equal to their more affluent peers (Vega, Moore & Miranda, 2015). Student perception is partly borne out by studies, which suggest that teacher distribution and teacher turnover affect underserved students to a greater degree than their more affluent counterparts (Hanushek, Kain, & Rivkin, 2004; Hanushek & Rivkin, 2012; Hanushek, Rivkin, & Schiman, 2016; Lankford, Loeb, & Wyckoff, 2001).

Students who believe their teachers care often achieve at higher rates, and when students believe the teacher cares and the teacher exhibits high value instructional practices, the effect is

even more pronounced (Riconscente, 2014). Furthermore, teachers' sense of self-efficacy, or their belief and confidence that all students can learn if taught properly, may transfer to students. In mathematics and science, teachers who are confident with difficult subjects may increase students' self-confidence. This occurs because students vicariously experience how their teacher's positive attitude is related to successful engagement with the material (Bandura & Adams, 1977; Miller, Ramirez & Murdoch, 2017). Reading outcomes have also been shown to improve when teachers have a strong sense of self-efficacy and implement high leverage curriculum (Cantrell, Almasi, Carter & Rintamaa, 2013). Oftentimes, the teachers who are most prepared to face students' achievement gaps are working in schools with the least need to close an achievement gap, those schools serving the most affluent, highest-scoring students. The difference in access to highly qualified teachers in the United States between high and low socio-economic status students is the fourth highest when compared to 46 other countries. This is likely because schools are funded locally and *de facto* segregation often places large groups of underserved students in a similar geographic area (Akiba, LeTendre, & Scribner, 2007).

On the other hand, some teachers attribute the lack of achievement to students, their families, or their lack of motivation. This trend becomes even more pronounced for teachers in schools with a higher enrollment of White students than their counterparts in higher minority enrollment schools (Bol & Berry, 2005). In other words, teachers with a high degree of self-efficacy appear to positively influence student achievement, especially with underserved students, but most often teach in schools where there are low numbers of underserved students. Their counterparts who may lack high levels of efficacy, and teach students in urban or high poverty schools, tend to assign blame to students quicker than those who teach more affluent, White students in suburban districts. Teachers who assign the cause of the achievement gap to

students often pathologize poor students and do so based on four myths, including the idea that anyone can pull themselves out of poverty by sheer will power; that people in poverty are lazy and not particularly smart; and that there is culture of poverty (Ullucci & Howard, 2015). Others have argued that applying the *at-risk* label has frequently categorized Black males in a way that associates them with immigrant status or fatherlessness, and as athletes, troublemakers, or underachievers. These labels all potentially undermine their productive participation in education and their academic achievement (James, 2012).

Further research has addressed these differing understandings of the barriers to achievement in terms of equity traps and deficit thinking (McKenzie & Scheurich, 2004; Valencia, 2010, 2012). Equity traps associate students' lack of success with the lack of academic behaviors and skills they possess when they arrive at school. Blame for underachievement is assigned to students. One key way to address this is to shift the lens and to start to see students in association with what they do bring to school, including their cultural perspective, their existing skillsets, and their own beliefs and goals. This avoids ignoring the role race and social background plays in learning, and acknowledging the unique contributions students can make to diverse classrooms. This view is associated with the Funds of Knowledge, which acknowledges the unique culture and background of each student as a resource for learning (Moll, Amanti, Neff, & Gonzalez, 1992). Additionally, district leaders can use data to create accountability and transparency for all students' learning by identifying the specific challenges and seeking teachers and other school leaders who have had success with similar student groups (Ramirez & Carpenter, 2005; Skrla & Scheurich, 2009). Collectively, these practices address the beliefs and understandings of teachers, students and school leaders who have the potential to begin to focus attention on the underlying causes of achievement gaps. While these understandings address

popular perceptions of the achievement gap, others question the way in which educators and researchers have named and addressed the problem.

Some scholars argued the achievement gap should be redefined as an education debt based on the understanding that all students do not begin school with the same resources nor do they have equitable access to educational resources when they enter schools. (Ladson-Billings, 2006; Ladson-Billings, 2007). Translating the achievement gap into an educational debt redefines how we understand the current disparities in academic achievement by casting the gap in context of the lack of resources and access underserved groups have had historically. If Black, Latino, and other minority students were actively blocked from the resources on which their White counterparts' higher achievement is built, then reducing the education debt precedes closing achievement gaps. This would require that all students receive access to high quality content, capable teachers, and adequate facilities, which is currently not the case. This understanding reconstitutes the achievement gap as a receivement gap because large groups of students have not received enough resources to reasonably compete with those who have (Chambers, 2009). One way of understanding the origin of the disparities in access to resources, which underlie the education debt, is to examine the trend in case law throughout history as it relates to education.

The Achievement Gap, Historical Context and Case Law

The underlying causes of the gap in standardized test scores, increased dropout rates, decreased enrollment in advanced coursework, and lower college attendance rates have been tied to systemic historical disadvantages (Ladson-Billings, 2004). In particular, the indirect historical influence on the achievement gap includes the effects of the Supreme Court's decisions in *Plessy v. Ferguson* (1896) and *Brown v. Board of Education* (1954). In its *Plessy* decision, the Supreme

Court declared that separate was equal, and in so doing, set the precedent for a physical gap between Black and White students in schools, and for segregation in almost all other public services (Smith, 2005). The court's ruling in Plessy accepted segregation on the foundation of equal access to resources, but did not comment on the psychological effect it might have on students. While on its face, the *Plessy* decision appeared to negatively influence Black students, some student groups were achieving at high rates despite separate and often unequal facilities. Further, once the court's decision in *Brown* was rendered, not all Black students saw increased access to resources; many were kept out of schools because of violence or political ends, and many Black educators lost their jobs in the South (Gooden, 2004). Since Brown, some question whether desegregation has actually occurred (Middleton, 1995; Orfield, Frankenberg, & Lee, 2003). Today, in large urban centers, where housing and race are often synonymous, schools within the same city experience widely disparate resources and outcomes—segregation may not be legal, but it still tacitly occurs and it still affects achievement outcomes for students based on access to resources (Denton 2001; Frankenberg, 2013; Kozol, 1997; Milner, 2013).

Despite the promise of *Brown*, in which the court reversed *Plessy* and argued that separate was inherently unequal, there were few mechanisms for integrating schools, and the court did not directly address the degree of racism, housing patterns, or tracking efforts within schools that would hamper efforts long after the decision to integrate was rendered (Henderson, 2004). In both *Serrano v. Priest* (1971) and *Robinson v. Cahill* (1976), the courts found that relying on local property taxes to fund schools caused inequities, yet in *San Antonio Independent School District v. Rodriguez* (1973), the court upheld the funding mechanism citing that education is not a right protected by the U.S. Constitution. Despite this disagreement, almost 20 state courts have ruled their education funding formula unconstitutional based largely on

inequitable funding. These decisions can be seen as an extension of the desegregation efforts that *Brown* prompted, but segregation and finance are rarely studied together (Ryan, 1999).

The findings in these cases serve as examples of the difficulty of achieving equal outcomes even after *Brown* established separate was unequal. While it was no longer legal to segregate students based on race after 1954, in many cases *de facto* segregation still exists and influences the achievement outcomes of children in schools. The intertwining influence of *de jure* and *de facto* segregation and school finance that started before *Plessy*, and ran through *Brown*, still influences case law today. This leaves little doubt about the systemic foundations of achievement gaps. Over 60 years have passed since the *Brown* decision, yet the promise of integration and more equitable resources for students has not been fully realized (Burris & Welner, 2005; Diamond, 2006). Although the vision of equal education for all has not been attained, some schools and organizations have responded to the inequity by organizing support systems that help mediate outside-of-school influences, and acknowledge that not all students come to school with the same resources (Contreras, 2011; Denton, 2001; Farkas, Grobe, Sheehan, & Shuan, 1990; Huerte & Watt, 2015). In spite of historic inequities, these programs acknowledge that access and support are necessary for increasing underserved students' achievement outcomes.

Theoretical and Methodological Orientations to the Achievement Gap

The influence of segregation and the degree of access to equitable resources on the achievement gap can also be used to understand how different methodological and theoretical orientations have been used to understand and address achievement gaps. Arum (2000), in his review of the sociological research on the achievement gap, revealed that research since Coleman (1966), including Coleman's own subsequent research (1988), has changed. On one

hand, researchers have addressed the inequitable outcomes students experience based on where they live and what resources they bring to school. These studies can be seen as a reaction to the influence of segregation. They have been mostly sociological in nature and addressed local, micro or meso-level influences on achievement that exist within neighborhoods and schools without offering solutions at the school level that might improve student outcomes (Milner, 2013).

On the other hand, researchers have explored the connection between the degree to which resources are invested in the schools and student outcomes. These studies have been mostly economic and conducted at the macro level with national or international level data sets involving regression analyses. These studies appear to respond to the financial influences on student outcomes in an attempt to discover what an adequate education requires. The two approaches to the achievement gap also highlight the divide in how the achievement gap is understood semantically as either an achievement gap, receivement gap, or an educational deficit (Chambers, 2009; Ladson-Billings, 2006; McKenzie & Scheurich, 2004), as well as how teachers and students understand and perceive the barriers to academic achievement and how to address them (Cantrell et al., 2013; McKenzie & Scheurich, 2004; Miller, 2017; Vega et al., 2015). Although there may be some disparity in how the achievement gap is understood and how researchers have addressed it, the volume of research, and the noted gaps, suggest there is still important work to be done to understand how to improve outcomes for underserved students. Sociological research associated with students' social backgrounds and achievement, and economic research using the education production function, which have often been applied separately, do not always acknowledge how sociological and economic factors interrelate to influence achievement.

This gap can be understood better with a systems theory approach, which acknowledges the interrelationship between a student's interactions and access to resources inside-of-school as it relates to their achievement, and mediation of outside-of-school influences. While experiences and interactions beyond school have a powerful effect on achievement, some research suggests that creating systems inside of schools that increase the level of reciprocal interactions situated to academics can both increase achievement and mediate dysfunction outside of school (Bronfenbrenner, 1994, 1998). In other words, even though outside-of-school influences on achievement have seemingly dominated the discussion about achievement gaps since Coleman (1966), the inside-of-school influences on achievement can arguably be changed by educational decision-makers easier than outside-of-school influences that exist on a macro scale. Doing so may be helpful in addressing students' achievement outcomes while also acknowledging the different experiences they bring to school.

Before directly reviewing the research on what types of inside-of-school systems influence achievement, I review the outside-of-school influences to provide context and to clarify how inside-of-school factors may play an important role in mediating the outside-of-school disparities in students' resources that have often been associated with their lack of academic success.

Outside-of-School Influences on the Achievement Gap

An early approach to explaining the achievement gap relied on a sociological lens to understand how family composition, class-based differences, and child-rearing techniques related to school achievement. Perhaps the most popular expression of this research was James Coleman's report (1966), which suggested within school differences outweighed between school differences in achievement. This finding implicated differences in home life as the cause of the

achievement gap. The factors influencing achievement were mostly outside of the school and involved analysis of the relationship between outside-of-school factors and school context (Acar, 2011; Israel, Beaulieu, & Hartless, 2001; Putnam, 1995; Sander & Putnam, 2010; White & Kaufman, 1997). While the match or mismatch between school context and parenting style was further explored by researchers (Desimone, 1999; Horvat, Weininger, & Lareau, 2003; Jeynes, 2007; Lareau & Weininger, 2003), little was done to suggest a better way for schools to support underserved students while they were at school. Pierre Bourdieu's theoretical work (1986) on social and cultural capital and Coleman's work on social capital also influenced research on how capital is formed and used in schools (Bourdieu & Passeron, 1990; DiMaggio, 1982; Farkas, Grobe, Sheehan, & Shuan, 1990; Huang & Liang, 2016; Jaegar, 2007; Sullivan, 2001).

Cultural capital research attributed achievement differences to a student's knowledge of the dominant culture's behavior and resources, and the ability to use and understand them in association with achievement. Yet these researchers did not necessarily address how coursework and educational experiences could be modified to provide students with access to the information and human resources necessary to challenge or change the dominant culture. Many researchers credit Bourdieu's theoretical work on cultural capital as a foundation for the research, which followed, including much of Coleman's research after the Coleman Report (1966). Bourdieu and Coleman's research, and that which followed, can be seen as a continued attempt at understanding the differences in student achievement.

Social Capital Theory and the Achievement Gap

Just over a decade after the *Brown* decision was rendered, James Coleman and his co-authors issued *Equality of Educational Opportunity* (1966), which documented the types of schools children attended and their academic outcomes. The Coleman Report (1966) attributed

70% of the variance in achievement to within school factors, not between school factors. This finding indirectly suggested to many readers that students' home lives, the outside-of-school factors, wielded far greater influence on achievement than within school factors on achievement. Coleman's conclusion, and his assertions about the importance of social capital to school achievement, exerted a tremendous influence on the sociological research that followed (Acar, 2011; Israel et al., 2001; Putnam, 1995; Sander & Putnam, 2010; White & Kaufman, 1997) because many scholars believed that schools functioned in a mostly uniform way as a reflection of existing socio-economic conditions, and even if there were disparities in the school-effect on achievement, they were minimal (Durkheim, 1977; Jencks, 1972).

This widely shared belief meant that much of the research in the 1980s, 1990s, and early 2000s addressed out-of-school influences on achievement including social class, social networks, and community interaction based on different degrees of cultural and social capital (Marsden, 2005). This 30-year trend in the research may have tacitly acknowledged the ways in which students' educational experience differed, but much of the research fell short of suggesting ways in which students' outcomes could be improved by addressing the systems inside of schools, over which educational decision-makers have more direct control when compared to the macro-level influences, including housing patterns, legislation, litigation, and other large-scale influences on learning

Coleman (1966), himself, cautioned his audience to acknowledge that students do not experience school in the fragmentary way in which it was measured in the report, and that between school differences would likely be minimized based on the design of the study. Almost 40 years later, Hanushek, Rivkin, and Kain (2005) responded to Coleman's research by establishing significant between-school differences that outweighed the effect of social

background on school performance. Coleman's results would not entirely disagree with Hanushek et al., especially as Coleman suggested that students from minority groups, particularly Hispanic and Black students, demonstrate more sensitivity to inside-of-school influences on achievement, including the people, places and resources they encounter, than their Asian and White counterparts. Coleman's observation that minority students are more influenced by school resources preceded the third hypothesis in Urie Bronfenbrenner's (1994, 1999) Bioecological Systems Theory, which suggests that when students have continuous, reciprocal interactions of increasing complexity, which they have not had in other environments, their potential to actualize innate talent is much greater than those who have had more consistent access to the same interactions. It would appear the notion of addressing how schools play a part in students' outcomes was present even as early as 1966, but the outside-of-school influences gained more favor in the research on the achievement gap (Acar, 2011).

Despite these acknowledgments about the nature and power of inside-of-school influences on achievement (Bronfenbrenner, 1994, 1999; Coleman, 1966; Hanushek et al. 2005), especially for minority students, Arum (2000) noted that by the end of the 1970s, most sociologists did not attribute influence on achievement to the variation in the ways in which schools taught students. Bourdieu (1986), Bourdieu and Passeron (1990), Coleman (1988) and others began to research the interaction between communities and schools based on capital theories from economics, and arrived at the theoretical concepts of cultural and social capital. Since the 1980s, this theoretical conception of the relationship between schools and communities has been used as a foundation for research on how to address achievement gaps based on how students' familial and social networks are built, and how they interact with the school. The vast majority of this research addressed parent-student interactions based on social class and race

(Lareau, 1987), and how these interactions influenced school achievement, but fell short of addressing how schools could interact more productively with students who brought different types of background experience and resources to school (DiMaggio, 1982; Farkas et al., 1990; Huang & Liang, 2016).

Bourdieu (1986) defined cultural capital as understanding the norms, behavior, and language of the dominant culture, and that possession of cultural capital differed between classes. Coleman's (1988) definition of social capital focused more on interactions and changes in the relationships among persons that facilitate action (Acar, 2011). This understanding of capital reconciles the economic understanding of capital as rational self-interest with the sociological understanding that behavior is shaped by social norms, which arise from obligations between individuals. Hence, social capital can be thought of in terms of individuals acting within a relational framework to achieve a desired end. These interactions can take place within and between families, workplaces, religious communities, and any other organization in which there are obligations to a group that shares information and creates norms and sanctions for desired behavior, including schools. Although Coleman and Bourdieu focused predominantly on how these resources are created outside of schools, others have made the case that creating capital can be done within schools, and doing so can help positively influence achievement (Black et al., 2008; Criss et al., 2002; Fletcher et al., 1995; Huerte & Watt, 2015; Huerte, Watt, & Butcher, 2013; Kinderman, 2007).

As an example, Coleman (1985) used Harlan County and Hyde Park as neighborhood examples of parental social networks that facilitate action on behalf of their children's education. These neighborhoods are organized around kinship ties and professional ties respectively. Parents and children, and parents of different children interact with one another frequently within

the community, which creates a closed system in which multi-level relationships can be used to assert influence on behalf of its members. Coleman (1987) also tested the degree of interaction between parents and students and its influence on graduation rate. The difference between a child with two parents, one sibling and an expectation to go to college versus a child with a single parent, four siblings, and no expectation to go to college yielded a 22.5% difference in dropout rate. Putnam (1995) and Sander and Putnam (2010) later detailed the general reduction in social capital in the United States, and similar to Coleman, believed that the more fragmented communities became, the less success students from those communities would experience. Coleman also suggested that this type of close-knit, community structure is becoming less common over time, and therefore, a system to sustain the relations that underlie social capital and its exercise are necessary, but not easy.

Coleman's claim in 1987 reflects the findings in the ETS report, *The Perfect Storm* (2007) as well as findings by Putnam (1995) and Sander and Putnam (2010), which all reiterated the decline in social capital. In their thinking, the decline continues at the beginning of the 21st century, and has resulted in a shift in responsibility for developing students' capital to institutions, especially schools, rather than homes. Sander and Putnam (2010) acknowledge a brief rebound in community involvement post-9/11; even so, they argue that organizations outside of the home will likely play a more dominant role in cultivating the attitudes and habits that underlie academic success.. Bronfenbrenner (1990) and Humphreys (1991) suggested this shift in responsibility for developing students' capital lies with schools, which serve as the major transition between adolescence and adulthood. This is especially true when the trend is for adults to join more professional organizations than civic organizations, which put them in networks outside of their communities, which does not correlate to a strong increase in the type

of social closure that supports student success (Coleman, 1987; Putnam, 1995; Sander & Putnam, 2010). Although the dwindling presence of social connection within communities appears to continue unabated, for students, some of the fragmentation may be reduced by connecting them to supportive social and academic networks inside of schools that are situated to their academic and social well-being (Mayer, 2008; McKenzie & Scheurich, 2004; Miretsky et al., 2016; Newman et al., 2007; Pugh & Tschannen-Moran, 2016).

The result of Coleman's research (1985, 1987, 1988) placed emphasis on how parents interact with children and with other parents and how these relationships influence school performance. As an extension of this work, Lareau (1987) and Desimone (1999) explored the difference in class-based parent interactions with schools based on the interrelationships in a working-class and a middle-class school. Working class parents tended to leave teaching to schools whereas middle class parents supplemented teaching with additional instruction at home. The number of relations between parents and students was higher in middle class homes and the relationship with school was reciprocal and interdependent—what the school expected to happen at home largely did. This result coincides with Bronfenbrenner's (1994; 1999) proposition that the degree and power of proximal processes underlie human development. The more reciprocal interactions of increasing complexity a child has with others over time, the more they will develop intellectually. This illustrates Coleman's (1985) argument about the degree to which parent-child interaction in the home and within a closed community supplements success at school. One way of addressing this imbalance is to increase the time students spend on academic work at school, including the amount of interaction they have with peers, teachers, and other support staff as it is oriented to achievement (Bronfenbrenner & Morris, 1998, 2006).

Although there appears to be a difference in the degree to which parents of different social classes and races are involved with monitoring homework and involved at school (White & Kaufman, 1997), Jeynes (2007) found that parental involvement has a positive correlation with student academic outcomes despite race ($r=0.42\text{-}0.49$, $p<.001$), with parental expectations showing the strongest correlation with achievement ($r=0.88$, $p<.001$). This finding aligns with Desimone (1999) who found the same relationship between home involvement and influence at school. Both studies highlighted the degree to which parent involvement influences achievement. Further, Huang and Liang (2016) and Jeynes (2007) both concluded that parental expectations outweighed all other factors influencing school achievement, which reiterates the power of embodied cultural capital in Bourdieu's (1986) theoretical conception of how capital is unevenly distributed and exists at higher rate in middle and upper social class homes.

The strength of these findings appears to substantiate other studies, which suggest that a closed network with common norms and expectations tends to increase social capital, which can be utilized by students and increase academic achievement (Coleman, 1988; Coleman & Hofer, 1987; Huang & Liang, 2016). While this is most often done in the home, other researchers (Newman, Myers, Newman, Lohman, & Smith, 2000; Stanton-Salazar & Spina, 2005; Walker, 2000) have found that for high school students, peer relationships formed in school can mediate the effect of home-based differences. Exposing students to peers who are academically focused may help build the kind of capital that is normally associated with outside-of-school networks. Although school-home partnerships remain important and relevant, expectations for performance and a homework-monitoring system, including tutoring, can be accomplished in a comprehensive, inside-of-school academic support system (nms.org, 2017). School-based support systems for students' academic and social success are not meant to dismiss the influence

of outside-of-school factors on achievement. However, support programs that are designed to open access to rigorous courses with targeted support may help address the imbalance in access to academic resources based on social background that have arguably underwritten achievement gaps since school integration efforts began in the middle of the twentieth century (Hanushek et al., 2009; Henderson, 2004; Jackson et al., 2016; Ladson-Billings, 2004.)

Summary of Outside-of-School Factors and Student Achievement

Sociological research and theory originating with Bourdieu (1971, 1986) and with Coleman (1966, 1987, 1988) and more contemporary studies of how social background influences academic achievement (Acar, 2011; Israel et al., 2001; Putnam 1995; Sander & Putnam, 2010), and how social class interacts with school context (Bourdieu & Passeron, 1990; Dimaggio, 1982; Farkas et al., 1990; Horvat et al., 2003; Jaegar, 2011; Jeynes, 2007; Lareau & Horvat, 1999; Sonnenschein et al., 2014; White & Kaufman, 1997) has established the importance of a student's social capital inside the home and in organizations that support them outside of the home (Coleman & Hoffer, 1987; Huang & Liang, 2016; Sullivan, 2001). At the same time, the degree to which social and human capital is distributed in relationship to schools is often the result of macro-level influences, which are difficult to control. This is evident in the difficulty of integrating schools since *Brown* (Denton, 2001; Diamond, 2006; Ladson-Billings, 2004,) and financing schools at equitable levels (Jackson, Johnson, and Persico 2016; Lafortune, Rothstein, & Schanzenbach, 2016) to give every student enough resources in order to succeed (Chambers, 2009; Ladson-Billings, 2006, 2007). However, much of this research remains on the periphery of how the organizational systems and individuals inside of, and more directly related to schools, affect students' achievement, including peers, teachers, time on task, and content. These are factors, which can be changed more directly with policy and decision-making, and

may both increase students' achievement and mediate the effects of social background on achievement. I explore how these within school systems influence student achievement is in the next section.

Inside-of-School Influences on the Achievement Gap

More recent research efforts have focused on the resources available to students inside of school in relationship to their achievement. This includes the influence of peers (Criss, Pettit, Bates, Dodge & Lapp, 2002; Fletcher, 1995; Hanushek, Kain & Rivkin, 2009; Kinderman, 2007; Maynard, Beaver, Vaughn, DeLisi & Roberts, 2014), teachers (Lankford, Loeb, & Wyckoff, 2002; Miller, Ramirez & Murdoch, 2017; Riconscente, 2014; Rivkin, Hanushek & Kain, 2005; Vega, Moore & Miranda, 2015), and professional development, content, and tutoring on achievement (Desimone, 2009; Dufour, 2004; Hirsh, 2015; Kennedy, 2010; Meissel, Parr, & Timperley, 2016; Olson, Matuchniak, Chung, Stumpf & Farkas, 2016; Opfer & Pedder, 2011; Stoll, Bolam, McMahon, Wallace & Thomas, 2006). This moves beyond the capital research conducted by educational sociologists to consider how specific educational inputs relate to achievement. In this research, an education production function is used to understand how inside-of-school factors, including human and financial resources, relate to different achievement outcomes (Clotfelter, Ladd & Vigdor, 2007; Hanushek, Kain, & Rivkin, 2004; Hanushek & Rivkin, 2012; Hanushek, Rivkin & Schiman, 2016; Jackson, Johnson & Persico, 2016; Lafortune, Rothstein & Schanzenbach, 2016). These researchers built on the work done by Coleman and others by exploring influences beyond the neighborhoods in which students reside, and specifically the inside-of-school factors influencing achievement. Much of their research builds on the idea of creating high-functioning communities within schools to support achievement much like Coleman and others identified the need for high-functioning

communities outside of the school to increase achievement. The two research methods identified factors influencing achievement from different locations. While the economic researchers acknowledged inside-of-school influences, and the sociological researchers acknowledged the outside-of-school influences, neither fully blend the interacting influences together into a comprehensive model. That said, the inside-of-school research does appear to question the strength of the outside-of-school influences Coleman highlighted and provide some hope that school policy change may result in higher achievement for underserved groups of students.

Peer Influence on Student Achievement

Students themselves admit their peers are a potential barrier to academic achievement, and that when peers come to school and focus on issues unrelated to academics it is distracting (Vega, Moore, & Miranda, 2015). The opposite has also been found in research. Peer relationships and acceptance has been shown to increase engagement, mediate adversity at home, and increase achievement. Students who maintain peer relationships with other students whose parents are perceived to have high expectations, and exert a higher level of authoritativeness, have been shown to positively influence grade point average, time spent on homework, and academic competence (Fletcher, Darling, Dornbusch, & Steinberg, 1995). Furthermore, when testing proximal and distal influence, the authors discovered that distal influence—a peer's influence on another peer as a proxy for their parents' authoritativeness—had more of an effect than direct interaction with parents. Thus, peer influence within schools may have a more profound effect on achievement than interfamilial relationships outside of school (Desimone, 1999; Horvat et al., 2003; Lareau & Weininger, 2003).

This appears to especially be the case for high school students whose school-based intellectual communities provide academic support and mediate negative peer influence on

achievement (Walker, 2000). In Walker's study, students reported that their peer group members competed for the highest grade in the class, but at the same time offered a supportive environment to get extra help. Newman, Myers, Newman, Lohman, and Smith (2000) echo these findings in their study of high achieving minority students. When comparing high performing and low performing students, 54% of high performers mentioned peer influence on achievement compared to just 22% of the low performers, and high performers were more likely to cultivate friendships inside the school related to school work than low performers whose relationships were often formed outside of school. The single highest influence according to the high performers was work ethic. No relationship between work ethic and peer group was explored, but the difference in the degree to which peers influenced achievement between high and low performers appears to indirectly indicate a connection. This distinction also echoes students' response to peer influence in Vega et al. (2015).

Kinderman (2007) studied the connection between peer groups within a population of sixth graders and the degree to which they engaged in school and found that once students selected a highly engaged peer group, their engagement tended to grow over time. The opposite was also true. If students selected a disengaged peer group, their engagement either did not improve or actually went down over time. Tellingly, even with a 40% change within peer groups, homogeneity was maintained, which suggests that the way in which students select peer groups may be based on finding peers whose parents have similar expectations. Again, the role of expectations on a student's peer selection and engagement appears to be a common foundation for academic success. Both Fletcher et al. (1995) and Jeynes (2007) identified connections between peers, parents, and expectations.

Finally, Criss, Pettit, Bates, Dodge, and Lapp (2002) explored the connection between peer acceptance and friendship, and its ability to mediate adversity at home, including ecological disadvantage, violent parental conflict, and harsh discipline. Across gender and ethnicity, peer acceptance and friendship mediated adversity at home and helped students minimize the degree to which they externalized behavior at school that reflected their adversity at home. These findings are consistent with Stanton-Salazar and Spina's (2005) findings who discovered that positive peer relationships helped mediate stress on teenagers arising from sources outside of school. While Criss et al.'s (2002) study was done amongst a group of kindergarten students, their findings appear to parallel student self-reported perceptions of peer influence on academic behavior and engagement, which suggests that peers play a critical role in giving students support at school (Fletcher et al., 1995; Newman et al., 2000; Walker, 2000; Vega et al., 2015). Collectively, the role of peer influence in relationship to engagement, achievement, and mediation of adversity may help explain other findings on the degree of peer influence on students' academic outcomes.

Hanushek, Kain and Rivkin (2009) investigated peer influence on mathematics achievement in the Texas Schools Project, and found that within-group, Black peer influence exerted a larger negative influence on Black students' mathematics achievement than Black students' influence on other peer groups including Hispanic and White students. The authors acknowledge that housing patterns in Texas tend to isolate homogeneous groups by property wealth, including low-income Blacks. They also suggest that integrating low-income, Black students with students of other races who are both high achieving and in well-resourced schools would likely increase achievement. This notion fits students' perceptions of the barriers to academic success in Vega et al. (2015), and aligns well with Kinderman's (2007) findings on the

degree of school engagement being related to peer groups, as well as to peers who can provide academic help inside of an intellectual community at school (Newman et al., 2000; Walker, 2000). Additionally, Maynard, Beaver, Vaughn, DeLisi, and Robert's (2014) found that twins' non-shared environments—schools where peer interactions take place outside of the home—had a greater impact on academic, behavioral, and emotional engagement in school than shared environments—the homes twins shared. Maynard et al.'s analysis on the degree to which peers' influence engagement outside of the home also parallels Kinderman's (2007) findings amongst a cohort of sixth graders.

Although Coleman (1987, 1988) and others (Horvat et al., 2003; Jeynes, 2007; Lareau & Horvat, 1999; Sonnenschein et al., 2014) have argued for the primacy of outside-of-school factors influencing students' achievement to a greater degree than inside-of-school influences, including peers and teachers, the research on peer influence on adolescents' achievement and motivation appears to suggest there may be more of a balance. There is perhaps a stronger effect in high school than in other grades considering that as students age, they tend to spend less time with their families and more time with their peers both inside and outside of school. Larson, Richards, Moneta, Holmbeck, and Ducket (1996) found that fifth graders spend 35% of their waking hours with family whereas twelfth graders spend only 14% of their time with family, and take more opportunities to be away from family as they get into later adolescence. The authors especially highlighted the marked decrease in adolescents' time spent in leisure activities with family. In light of these findings, and in consideration of the research that identified strong peer influence on achievement (Fletcher et al., 1995, Newman et al., 2000; Vega et al., 2015; Walker, 2000), it appears that further research into school-based interactions at the microsystem level and how they support student development is warranted (Bronfenbrenner, 1999; Bronfenbrenner &

Ceci, 1994), especially for students who do not have strong support networks at home and in outside of school organizations (Coleman, 1985).

Teacher Quality and the Academic Gap

Beyond the research on peer influence on academic achievement, research also suggests that interactions between students and teachers have a measurable effect on achievement. This makes sense in light of Larson et al.'s (1996) findings on the decrease in time spent with family as students age, and the increasing influence of peers on academic outcomes (Fletcher et al., 1995; Newman et al., 2000; Walker, 2000). While Larson et al. (1996) suggested that late adolescent students spent more time with their peers outside of the home, it also indirectly suggests that students spend a larger percentage of time with their teachers as they age since approximately seven of their waking hours are spent at school, and there is over a 50% reduction in hours spent with family across adolescence overall. Just as peer influence increases over time, there may be an analogous effect as adolescents spend a higher percentage of their time outside of the home, a large portion of which is in a classroom with a teacher. The degree of interaction between a teacher and student, and students and their peers in an academic environment also has the potential to increase achievement by providing the attitudes, efforts, and motivation which underlie achievement (Bronfenbrenner, 1994; Bronfenbrenner & Ceci, 1994; Coleman, 1985, 1987). Much of the research on teacher efficacy, and student perceptions of their teachers who exhibit high self-efficacy, suggested that effective teachers often deliver affective and academic skills simultaneously (Cantrell et al., 2013; Miller et al., 2017; Riconscente, 2014; Vega et al., 2015). It stands to reason that the quality of a teacher's affective and academic instruction has an effect on a student's academic outcomes.

In response to the Coleman Report (1966), which found that between school variance in achievement was low, and therefore students' outside of school experiences tended to exert a greater influence on achievement, Rivkin, Hanushek, and Kain (2005) countered the popular conception in their study, and claimed that the between teacher difference, and by extension, the between school difference does matter for achievement. Their study found differences between teachers and schools that influenced achievement and ruled out the differences being attributed to family background or outside-of-school influence. The authors point out that for every standard deviation increase in teacher quality as measured by value-added on standardized test scores, students experience a 0.11 standard deviation and 0.09 standard deviation increase in mathematics and reading respectively. This suggests the difference between the lowest quality and highest quality teacher is vast. Clotfelter, Ladd and Vigdor (2007) extended Rivkin et al.'s (2005) findings and suggested the difference between a teacher who scores two standard deviations below the mean and two standard deviations above the mean on the content licensure test corresponds to a 0.13 standard deviation difference in mathematics achievement. Clotfelter et al. also found strong influences on achievement in relationship to full licensure versus lateral pathways to licensure, years of experience, and National Board Certification as a proxy for effective teaching. Measured in terms of persistence and earnings, Hanushek and Rivkin (2012) found that a one standard deviation increase in teacher quality corresponded to a $20,000 increase in lifetime earnings for a student or $400,000 for a class of 20 students. Whether measured in terms of achievement or earnings, the results suggest there is wide variation in the quality of teachers within and between schools, and that inside-of-school interactions with peers and teachers can make a difference in achievement.

The question follows whether different groups of students have differing access to high quality teachers. According to Rivkin et al. (2005), students having a succession of teachers who are above average holds the promise of closing the achievement gap. However, this assertion is predicated on the most underserved students being taught by the most highly qualified teachers, and based on the research, this simply is not the case (Diamond, 2006; Chambers, 2009; Hanushek, Kain, & Rivkin, 2004;). Examining the distribution of teachers in New York, Lankford, Loeb, and Wyckoff (2002) discovered that the most experienced teachers, who attended the most competitive undergraduate programs, who were the most credentialed, and who scored the highest on content area certification tests, taught in the most affluent districts in the state. Conversely, students in urban environments in New York, where many underserved students tend to reside, were taught by less experienced, less credentialed, and less high achieving teachers. As an example, non-White and poor students, and English Learners were more likely to have non-certified teachers with few years of experience (17%) than their more affluent, White peers (4%). Lankford et al.'s findings suggest that the students who need the highest performing teachers get access to them the least.

This assertion is backed by studies of the effect of teacher turnover on student achievement. Rivkin et al. (2005) found that the lower the quality of teacher, the higher the attrition rate, and that turnover has a large effect on student achievement. Coupled with Lankford et al.'s study, this suggests that low quality teachers are most likely to move schools, and when they move, they are likely to move to schools where students are underserved and lower achieving. This arguably extends the achievement gap because teacher turnover has been found to more adversely affect lower achieving schools, even though bad teachers may leave (Hanushek, Rivkin, & Schiman, 2016). On the contrary, teachers with the most stability tend

also to be of higher quality, and their longer-term commitment translates into better achievement outcomes for students. In an earlier study, Hanushek, Kain, and Rivkin (2004) found that teacher turnover also relates to race and achievement, with many teachers motivated to leave schools with higher percentages of minority and low achieving students. This may help explain Lankford et al.'s findings about the distribution of higher quality teachers in the suburban parts of New York. Salary is also an issue in this study, but Hanushek et al. (2004) suggested urban schools with lower achieving, higher minority student populations would have to pay between 20-50% more to retain teachers at a higher rate, which is not currently feasible on a large scale.

Professional Development and The Achievement Gap

Since teacher quality has been shown to influence student achievement, and the most underserved students tend to be taught by lower quality teachers, improving underserved students' outcomes may be accomplished through professional development rather than salary incentives and other factors that have shown to have little effect on teacher distribution. Research suggests that the features, processes, and types of professional development relate to increases in student achievement (Desimone, 2009; Hirsh, 2015; Opfer & Pedder, 2011). Desimone (2009) proposed a framework for understanding the key features of professional development: content focus, active learning, coherence, duration, and collective participation. In short, Desimone argues that a focus on content and how students learn in conditions that build on teachers' existing practice and beliefs over time in a learning community holds the promise for increasing student achievement.

Opfer and Pedder (2011) questioned the viability of Desimone's model and suggested that it is oversimplified and does not account for the differences in the ways in which teachers collaborate and how those interactions are situated to both content and other objectives. This

argument relied heavily on Lave and Wenger's (1991) work on apprenticeships and how they rely on the interactions between experts and novices to increase skills. However, Opfer and Pedder pointed out that not all teachers are beginners when they enter a learning community, and individual characteristics, including competency and experience, affect the degree to which instruction changes as the result of professional development. Personal characteristics and the environment play a role in the degree to which teachers change. Not all environments are equally suited to changing practice either. However, in a review of the research on professional learning communities (PLCs), Stoll, Bolam, McMahon, Wallace and Thomas (2006) emphasized that despite the composition of a learning community, if oriented to student learning in context of teaching practice, learning communities hold the promise of increasing teaching capacity and student learning. Richard Dufour (2004) helps clarify Stoll et al.'s claim by suggesting that external norms create opportunities for reflection, which often underlie change in teaching practice. In this sense, normative data that reflects students' learning in response to changes in teaching practice help sustain the quality of a PLC over time. Dufour (2004) and Stoll et al. (2006) help allay the concerns identified by Opfer and Pedder (2011) when they highlighted the necessity of connecting student learning data to teaching despite the experience and competence of teachers within the community of practice. This clarification relies on the assumption that even effective veteran teachers need continual job embedded professional learning because they face a different set of students each semester or year. This is particularly the case when teachers are working with students who have been underserved.

In light of these findings, other researchers have studied the relationship between professional development programs and student achievement (Hirsh, 2015; Kennedy, 2010; Meissel, Parr, & Timperley, 2016; Olson, Matuchniak, Chung, Stumpf & Farkas, 2016), and

many of these programs exhibit the features identified in the work of Desimone (2009), Opfer and Pedder (2011) and Stoll et al. (2006). Professional development that is site specific based on student need, that honors teachers' assets, and is based on challenging curriculum, has been shown to make an impact on literacy (Kennedy, 2010). Kennedy's findings echo Desimone's emphasis on content, active learning and coherence in that teachers situate their professional learning to students' needs in context of their classroom experience. The result was 0.05 standard deviation increase in literacy achievement between first and second grade that was significant and larger than could be expected based on previous scores ($p<.0001$, $d=1.29$), and a reduction of the students achieving below the tenth percentile in reading by 75%.

Olson et al. (2016) highlight similar results in their work on the relationships between professional development and achievement for Latinos and English Learners (ELs) in grades seven through 12. Using an experimental and control group to measure the efficacy of the Pathway Project instructional framework on student achievement, the authors found an 18.4% difference in writing achievement between the experimental and control group overall ($p<.001$), a 37.8% difference for ELs ($p<.01$), and a 16.39% difference for students receiving free and reduced lunch ($p<.05$). Collectively, these findings suggest that targeted professional development situated to students' needs that is based on viable content can influence achievement for a wide array of underserved groups and reduce achievement gaps. Olson et al.'s study of professional development also highlighted the role of cognitive strategy instruction, partnership with the National Writing Project to sustain a PLC, as well as analysis of student work, all of which also fits within the frameworks of effective professional development as outlined by Dufour (2004), Desimone (2009), and Opfer and Pedder (2011).

In another study, the professional development of four cohorts of teachers were monitored to explore the relationship between professional learning and achievement on a broad scale (Meissel et al., 2016). In their study, the professional learning was predicated on Desimone's (2009) process-product theory of professional learning based on the five aforementioned features. The results align well with those of Kennedy (2010) and Olson et al. (2016). Specifically, that professional learning focused on student data, in partnership with a literacy leader, prompted students to increase their rate of achievement in comparison to non-Pathway Project schools (two to three times faster in writing and one to two times faster development in reading). Like the other initiatives, these achievement returns were based on teachers working together on content with a focus on student outcomes, and modification of practice in light of student need, which resonates with Dufour (2004) and Stoll et al.'s (2006) assertions about what makes professional learning effective. The relationship of professional development and student achievement suggests that the time teachers spend outside of their classrooms engaged with one another and focused on student learning outcomes has the possibility of strengthening the classroom-based interactions between students and teachers that influence learning. When the classroom system is well aligned to the school system, which is well-connected to the type of professional development teachers enact, possibilities for increasing achievement appear to be greater based on the systems alignment and interaction.

Summary of Inside-of-School Factors and Student Achievement

The inside-of-school factors influencing student achievement are primarily associated with the social interaction of peers, teachers and other adult mentors who influence students' educational development in classrooms, and in other structured organizational contexts. Additionally, student achievement appears to benefit from teacher access to professional

development programs that provide access to rigorous curriculum, to learning communities which support the teaching of higher order cognitive strategies for learning, and processes that help teachers modify instruction to provide extra support based on the patterns they observe in their students' work. These within classroom interactions for students, and outside-of-classroom supports for teachers appear to make a particular difference for underserved students who may not have been exposed to all of these variables underlying achievement as consistently as their more affluent counterparts. However, there are programs, which contain these elements, and whose purpose is to increase academic outcomes for underserved students and students who may not self-select into rigorous coursework during their secondary school experience. In the next section, I link the inside-of-school factors discussed above to a program that contains those factors and is concentrated on increasing achievement for underserved students.

AVID and Inside-of-School Influences on Achievement

Many of the inside-of-school factors influencing student achievement, including peer and teacher interaction, rigorous curriculum, and modified instruction based on student outcomes, are part of the Advancement Via Individual Determination (AVID) model, which was founded by a California teacher in 1980 and has since expanded to 4,000 schools, and which supports primarily underserved students when they access more rigorous curriculum, including AP and IB programs (avid.org). The results of program evaluations appear to support AVID as a program for helping to close achievement gaps (Adelman, 2006; Contreras, 2011; Gandara & Bial, 2001; Mehan, Hubbard, Lintz, & Villanueva, 1997). Numerous studies evaluate specific features of AVID and highlight the role of institutional support for adult mentors and teachers to track progress over time, building supportive peer networks, providing outside support and tutoring, which increases success with rigorous content, and acknowledgement of the interplay between

cultural background and achievement (Black, Little, McCoach, Purcell, & Siegle, 2008; Chennault, & Fraynd, 2016; Mayer, 2008; Pugh, & Tschannen-Moran, 2016; Radcliffe, & Stephens, 2008; Stanton-Salazar, & Spina, 2005).

In an early study addressing the effectiveness of AVID programs in the San Diego Schools, Mehan et al. (1997) identified several features of the program that would become the subject of several successive studies on AVID programs elsewhere (Adelman, 2006; Contreras, 2011; Gandara & Bial, 2001). The programmatic features that appeared to have the most positive influence were the length of time a student was enrolled in AVID, the AVID elective program that made the hidden curriculum explicit and provided tutoring, and socially scaffolded, supportive peer and teacher relationships. Black and Latino students in this program enrolled in college at rates far exceeding the state and national averages (55% and 43% for AVID students versus 33% and 29% nationally). The authors argue this outcome suggests that institutional support for underserved students can mediate the effects of social disadvantage. These findings are consistent with Coleman's (1966) assertion that minority students respond more strongly to inside-of-school supports than their counterparts. Additionally, it lends support to the notion that programmatic supports for students and teachers can provide a powerful influence on students and increase teacher efficacy in underserved areas (Diamond, 2006; Chambers, 2009; Hanushek et al., 2004; Lankford et al., 2002).

Gandara and Bial's (2001) research strengthened Mehan et al.'s (1997) findings in their national study of programs designed to increase achievement amongst underserved groups. AVID was one of the school-based programs studied. The authors found that the number one strength was an adult mentor, which was closely followed by access to rigorous content and tutoring, long-term investment, and social, emotional, and academic peer support. This latter

finding extends Vega et al.'s (2015) assertion about the degree to which peer relationships relate to achievement and Kinderman's (2007) findings on the degree to which a peer group influences achievement over time. When AVID students are supported by socially scaffolded peer and adult relationships situated to academic achievement, the degree to which peers affect achievement may potentially increase. This also echoes Walker (2000) and Newman et al.'s (2000) findings that identified intellectual communities can mediate negative influences on academic achievement. Additionally, Stanton-Salazar and Spina (2005) and Contreras (2011) found that peer relationships that offer reciprocal support for social, emotional, and academic engagement can mitigate the effect of stress on mental health in teenagers, and that effective peer networks appear to provide developmental gains. While Stanton-Salazar and Spina's study was not specifically addressing AVID programs, Contreras did, and the combined results of their research align well with prior studies on the degree to which supportive peer relationships can both mediate negative outside influence, and increase academic achievement.

In a study by Adelman (2006) for the U.S. Department of Education, which closely relates to Mehan et al. (1997) and Gandara and Bial (2001), the author reviewed the high school histories of students who successfully completed post-secondary education. Among the author's findings, academic intensity counted more than anything else in predicting college success, and grade point average (GPA) closely followed. The measure of academic intensity included completion of more than one Advanced Placement course, and completion of at least Algebra Two and credits in laboratory science, foreign language, and history at a minimum. Adelman also considered demographics in his study, and noted that Latino and the lowest SES quintile students do not routinely have access to the type of courses needed to sustain academic intensity. This extends the "receivement gap" argument made by Chambers (2009) about the degree to

which underserved students have access to rigorous academic content and teachers as well as the argument for recruiting students into rigorous programs who may not otherwise enroll because of social background factors (Miretsky, Chennault, & Fraynd, 2016).

However, when underserved students had access to the resources of their more affluent peers, the social background logic model in Adelman's study did not attain significance, which suggests that when academic supports are put in place, students from underserved backgrounds can overcome the obstacles and achieve at a level similar to their more well-resourced counterparts. This was particularly reflected in the effect size of academic resources (d=0.64, p=.01) compared to the effect size of SES (d=0.30, p=1.0) on enrollment in college. While Adelman's review of students' high school histories did not directly focus on support programs for underserved students, AVID's support structures arguably increase access to the resources Adelman argues are necessary for meeting higher academic expectations, which could increase the rate at which underserved students get access to the resources necessary to become successful in college.

In context of national studies on program effectiveness based on content and relationships, many researchers have completed more targeted evaluations of AVID programs, and answered Gandara and Bial's (2001) call for more rigorous studies using control groups to compare effects on populations of students who received supports and those who did not. While Mehan et al.'s (1997) study did this to a certain degree, more contemporary studies have extended those findings.

Among these studies is the work by Huerta, Watt, and Butcher (2013), and Huerta and Watt (2015). Huerta et al. (2013) addressed the relationship between longevity of enrollment in an AVID program and college success. They found the program eliminated barriers, and the

longer a student was enrolled in the program, the more likely they were to be prepared to attend college and be successful once there. In particular, students who enrolled in AVID in middle school completed more college requirements than their high school only counterparts (93% versus 89%), and took more AP courses and exams (78% versus 71%). Huerta and Watt's (2015) later study builds on this trend in their research. AVID students who attended a four-year university rather than a community college had significant differences in high school achievement. University students completed one more AP course and their GPAs were almost half a point higher than their community college counterparts ($p<.001$). Furthermore, they found university students using more peer support and interaction to increase achievement whereas community college students often used strategies from AVID, like note taking and organizational techniques. These findings reiterate the necessity of having positive and supportive peer networks in place to support achievement beginning in early secondary school and extending through college (Newman et al., 2000; Walker, 2000).

Huerta et al. (2013) and Huerta and Watt (2015) built on Mehan et al.'s (1997) earlier program evaluation and illustrated that untracking classes provided more access to rigor and better social support from peers and teachers. The findings about length of enrollment and access to rigor also indirectly strengthens Hanushek et al.'s (2016) conclusions about the relationship between teacher stability and achievement, particularly how teacher turnover affects underserved students to a greater degree than their more well-resourced peers. Llamas, Lopez, and Quirk's (2014) qualitative findings also strengthen the connection between stability and achievement. The authors argue that institutional structures that systemize peer assisted learning, and build community with a smaller cohort of teachers over time, were related to achievement motivation. Students particularly noted the consistency over time and the feeling of classroom

community as a result of the stability of the AVID program. Their ability to succeed in rigorous coursework was linked to structured academic preparation with their peers and teachers in a controlled classroom environment over a longer period of time than most of their non-AVID peers experienced. This relationship between institutional structures that support classroom and school-based community building reiterates the findings in the larger program evaluations done by Gandara and Bial (2001), Mehan et al. (1997), and Contreras (2011). Further, in Llamas et al.'s quantitative findings, the effect size for school support (d=1.81) and meaningful participation (d=1.16) were noted. These differences were both large and positive for AVID students in comparison to their non-AVID peers. These two measures, in particular, back Vega et al.'s (2015) review of students' perceptions about what is necessary to bridge the achievement gap as well as the role of student and teacher social networks that are both stable and situated to academics (Kinderman, 2007; Newman et al., 2000).

In a separate study, Radcliffe and Stephens (2008) found that consistent tutoring from pre-service teachers in grades eight through 11 corresponded with greater aspirations to go to college and a better understanding of the necessary work in order to qualify. Radcliffe and Stephens and Huerta et al.'s (2013) findings about length of time in an AVID program, access to increased rigor and completion of more college requirements and AP courses extends Adelman's (2006) conclusions about what kind of academic intensity is required to be well-prepared for post-secondary academic work. Adelman established a pattern of minimally rigorous coursework to be competitive in college, and the AVID program analyses appear to have identified ways of providing institutional scaffolding for access to rigorous courses and scaffolded academic support once enrolled in them.

In a set of studies on student effects as a result of enrollment in AVID programs, Black, Little, McCoach, Purcell, and Siegle (2008) and Pugh and Tschannen-Moran (2016) came to slightly different findings. Black et al. found significant differences between the AVID and control groups for time spent on homework (M_{AVID}=3.54, $M_{Comparison}$=2.50, p=.024), having college plans (M_{AVID}=6.21, $M_{Comparison}$=5.61, p=.019), and percent enrollment in algebra in eighth grade (AVID=100%, Comparison=47%, p<.001). The authors note the modest difference; yet, the significance of enrollment in algebra in eighth grade should not be underplayed since Adelman's (2006) academic intensity measure included completion of algebra two by the end of high school, and a student who starts with algebra in eighth grade is likely to be able to take Calculus while still in high school. Beyond the quantitative results, Black et al. note their qualitative survey data, including individual interviews and focus group discussions that indicate universally positive perception of participation in an AVID program, especially as it related to parent perception of their child's improved academic habits and expectations for academic success.

Pugh and Tschannen-Moran (2016) cited Black et al.'s (2008) findings in their own study of AVID, and also found positive correlations to self-efficacy for academic achievement and participation in AVID, which reflect Black et al.'s finding about improved self-concept in English and language arts courses. Responding to AVID's influence on GPA, Pugh and Tschannen-Moran found a significant, positive relationship that Black et al. found in middle school students in their study, but others did not find (Watt, Huerta, & Lozano, 2007). Of note, in Pugh and Tschannen-Moran, length of enrollment in an AVID program explained 12% of the variance in GPA beyond age and grade level for African American students. This finding is important in light of Adelman's (2006) discovery that GPA was the second most predictive

variable to successful college completion and second only to a composite variable of academic intensity. Collectively, Black et al. and Pugh and Tschannen-Moran's findings on the relationship between AVID and self-efficacy and achievement help support the programmatic elements the larger scale studies identified as important for underserved students' success (Adelman, 2006; Gandara & Bial, 2001; Mehan et al., 1997), and "suggests strategies for addressing the persistent and intractable problem of academic achievement gaps among ethnic minority and low-income students" (Pugh & Tschannen-Moran, p. 155). Mayer (2008) builds on this assertion when the author argues that programs like AVID hold the promise of creating a school-based environment that allows students who do not have supportive home environments to "rely on one another and their teachers for support and motivation" (p. 228).

Program Summary. Based on the program evaluations, there appear to be three key elements of the AVID program that help support underserved students and that may help begin to close the achievement gap. The first and most consistent finding was institutionally supported social networks between students, and between students and teachers and outside mentors who help monitor progress and motivate students (Gandara & Bial, 2001; Stanton-Salazar & Spina, 2005). This finding highlights the role of interactions in classrooms and schools and how they can help mediate outside-of-school stress and instability. The second aspect is academic intensity (Adelman, 2006). Students in AVID programs are exposed to AP courses as well as an AVID elective course, which teaches strategies for successful completion of rigorous coursework. This helps alleviate the access problem noted by Adelman (2006) and Chambers (2009), and also provides time and academic support that may be lacking at home. A third element is long-term investment and enrollment in the program (Huerta & Watt, 2015; Huerta et al., 2013). Successive years of supportive interactions between teachers and peers situated to academic rigor

appear to provide underserved students with the resources to match their more affluent peers. This helps close the gap, and fulfill the possibility of increasing underserved students' achievement with increasing access to high quality teachers with less turnover and more long-term commitment, which was identified as a key factor in Hanushek et al.'s (2016) work on teacher turnover and how it affects underserved students more severely than their more affluent peers. Collectively, providing students with peer and adult support when accessing academically rigorous courses throughout their secondary school career appears to provide the best chance for minority and underserved students to close the gap to their peers and prepare to be successful in college or in other endeavors in life after high school.

Theoretical Orientations, The Achievement Gap, and AVID

The three highlighted features in AVID programs bear strong connections to both the sociological and economic research done on the achievement gap. Research done by sociologists like Coleman (1966, 1985, 1987), Desimone (1999), Horvat, Weininger & Lareau (2003), Lareau and Horvat (1999), and Lareau and Weininger (2003) highlight the need for students to have stable social networks that allow them to build their human capital, which tends to allow them to be more successful in school. Additionally, these sociological studies also highlight the complementary nature of home and school, and the need for homes to provide academic and social and emotional support so that students are prepared for school. In AVID programs, many of these features are built into the school day in the form of the AVID elective and socially scaffolded relationships with peers, teachers, and outside mentors. On the other hand, economic researchers highlighted the need for consistent, high quality teachers, rigorous content, and adequate financial resources (Clotfelter, Ladd & Vigdor, 2007; Hanushek, Kain, & Rivkin, 2004; Hanushek & Rivkin, 2012; Hanushek, Rivkin & Schiman, 2016; Jackson, Johnson & Persico,

2016; Lafortune, Rothstein & Schanzenbach, 2016). Students in AVID programs are exposed to AP courses, which are driven by well-vetted curriculum, course audits, and professional development for teachers. Additionally, AVID provides academic support in a separate elective course for students, which uses high-leverage literacy, writing, and note-taking strategies. Taken together, AVID addresses many of the key factors underlying academic success, which the outside-of-school sociological research and inside-of-school economic research found were lacking. These theoretical and methodological divides (Arum, 2000) appear to provide a new direction for research, which includes a more comprehensive model for studying the achievement gap, and evaluating programs that are meant to address it.

Bioecological Systems Theory as a Unifying Mechanism for Program Evaluation

Urie Bronfenbrenner's Ecological Systems Theory (1977, 1979, 1989), which initially attempted to bridge the methodological divide between naturalistic and experimental research, has evolved into Bioecological Systems Theory (BST) (1994, 1998, 1999) in the last two decades and highlighted proximal processes, the reciprocal interactions between a person and his or her environment in increasing complexity over time, as the main mechanism for human development. Bronfenbrenner's (1999) theory is predicated on three propositions and three related hypotheses, which can be used to understand the non-additive, synergistic effects of the interactions of multiple variables within and between environments on human development. Bioecological Systems Theory (BST) enables some of the elements of the sociological theories inspired by Coleman (1966) to be placed within the same theoretical confines as elements of the economic theories (Clotfelter, Ladd, & Vigdor, 2007; Hanushek, Kain, & Rivkin, 2004) and provides a more integrated method for evaluating programs like AVID and NMSI. Systems theory also creates the possibility for developing a model for enhancing student achievement

despite social background and other limiting factors. In particular, the third hypothesis in the theory is applied in order to clarify how underserved students can close the gap to their more affluent and well-represented peers, if underserved students are exposed to the interactions which underlie academic achievement. Adapted to achievement gaps, Bronfenbrenner's third hypothesis suggests that students who come from underserved areas and who are exposed to beneficial peers and teachers situated to rigorous content over time can theoretically match the achievement of their peers who have had access to strong processes in multiple environments. Many of the AVID evaluations appear to verify Bronfenbrenner's final hypothesis, and therefore also appear to strengthen the first two, particularly because as underserved students develop socially and academically, they may reduce dysfunction at home or in environments outside of the school—this notion is tied to previous research below. Below I cast program evaluation studies in light of BST in order to illustrate how theory might inform practice in schools, which seek to close achievement gaps.

Bronfenbrenner (1994) sets out five interacting systems in which interactions between persons and environments take place. The systems are defined here with reference to existing research that implicitly used the systems understanding. The microsystem is self-contained and is the primary location of interactions and includes homes, schools, classrooms, and peer networks. Huerte et al. (2013) and Huerta and Watt (2015) illustrate the microsystem effect in their exploration of how interactions within an AVID classroom over time result in more beneficial outcomes the longer a student is enrolled. This is particularly apt in understanding the AVID elective course, which specifically addresses academic strategies for success in rigorous coursework in a self-contained classroom containing a teacher and students whose interactions are reciprocal and strengthen over time as students become more fluent with academic practices.

The mesosystem is made up of more than one microsystem in which a student interacts; for instance, classroom and peer network or classroom and home. Bronfenbrenner (1999) specifically cites Fletcher et al.'s (1995) work as a mesosystem, which addressed how the authoritative nature of parenting at home tended to influence a student's peers in school so long as the type of authoritative practices of both students' parents agreed. Stanton-Salazar and Spina's (2005) work also demonstrates the mesosystem in that principled peer relationships in school were found to mediate the effects of mental stress arising outside of school; hence, interactions in one environment affected the other and reduced dysfunction (Proposition Two). Yet another example is Black et al.'s (2008) AVID evaluation. The qualitative findings suggested that when students improved on academic practices and college plans, parents' positive perceptions of their students increased. This bridge between school and the home is synonymous with a mesosystem, which contains two microsystems in which interactions between students and others takes place.

Exosystems do not contain the student, but affect him or her indirectly. For students, this is most likely a parent's workplace responsibility, but could also consist of educators who collaborate on instructional practice in relationship to student achievement, both of which indirectly influence a student's development. Bronfenbrenner's own work (1986a, 1986b), and Coleman's work on social fragmentation as a result of parents working outside the home (1985, 1987), as well as some of the economic research by Hanushek et al. (2004, 2009), which addressed why some schools lose teachers and the effect of de facto racial segregation; Hanushek and Rivkin (2012) on the distribution of teacher quality, and Hanushek et al. (2016) on teacher turnover, all illustrate how systems operating outside of schools often influence how interactions take place within them. Bronfenbrenner and Coleman highlighted the increasing incidence of

both parents working outside of the home, which reduces the number of interactions between parents and children and parent networks. What takes their place is most often peer relationships, which are not always positive nor well-monitored and can result in greater dysfunction and lowered achievement. The research in which Hanushek was involved identifies how policy, governments, and historical trends indirectly influence the current segregation and allocation of resources for different student groups. Naturally, students had no role in determining these policies and trends, yet their access to teachers, content, and financial resources are to some degree controlled by others over which they have little influence. However, it should be noted that inside-of-school systems are arguably easier to control than macro scale historical or economic trends in response to influences that reside outside of a system of which a student is a part.

This is illustrative of how exosystems, which do not contain the principle individuals or environments in which they develop, can wield a strong influence on outcomes. Further, it suggests that policy approaches, which involve modifying environments in which learning occurs, could lead to greater actualization of all students' potential, but that would require more equitable access (Bronfenbrenner, 1990; Humphreys, 1991). In response to this implication, programs like AVID and NMSI may be initial steps toward actualizing potential for students who do not typically have access to high quality teachers, rigorous content, and beneficial peer relationships, all of which could be used to test Bronfenbrenner's Third Hypothesis about the degree to which strong interactions in one environment (classroom or school) can mediate disadvantage in other environments (home or peer groups). Of note, academic support programs often place teachers in a professional development system outside of the classroom, which

positively influences student learning. The system lies outside of the environments that contain the student, yet still help support them.

Macrosystems are the overarching pattern of the previous systems and are based on cultural beliefs and practices. For instance, United States culture tends to subscribe to strong beliefs in meritocracy, rising through hard work, and rugged individualism. These macro-level beliefs inform how Americans see and use systems. While the research in this review does not directly address cultural and behavioral patterns of the larger culture in the United States, Malcolm Gladwell's (2008) *Outliers: The Story of Success* serves as a fitting example of how our popular belief in the self-made man is misinformed, yet how it still influences how most view schools and other institutions through which merit is accrued. According to Gladwell, outliers like Michael Jordan, Bill Gates, and the Beatles did not magically become great—they were in environments, which gave them access to resources and practice over time, all of which are accounted for in Bronfenbrenner's theory. Gates, for instance, had access to a desktop computer long before it was common in homes. He snuck out at night and coded for several hours uninterrupted throughout his teenage years. Gates then attended Harvard, which had more digital resources than other universities he could have attended and where he continued to code instead of going to class. What stands out here is the degree to which these individuals had interactions with others in environments, which were aligned to their eventual success. Their success looks self-made, but is the byproduct of systemic interactional and environmental advantages over time.

Finally, the chronosystem is another dimension of development and pays heed to role transitions through life, what might be called rites of passage, and how this affects development. Bronfenbrenner cites two studies to illustrate how role transitions can affect development. Elder

(1974) studied how the Great Depression and World War II affected a whole generation's development. In general, young people had to take on more responsibility early in life than they otherwise would have if there was not an economic downturn or a global conflict. According to Elder, those who entered military service at an earlier age show greater development long after their service ended (Elder, 1986), which appears to align well with Bronfenbrenner's proposition about how role expectations affect development. Military service for young men, in particular, set high expectations that lasted for the rest of their lives. In another study, Pulkkinen and Saastamoinen (1986) studied the effect of domestic instability on individuals' development from age eight to 20. The higher the rate of instability, the more dysfunction was seen later in life. The effect of instability on development was stronger than socio-economic status, which also reiterates the strength of Bronfenbrenner's assertion about the power of interactions to outweigh environmental context. In context of academic support systems, the chronosystem is embodied by the differing expectations placed on students in more rigorous academic work as well as the amount of time they are exposed to those expectations and the other supports within a support system.

Collectively, Bronfenbrenner's propositions, hypotheses, and systems provide a powerful lens through which to evaluate previous research, yet very little of the previous research in either the sociological or economic tradition has acknowledged its influence or its ability to integrate findings under a more comprehensive approach to how students develop as a result of their interactions with peers, parents, other adults, and the environments in which they learn. Mercon-Vargas, Cao, Liang, and O'Brien (2017) conducted a meta-analysis of research that uses Bronfenbrenner's theory and found that only two out of 20 studies have fully utilized the Process-Person-Context-Time (PPCT) Model in a genuine way (Benson & Buehler, 2012;

Farrant & Zubrick, 2010). The first study explored the relationship between parents, the home environment and literacy, and the second investigated how the degree of hostility in the home related to school and peer groups, which leaves specific research on the interrelationships between peers, teachers, adult mentors, content, and classrooms open for further exploration. Mercon-Vargas et al. (2017) also note that many studies allude to BST in passing or apply it conceptually instead of experimentally. Their findings build on Tudge, Mokrova, Hatfield, and Karnik (2009) and Tudge (2016), who reiterate the lack of thorough application of the theory in research, which would involve consideration of the variables in the PPCT model, and how they interact to influence human development.

This relative lack of research provides an opportunity to address how programs like AVID and NMSI can influence academic development and help close the achievement gap from a systems perspective, which builds on much of the previous research, but casts it in a new light. Employing the PPCT model in educational evaluation of the AVID or NMSI program would allow the people, content, environments and other features to be considered in a single, nested systems design to explore the ways in which systems interact to increase achievement among underserved groups. The results of an evaluation of this nature contain the potential for identifying a model, which effectively increases academic development while mediating outside-of-school dysfunction.

Summary of the Research on Factors Influencing the Achievement Gap

I began this review by defining the persistent achievement gap between non-White, lower income students and their White, more affluent counterparts based on NAEP scores in language arts and mathematics. The achievement gap was then addressed from multiple perspectives, including students, teachers, and researchers, all of whom have slightly different understandings

of its causes. Students tend to attribute the achievement gap to teachers, their peers, and access to resources (Vega et al., 2015). Teachers tend to attribute the gap to students' motivation and social backgrounds (Bol & Berry, 2005; James, 2012; Ullucci & Howard, 2015). Researchers question the very nature of the terminology used to label the gap in achievement, calling it a "receivement gap" or "education debt" (Chambers, 2009; Ladson-Billings, 2006, 2007; McKenzie & Scheurich, 2004). The differing understandings of the achievement gap were then cast in light of systemic inequalities whose foundations were two key court decisions: *Plessy v. Ferguson* and *Brown v. Board of Education* (Gooden, 2004; Middleton, 1995; Orfield et al., 2003; Smith, 2005). After outlining these cases, I discussed the challenges of overcoming inequitable access to resources, which often underlies the achievement gap (Burris & Wellner, 2005; Diamond, 2006; Ryan, 1999).

With the definition, understandings of, and historical foundations of the achievement gap established, I addressed theoretical orientations. Sociologists, beginning with Bourdieu (1986) and Coleman (1966, 1988) tended to focus on outside-of-school factors, including family relationships, social networks, and how social and cultural capital is amassed and how it influenced school achievement (Acar, 2011; Israel et al., 2001; Putnam, 1995; Sander & Putnam, 2010; Sullivan, 2001). I noted the limitations of this view of the achievement gap. Since most sociological research focused on macro-level trends, which are not feasibly changed, as evidenced by the degree of financial inequity and segregation even 60 years after *Brown*, I then considered inside-of-school factors, which are often related to economic theories of education. These inside-of-school factors included peer influence (Criss et al., 2002; Fletcher et al., 1995; Kinderman, 2007; Walker, 2000), the variation in teacher quality (Clotfelter et al., 2007; Hanushek et al., 2012; Lankford et al., 2002) and the role of professional development in

improving achievement for underserved students (Desimone, 2009; Hirsh, 2015; Kennedy, 2010; Meissel et al., 2016; Olson et al., 2016; Opfer & Pedder, 2011). The limits of the economic research were also noted. Similar to sociological theories, economic theories tend to focus narrowly on inputs, which do not acknowledge the synergistic interrelationships underlying the achievement gap (Bronfenbrenner, 1994, 1999).

Following a review of the sociological and economic research, including its limitations, I reviewed the Advancement Via Individual Determination (AVID) program (Adelman, 2006; Contreras, 2011; Gandara & Bial, 2001; Mehan et al., 1997). I established AVID as a program that unified some of the outside-of-school elements from the sociological research while also addressing the inside-of-school elements from the economic research (Huerta et al., 2013; Huerta & Watt, 2015; Llamas et al., 2014; Stanton-Salazar & Spina, 2005). After reviewing the research on AVID's overall effectiveness, which appeared to rely mainly on relationships and access to rigorous content, Bioecological Systems Theory was defined and used as a unifying theory to address how the systems within AVID interact with one another to support underserved students and close the achievement gap (Bronfenbrenner, 1994, 1999; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006).

The review closed with an overview of the application of Bioecological Systems Theory in the research, and a call for more research that rigorously applies the Process-Person-Context-Time model (Mercon et al., 2017; Tudge, 2009; Tudge et al., 2009). Of note, the academic support systems associated with the National Mathematics and Science Initiative's (NMSI) College Readiness Program, which provides supports for students similar to AVID, remains largely unaddressed in the research. I suggested the application of Bioecological Systems Theory (BST) as an evaluation tool, which could identify the systems that support underserved students,

and which holds the promise of understanding the inside-of-school factors underlying student achievement while not discounting outside-of-school realities. In this sense, BST helps address the milieu of interacting influences on achievement that the sociological and economic theories tend to address separately.

In Chapter three, I outline the research design and the two-part research question, which drives my study. I then describe the student samples and the academic support systems in the intervention schools. Following this description, I outline the independent and dependent variables, how data were collected, and analyzed. I end with the limitations of my student, my role as the researchers, and a brief conclusion.

CHAPTER 3

METHODS

Introduction

I begin this chapter by outlining the research design. Following a discussion of the research design, I describe the sample based on the quantitative and comparative nature of this study. Following this discussion, the independent and dependent variables are discussed. This leads to a brief summary of how the archival data were collected and compiled. Next, the data analysis section provides an overview of the statistical methods used to explore the odds of students passing an AP exam and earning a higher letter grade in an AP course based on social background as well as the school they attended. In the final section of this chapter, I establish my role as the researcher and end with a brief conclusion.

Research Design

In this study I used a quasi-experimental, logistic regression model to compare student achievement outcomes on AP exams and in AP courses. It included one intervention sample and one nonequivalent, comparison group sample. I included four student-level demographic variables and three school-level variables in relationship to the odds of receiving a passing exam score and earning a higher letter grade. The intervention sample attended two different high schools, one Urban and one Suburban school, where academic support systems associated with the grant were implemented over a three-year period from 2013 to 2015 to support Advanced Placement mathematics, science, and English coursework. The comparison group attended two different high schools, an Urban and Suburban school, where no grant was present, but that shared similar student populations, offered the same AP courses, and which were in close

geographic proximity to the grant schools. The four schools represent both suburban and urban students based on their locations within a large Southcentral Alaska school district

Student cohorts at the two NMSI grant schools were compared to the two non-grant, comparison schools. The two groups were compared based on three time periods: two years before the grant, the three years in which the grant was active, and two years post-grant. The regression model contained four moderator variables, including a student's ethnicity coded: White or Non-White, military mobility: no or yes, gender: female or male, and free and reduced lunch (FRL) status: no or yes. Additionally, the model contained three school-level variables including a two-factor grant status variable: No Grant or Grant, a two-factor location variable: Urban or Suburban School, as well as a three-factor Grant Years variable: pre-grant years, grant years, post-grant years. The logistic regression model returned the odds of a student earning a passing score (3-5) and receiving an A or B in an AP course based on their group membership in the above seven categories.

In an attempt to address the effect of the academic support systems associated with the grant, AP test scores and AP course grades in mathematics, science, and English courses were collected from AP Score Reports and student transcripts for two years before the grant was implemented (2011-2012), three years during grant implementation (2013-2015), and two years post-implementation (2016-2017). The research design helped explore how different student samples achieved in reference to one another as well as helping to identify achievement trends before, during, and after the grant was administered.

Shadish, Cook, and Campbell (2002) point out that using logistic regression models is becoming more common, including in the evaluation of high school education. The logistic regression models tested in this study also helped identify which student and school-level factors

were significant predictors of academic outcomes for different student groups, and may help future programs target resources where they have the potential to make the biggest difference for underserved students. Further, the results have the potential to illuminate how underserved students' achievement and access to rigorous courses might be improved upon when compared to the achievement results reported in *The Condition of Education* (2017) as well as overall enrollment analysis in *The Nation's Report Card* (2011), published by National Center for Educational Statistics. The results also provide a comparison to AVID and GEAR UP programs, which are more comprehensive than the NSMI grant implementation, but both types of intervention offer similar student supports, and provide a research base on which the results of this study have the potential to build. In particular, the support systems associated with the NMSI grant may have a different effect on student achievement in Alaska because the student demographics are different than those typical of programs in the contiguous United States. Additionally, the systems associated with NMSI are less costly, and are arguably easier to replicate in other schools. In contrast to AVID and other similar programs, the support systems associated with NMSI extend instructional time and increase professional development without adding classes during the day.

Research Question

The research question which guided this study includes a two-part question that address AP achievement outcomes, one in terms of AP exam score and the other in terms of AP course grade. The question addresses the relationship between student and school-level demographics and the odds of obtaining higher achievement outcomes. The probability of passing an AP exam and receiving an A or B in the class are identified based on a student's ethnicity, military

mobility, gender, and free and reduced lunch status as well as the grant status of the school and the time period in which students attended:

> How do student demographics and exposure to academic support systems predict achievement outcomes in terms of AP course grade and AP exam score?

Sample

A nonrandom, convenience population consisting of 3,289 students enrolled in mathematics, science, and English AP courses at four Alaska high schools was used in this study. Two of the high schools implemented the grant and two did not, which allowed for student achievement comparisons between grant schools and non-grant schools. Total Population Sampling (TPS) technique was used because omitting students who were enrolled in AP courses and took AP tests supported by the grant would leave "obvious pieces missing" and an incomplete understanding of how student outcomes were influenced while exposed to the supports the grant offered when compared to their counterparts who were not exposed to the supports (Etikan, Musa, & Alkassim, 2016, p. 3). The intervention population was based on student enrollment in high school mathematics, science, and English AP courses from 2011 to 2017 at two Alaska high schools where the academic support systems associated with the National Mathematics and Science Initiative Grant's (NMSI) College Readiness Program were implemented from 2013 to 2015. The nonequivalent comparison population consists of students enrolled in the same AP courses at two Alaska high schools over the same time period. The enrollment at each type of high school from 2011-2017 is illustrated in Table 1 below:

Table 1
AP Mathematics, Science, and English Enrollment at Four Alaska High Schools from 2011-2017

	2011	**2012**	***2013***	***2014***	***2015***	**2016**	**2017**	**Total**
Urban Grant	49	50	99	139	135	128	128	728 22.1%
Urban Comparison	137	134	103	110	133	143	178	938 28.5%
Suburban Grant	79	93	96	130	127	130	139	794 24.2%
Suburban Comparison	116	112	107	113	131	134	116	829 25.2%
Total	381 11.6%	389 11.8%	405 12.3%	492 15.0%	526 16.0%	535 16.3%	561 17.0%	3289 100%

Note. Grant schools and the years in which the grant was active are italicized.

Support Systems

The grant schools in this study differed based on the academic support systems associated with the grant. The academic support systems include one hour of after school tutoring in each AP subject per week; three, six-hour Saturday Study Sessions addressing test structure and test taking strategy; a mock exam with targeted areas of improvement for each student; yearly College Board professional development for teachers; and monetary incentives for students and teachers based on the number of qualifying scores on the end of year exam. In contrast, the non-grant schools did not have the aforementioned support systems built into their schools. Some teachers may have offered tutoring and test practice and sought professional development, but doing so was at the teacher's individual discretion and not by design nor necessarily in collaboration with other teachers in their department or building. Additionally, the teachers at the

non-grant schools did not have access to the professional development and Saturday Sessions, which all grant teachers and students did, respectively.

Both the grant and non-grant schools in this study maintained open enrollment for all students who wish to take an AP course; however, grant schools actively encouraged students to enroll in AP courses despite their academic background. As part of this effort, AP information nights were held at each school where parents and students could confer with teachers in each AP subject and review the textbooks and other materials. The program was also publicized in school newsletters and one school made sweatshirts as a way of identifying students who signed up for an AP course during the grant years as a means of visually recognizing their collective effort in more rigorous coursework. The non-grant schools did not change their regular approach to scheduling students for AP courses nor necessarily make an extra effort to draw attention to AP programs.

Ultimately, the aim of this study was to explore differences in achievement outcomes based on the differences in the school programs outlined above. Of particular interest are achievement outcomes in AP courses for students who are members of underrepresented groups, including non-White students, military dependents, and students who receive free and reduced lunch. Depending on the results, it may be possible to scale academic support systems resembling those associated with grant schools to other schools that have an interest in encouraging higher enrollment of underserved students, as well as creating academic support systems that give all students additional social and academic resources in order to meet the higher expectations of rigorous courses once enrolled.

Measures and Instrumentation

The research question in this study explores the relationship between achievement in terms of AP Exam score and grades in Advanced Placement (AP) coursework in relationship to student background and the implementation of academic support systems associated with the National Mathematics and Science Initiative's (NMSI) College Readiness Program Grant. The purpose of the grant was to increase overall enrollment, and to increase achievement outcomes for middle achievers, underserved student groups, and transient students. The independent and dependent variables outlined below were collected and consolidated into an Excel Spreadsheet by the school district's Research Analyst in order to ensure accurate reporting and anonymity for each student in the dataset.

The first independent variable in this is student ethnicity coded 0=White and 1= Non-White. Membership in Native groups was small enough that comparisons to larger minority groups and White students was not reliable; so, all non-White student groups were put into a single non-White category. This also made the model more parsimonious when reporting the odds of passing an exam and receiving a higher letter grade based on group membership.

The second independent variable is a student's military mobility, which is coded 0=no and 1=yes. Students who are considered military mobile had at least one parent who was active duty military during the year in which they took an exam or enrolled in an AP course. Although many students have parents who have separated or retired from the military and who have also experienced numerous military moves, they are not counted in the yes category.

The third independent variable is gender, coded 0=female and 1=male, and the final student-level independent variable is free and reduced lunch status, which is coded 0=no and 1=yes. For a student to receive free and reduced lunch, they must meet certain minimum income

limits and apply to receive it. Therefore, there may be more students who are eligible than who are reported in the sample.

The first school-level variable is grant status, which is coded No Grant = 0 and Grant = 1. One urban school and one suburban school make up each of the groups compared in the model.

The second school-level variable is location, which is coded Urban = 0 and Suburban = 1. The two urban and two suburban schools are in close proximity to one another within a single large school district and serve demographically similar student populations.

The third school-level, dependent variable is grant implementation, which is coded pre-grant=1, grant=2, and post-grant=3. The pre-grant years include 2011 and 2012, the grant years include 2013 through 2015, and the post-grant years include 2016 and 2017.

For the grant years variable, repeated contrasts were used to compare each time period to its predecessor in the regression model, starting with Pre-Grant, followed by Grant, and finally Post-Grant. This allowed for comparison of academic outcomes in the time period before the grant was implemented, and after the grant was no longer in existence to explore whether there were discernable trends in the achievement outcomes based on its presence or nonexistence.

The first dependent variable was AP Exam Score (AP_PassFail) in each of the following courses for each student who took an AP Exam: AP Statistics, Calculus, Biology, Chemistry, Physics, Language and Literature. The measure was coded fail=0, pass=1 in order to make predictions about the relationship between a student's background and school and the odds of passing an AP Exam with a passing score. AP Score is based on the composite scores on each test, which are reported by the College Board each July following test administration. To receive a passing score, a student must earn between a 3 and 5. Earning a 0, 1 or 2 is not considered passing and does not carry the potential to earn college credit. A score of (5) = extremely well

qualified, a score of (4) = well-qualified, a score of (3) = qualified, a score of (2) = possibly qualified, and a score of (1) = no recommendation (apscore.collegeboard.org).

The second dependent measure is AP Course Grade (AP_ABvCDF), which consists of the letter grade a student earned in his or her AP Course in the same seven subjects for which AP Exam Scores were collected. The variable was coded C, D or F=0 and A or B=1 in order to make predictions about the relationship between a student's background and school of attendance and his or her odds of earning a higher grade in an AP course. Higher marks in AP courses in high school is associated with both better preparation for college coursework and greater likelihood of passing the AP Exam.

Data Collection Procedures

The archival demographic, school-level, and achievement data used in this study were collected and shared by the school district's Research Analyst who works with the Federal Programs and Accountability department to fulfill requests for information (RFIs). The collection of the information and the purposes of the research were supported by the Associate Superintendent and all FERPA requirements were met.

Data Analysis

The first part of the research question in this study involved exploring the relationship between and student's ethnicity, military mobility, gender, free and reduced lunch status, a school's grant status, a school's location, and the years in which the AP exam was taken, and the odds of a particular student group receiving a passing AP Exam score (3-5). The groups of reference, those coded zero in the logistic regression model, for predicting the odds of passing were: White, non-military mobile, female, and non-free and reduced lunch status. These four demographic categories were chosen as a comparison reference based on the tendency of a

White, non-mobile, female student who does not receive free and reduced lunch tending to outperform students who are not part of each of those groups respectively. For the school-level variables, Urban and No Grant were both coded zero in order to makes odds comparisons based on suburban students and those who received grant support in AP classes in comparison to their counterparts. Repeated contrasts allowed for comparison of grant years and the non-grant years in order to explore trends in the odds of passing depending on the status of the school and the years in which students took exams.

The second aspect of the research question in this study explored the relationship between a student's background, school, years of attendance, the same six variables described above, and the odds of receiving a higher letter grade (A or B) in an AP course. Likewise, the reference categories for each demographic variable and the contrasts used with grant years variable were chosen for the same reasons as outlined above.

Limitations

All research methods are vulnerable to threats, and the known threats can be partly addressed my methodological design, which helps minimize threats and maximize the explanatory power of the experiment (Creswell, 2014; Roberts, 2010; Shadish, Cook, & Campbell, 2002). The potential threats to this study are addressed below, including how elements of the design were constructed to minimize threats to validity.

Based on the longitudinal nature of this study, history posed a threat based on the changes in conditions inside of schools not necessarily associated with the grant. One major threat would be a change in teaching staff, particularly during the grant years. However, with the exception of one teacher change at one school, all other teachers remained constant throughout the grant years. However, it should be noted that there was a large turnover in teaching staff at the Urban

Grant School preceding the year in which the grant was introduced; therefore, it is possible the staffing change influenced students either positively or negatively despite the presence of the grant. Despite the personnel change, which may influence the results, the student populations in this study experienced the same grant supports, and were exposed to the same curricular standards as outlined by the College Board for each AP subject, took the same AP exam(s), and were scored on the same scale.

The threat of maturation is also relevant to this design because achievement scores and letter grades as recorded on a transcript are measured once per year, which means the potential growth in student learning is only revealed at one time point. That said, the design of this study seeks to measure the degree to which students achieved based on exposure or non-exposure to academic support systems that are designed to be implemented over an academic year and measured based on one time point. Additionally, the students in each cohort year were close to the same chronological age based on their year in school. At most, students differed in age by two years. Ultimately, exploring the different rates of maturation in learning and achievement based on exposure to academic support systems is the desired outcome of this study. As a result, this threat is less of a concern, and with comparisons based on cohort year, the student samples' maturation rate is limited to a single academic year. The only exception to this limitation is a student who may have enrolled in different AP courses in consecutive years.

Considering the purpose of this study was to measure AP achievement, and students who signed up for AP courses may have been more academically motivated than their peers, selection may also pose a threat. However, this is partly mitigated by opening enrollment to AP courses to all students, and encouraging middle achievers and underrepresented students to sign up for AP courses as part of the grant implementation process. Increasing enrollment despite social

background, prior coursework or academic outcomes is one objective of the grant, which allowed for monitoring growth in AP course taking as a result of the grant. Based on the sample, enrollment numbers in the two post-grant years was larger on average than any given year preceding them, which may suggest a reduction in selection bias because more students who may not have taken the course without additional encouragement are present.

Measuring the achievement outcomes of all students enrolled in AP courses is vulnerable to the threat of mortality if students who are enrolled in the course do not take the AP Exam at the end of the year. However, as part of the grant process, students' AP Exam fees were subsidized by 50%, meaning students paid $44.50 for each exam, and could apply for a fee waiver, if they demonstrated need. School counselors are also routinely present in courses to sign up students as the deadline nears, which builds in a process to encourage students in AP courses to take the exam. These features both maximize participation in the exam, but do not guarantee that all students take the exam. The disparity in the number of students taking the AP exam and taking the course are displayed in Table 3.

Based on the four student samples at high schools in this study, there is also the threat of diffusion of treatment. However, since the grant was present at the treatment schools, but not at the control schools, and the school's populations are independent of one another, there is less concern about this threat. The grant school students did participate in Saturday Study Sessions together, but no control students were present, which maintains the integrity of the separation of the two major groups in this study. However, there is a chance that some students transferred between high schools during the academic year, which would mean they moved from a control to a treatment school or vice-versa. Even though a mid-year transfer is possible, most of them occur at or near the beginning or end of the school year. Since this study is concerned with full

academic years, it is less likely that a student would experience both conditions within a single year.

Finally, the College Board changed the way they categorized racial groups on their AP School Score Report by Demographic in 2015, which is the final year of the grant process in this study. The change in the way students were coded poses an instrumentation threat to this study. One way of controlling for this by design is the way in which the student racial groups were coded for analysis. To test the response in achievement based on historical gaps in access and achievement, White students were coded as one group and all other races were coded as a non-White group. Despite the change in way racial groups may have been delineated in the College Board report, the coding should help measurement continuity and minimize the instrument threat.

Threats to the external validity of this study are based upon the degree to which the student samples at the four high schools in the study represent the entire high school student population of the district, which includes eight high schools, for the purposes of generalizability. In order to conduct this study, participants were selected using naturally occurring groups who met specific criteria and were compared on demographic similarities between high school populations (Creswell, 2014). The fact that the district uses an open enrollment model, which allows students to attend schools outside of their normal attendance area helps increase the generalizability because school enrollment is not entirely dependent on attendance areas. Additionally, the two comparisons in this study were from two geographically different areas within a large district. One comparison consists of largely suburban students and the other is from an urban area in the district.

Role of the Researcher

I am currently employed by the district from which the data for this study were requested, and was an English teacher in the Suburban Grant School during the 2013 and 2014 school years in which the grant was implemented. I benefited from the financial incentives offered. However, I am receiving no financial incentive from the National Math and Science Initiative for conducting this program evaluation. The quantitative nature of this study, as well as the data collection method are both efforts to eliminate bias in the reporting of results that may be construed to favor the grant's influence on achievement in the schools which received its supports.

Conclusion

In this chapter I outlined the research design and research questions, and described the sample, including how it fits the experimental design and how it was identified. The chapter then moved on to address the instrumentation, data collection procedures, and the statistical methods used to analyze the data. In the final section, I addressed my role in relationship to the study and my attempts to reduce bias. Chapter four presents the results of the statistical tests, including data visualization and descriptive statistics to provide context for the findings in this study.

CHAPTER 4

RESULTS

Introduction

The results reported below address the research question in Chapter 1 and report the odds of a student receiving a qualifying score on an Advanced Placement Subject-Level Exam (3-5) when compared to a non-qualifying score (0-2) as well as the odds of a student receiving an A or a B in a AP subject when compared to a C, D, or F in terms of a students' ethnicity, military mobility, gender, free and reduced lunch (FRL) status, exposure to academic support systems associated with the National Math and Science Initiative (NMSI) Grant, the location of a student's school of attendance, as well as the years in which they attended school. I first present a univariate analysis of the independent and dependent variables (Tables 2-3) before moving on to present the results of the logistic regression analyses based on the seven independent variables above and a student's odds of obtaining a passing AP Exam score and higher letter grade in each AP subject, including Calculus, Statistics, Biology, Chemistry, Physics, Language, and Literature (Tables 4-10). The chapter concludes with a summary of the results of the analyses, including a brief discussion of the discernable patterns from the results (Table 11).

Student Demographics

The student sample contains 3,289 students who enrolled in AP mathematics, science, and English courses between 2011 and 2017 at four Alaska high schools in the Anchorage School District. The sample is 37.4% female, 39.9% non-White; 15.4% of the students receive free and reduced lunch, and 13.5% of the students have experienced a military-related move and live in a household with an active-duty military service member. Table 2 displays the sample's overall demographic information.

Table 2
Student and School Demographics for AP Mathematics, Science, and English Enrollment 2011-2017

	N	Percent
Gender		
Female	1905	62.6
Male	1384	37.4
Ethnicity		
White	1978	60.1
Non-White	1311	39.9
Free and Reduced Lunch		
No	2782	84.6
Yes	507	15.4
Military Mobile		
No	2845	86.5
Yes	444	13.5
Grant Status		
No Grant	1767	53.7%
Grant	1522	46.3%
Location		
Urban	1666	50.7%
Suburban	1623	49.3%
Grant Years		
Pre-Grant (2011-2012)	770	23.4
Grant (2013-2015)	1423	43.3
Post-Grant (2016-2017)	1096	33.3

Note. Each variable in the table reflects the 3289 students in the sample

By comparison, the current total high school population is 48.4% female, 57.3% non-White, and 49.0% economically disadvantaged (ASD Data Dashboard, public.tableau.com). Overall, the AP enrollment in this study has less female students, less non-White students, and less students who are likely to receive free and reduced lunch compared to district-wide high school enrollment. According to the 2016-17 Ethnicity Report, the East and Northeast portions of the district, which encompass the urban schools in this study, enrolled up to 81.3% non-White students, which is almost double the percentage of non-White students enrolled in the sample.

The suburban schools enrolled 31.8% non-White students, which is slightly lower than the percentage in the sample (www.asdk12.org).

Grant Status and Grant Years

Beyond a student's gender, ethnicity, FRL and military mobile status, there are three additional independent variables. The first is grant status, which reflects whether a school received the grant resources to provide academic support systems to students or whether the school is a comparison school. The highest AP course enrollment was at the No Grant schools (*n*=1767), followed by the Grant schools (*n*=1522). Both Urban and Suburban schools enrolled over 1600 students, with Urban schools enrolling 43 more students overall (see Table 2).

The third school-level variable is grant years, which indicates the years in which the grant was present and when it was not at two of the four schools in the study. The grant years (2013-15) indicate the highest enrollment (*n*=1423), and the pre-grant years (2011-12) the lowest (*n*=770). The two post-grant years (2016-17) are lower (*n*=1096) than the grant years, but still notably higher than the two pre-grant years (see Table 2 for further descriptive statistics pertaining to grant status and implementation).

Student and School Relationship with Odds of Passing AP Exams and Receiving an A or B in an AP Course

A logistic regression model containing the four student-level demographic variables and three school-level variables was used to address the likelihood of a student receiving a passing exam score (3-5) and a higher letter grade (A or B) in each AP mathematics, science, and English course based on their background, the grant status of the school they attended, and in what years they attended (Tables 4-10). All logistic regression models for AP score were

significant; however, the models for AP Chemistry, Physics, and Literature grade were not significant (See Tables 7, 8, and 10 for AP Grade results in each subject, respectively).

Of the significant models, the most common, significant predictors of a student's odds of passing and receiving a higher letter grade are school location and a student's FRL status, followed by gender, grant status, ethnicity, years, and military mobility respectively. The years in which a student attended is a significant predictor in only two of the seven subjects: AP Statistics Grade, and AP Physics Score. Likewise, military mobility is only a significant predictor in the AP Statistics Score and AP Chemistry (see Table 11 for a summary of all results).

AP Calculus and Statistics Score and Grade.

The logistic regression models for AP Calculus Score ($X^2(8, N=821) = 76.281, p<.001$) and AP Calculus Grade $X^2(8, N=869) = 19.997, p\leq.01$ were significant. The model predicted 76.7% of all cases successfully, and explained 13.3% of the variation (Nagelkerke R^2) in students' AP test scores. In terms of AP Calculus Grade, the model predicted 74.5% of all cases successfully and explained 3.3% of the variation (Nagelkerke R^2) in letter grade earned in the course.

A student's ethnicity, and free and reduced lunch (FRL) status were both significant predictors of AP Calculus Score. Non-White students were 42.5% less likely to pass the AP Calculus Exam, while students who receive FRL were 43.9% less likely to pass the exam than their counterparts who do not receive FRL. Additionally, students receiving FRL were over 59% less likely to receive an A or B in the course than their peers who do not receive free and reduced lunch. There were no significant differences in student's exam scores or grades based on gender and a student's military mobility.

At the school level, students attending the schools where the grant was present were 49.6% less likely to pass the Calculus Exam, but there was no difference in AP Calculus Grade. Finally, students attending the suburban schools were over 110% more likely to pass the AP Calculus Exam than their counterparts at the urban schools, yet there was no difference in students' grades at the different locations, and the years in which a student took the exam and course were not predictive of a student's academic outcomes (see Table 4 for full results on the following page).

Table 4
Student and School Relationship to Odds of Passing the AP Calculus Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-.533**	8.169	0.575	-42.5%
	-.0.104	0.311	0.901	-9.9%
Military Mobile	0.219	0.394	1.245	24.5%
	-0.379	1.610	0.684	-31.6%
Gender	0.333	3.707	1.395	39.5%
	-0.211	1.769	0.810	-19.0%
FRL	-0.579*	5.314	0.561	-43.9%
	-0.895***	12.862	0.409	-59.1%
Grant Status	-0.685***	14.356	0.504	-49.6%
	-0.127	0.585	0.880	-22.0%
Location	0.759***	13.311	2.116	111.6%
	-0.154	0.721	0.857	-44.3%
Pre-Grant Years		1.322		
		2.547		
Grant Years	-0.145	0.419	0.852	-13.5%
	-0.210	1.131	0.811	-18.9%
Post-Grant Years	0.231	1.248	1.260	26.0%
	-0.150	0.574	0.861	-13.9%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: $X^2(8, N=821) = 76.281$, $p<.001$
Nagelkerke R^2=13.3%
% Correct=76.7%

Grade: $X^2(8, N=869) = 19.997$, $p\leq.01$
Nagelkerke R^2=3.3%
% Correct=74.5%

The models for AP Statistics Score ($X^2(8, N=333) = 73.714$, $p<.001$) and Grade ($X^2(8, N=375) = 28.327$, $p\leq.001$) were both significant. The model successfully classified 73.6% of all AP Statistics Scores and explained 27.3% of the variation (Nagelkerke R^2), while the model for

AP Grade successfully predicted 68.5% of all grades and explained 10.1% (Nagelkerke R^2) of the variation in AP grade.

Military Mobility and a student's gender were predictive of AP Statistics Score with mobile students over 60% less likely to pass the exam, and male students 75.2% more likely to pass the exam. In addition, male students were also over 62% more likely to receive an A or B in the course than their female counterparts. At the school level, a school's location was predictive of both AP Score and Grade. Students attending suburban schools were between 50-72% more likely to receive a passing score and an A or B in the course when compared to their urban counterparts. Lastly, students who attended class during the grant years were 95% more likely to receive an A or B when compared to the pre-grant years. Full results are available in Table 5.

AP Biology, Chemistry and Physics Score and Grade.

The models for AP Biology Score ($X^2(8, N=496) = 96.150, p<.001$) and Grade ($X^2(8, N=550) = 35.513, p<.001$) were both significant, successfully predicting 69% of all scores and 72.2% of all grades. The model for AP Score explained more of the variation in students' exam scores (Nagelkerke R^2=23.7%) than in their letter grades (8.9%).

Gender and FRL status were both predictive of AP Biology Score, with male students over 68% more likely to pass the exam than female students, and students receiving FRL 78.4% less likely to pass the exam than their counterparts who do not receive FRL. At the school level, grant status and location were predictive of AP Exam Score, but in opposite directions. Students attending grant schools were 53.6% less likely to pass the exam. On the other hand, students attending suburban schools were over 115% more likely to pass the exam. Collectively, gender, FRL, grant status, and location were predictive, while ethnicity, military mobility, and the years in which a student took the course and exams were not predictive. Notably, the only difference

in grade was based on FRL status. The other predictive variables were confined to AP Exam Score only. Full results for both AP Exam Score and Course Grade are reported in Table 6 below.)

Table 6
Student and School Relationship to Odds of Passing the AP Biology Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.394	3.197	0.675	-32.5%
	-0.091	0.171	0.913	-8.7%
Military Mobile	0.162	0.293	1.176	17.6%
	0.129	0.182	1.138	13.8%
Gender	0.522*	6.138	1.686	68.6%
	-0.255	1.585	0.775	-22.5%
FRL	-1.531***	16.724	0.216	-78.4%
	-1.110***	14.539	0.329	-67.1%
Grant Status	-0.747***	11.510	0.474	-53.6%
	0.365	3.185	0.694	-30.6%
Location	0.786***	12.681	2.195	119.5%
	0.334	2.300	.1.396	39.6%
Pre-Grant Years		4.365		
		2.074		
Grant Years	-0.199	0.539	0.820	-28.0%
	0.324	1.551	1.382	38.2%
Post-Grant Years	-0.414	2.730	0.661	-43.9%
	-0.255	1.107	0.775	-22.5%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: $X^2(8, N=496) = 96.150$, p<.001
Nagelkerke R^2=23.7%
% Correct=69.0%

Grade: $X^2(8, N=550) = 35.513$, p<.001
Nagelkerke R^2=8.9%
% Correct=72.2%

The models for AP Chemistry Score ($X^2(8, N=319) = 78.181, p<.001$) and AP Physics Score ($X^2(8, N=410) = 77.009, p<.001$) were both significant, yet neither model for AP Grade was significant. Of the AP Chemistry scores, 71.5% were successfully classified and 29.9% of the variation was explained (Nagelkerke R^2). Of the Physics scores, 69.8% were correctly classified and 23% of the variation was explained (Nagelkerke R^2).

Military mobile students and students receiving FRL were between 50-75% less likely to pass the AP Chemistry exam respectively, but male students were 138.4% more likely to pass the exam than their female counterparts. Students at grant schools were 77.7% less likely to pass the exam, but students attending suburban schools were substantially more likely to pass the exam than their urban peers (278.7%). Full results are reported in Table 7.

On the AP Physics exam, non-White students were 55.1% less likely to pass, but male students were 71.5% more likely to pass the exam. Students attending the grant schools were over 60% less likely to pass the exam, and students attending the suburban schools were 41.6% less likely to pass the exam—this latter result constitutes the only exam on which urban students were more likely to pass than suburban students. Further, students taking the AP Physics exam in the grant years were 141.6% more likely to pass the exam compared to the pre-grant years, and in the post-grant years 128.3% more likely than the grant years. Full results are reported in Table 8.

AP Language and Literature Score and Grade

The models for AP Language Score ($X^2(8, N=1622) = 148.944, p<.001$) and Grade ($X^2(8, N=1634) = 106.536, p<.001$) were both significant, and correctly classified 67.3% of all scores and 74.2% of all grades. The models accounted for 11.9% of the variation in AP exam scores and 9.3% of variation in AP course grades (Nagelkerke R^2).

A student's ethnicity and FRL status both accounted for lesser odds in receiving a passing AP Language score and a higher AP course grade with non-White students over 50% less likely to pass the exam and over 35% less likely to receive an A or B in the course when compared to their White counterparts. Students receiving FRL were 36.9% less likely to receive a passing score and 40.9% less likely to receive an A or B in the course than their peers who do not receive free and reduced lunch. The results were split based on gender, with male students 36.6% more likely to pass the exam, yet 28.1% less likely to receive a higher letter grade. There were no differences based on a student's military mobility.

Contrary to the results on other AP exams, there was no difference between students attending the grant and non-grant schools on AP Language exam score. However, students attending grant schools were 33.5% less likely to receive an A or B in the course than their peers at non-grant schools. Finally, students attending suburban schools were both 51.7% more likely to pass the AP Language exam and over 89% more likely to receive an A or B in the AP Language course. The years in which a student took the exam or course were not predictive. Full results for AP Language are reported in Table 9 on the following page.

Table 9
Student and School Relationship to Odds of Passing the AP Language Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.748***	38.889	0.473	-52.7%
	-0.443***	11.255	0.642	-35.8%
Military Mobile	-0.012	0.005	0.988	-1.2%
	-0.027	0.020	0.974	-2.6%
Gender	0.312**	7.854	1.366	36.6%
	-0.330**	7.525	0.719	-28.1%
FRL	-0.461**	8.549	0.631	-36.9%
	-0.525***	10.784	0.591	-40.9%
Grant Status	-0.174	2.437	0.841	-15.9%
	-0.407***	11.236	0.665	-33.5%
Location	0.417***	11.984	1.517	51.7%
	0.637***	22.411	1.891	89.1%
Pre-Grant Years		7.831		
		4.288		
Grant Years	0.234	2.837	1.264	26.4%
	-0.243	2.655	0.784	-21.6%
Post-Grant Years	0.196	2.300	1.217	21.7%
	-0.090	0.386	0.914	-8.2%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: X^2(8, N=1622) = 148.944, p<.001
Nagelkerke R^2=11.9%
% Correct=67.3%

Grade: X^2(8, N=1634) = 106.536, p<.001
Nagelkerke R^2=9.3%
% Correct=74.2%

The model for AP Literature Score was significant (X^2(8, N=794) = 150.154, p<.001), classified 72.4% of all scores correctly, and explained 23.3% of the variation (Nagelkerke R^2). However, the model for AP Literature Grade was not statistically significant.

Of the student-level variables, a student's ethnicity and FRL status were predictive of lesser odds of passing the AP Literature exam. Non-White students were over 50% less likely to pass the exam than their White counterparts, and students receiving FRL were 48.3% less likely to pass the exam when compared to their peers who do not receive free and reduced lunch. Furthermore, students attending grant schools were 62.3% less likely to pass the exam than their non-grant counterparts, and students attending suburban schools were 186.5% more likely to pass the AP Literature Exam than their urban school peers. The pattern of results for grant status and school location for AP Literature aligns with all other exam-level results with the exception of AP Physics on which urban students were more likely to pass the exam. Results for AP Literature grade and score are reported in Table 10.

Summary of AP Score and Grade Results

The most frequent significant predictors of AP score and grade were a student's FRL status and the location of the school. Students receiving free and reduced lunch had significant and lesser odds of receiving passing exam scores on five of the seven exams, and lesser odds of receiving an A or B in three of the seven courses. Notably, there were no significant differences in either AP Statistics score or grade for students receiving FRL. Contrary to the significant and lesser odds for FRL students, student attending suburban schools had significant and better odss of receiving a passing score on six of the seven exams, with AP Physics being the only exception to the trend.

Following a student's FRL status and the location of the school, a student's gender, the grant status of the school, and a student's ethnicity were the next most predictive variables in the model respectively. Males students had significant and better odds of passing five of the seven AP exams—on the remaining two exams, Statistics and Literature, there was no difference. AP

course grade was split based on gender, with males more likely to receive an A or B in Statistics, but less likely in AP Language. Students attending the grant schools had significant and lesser odds of passing five of seven AP exams—on the remaining two exams, Statistics and Language, there was not difference. Again, the lack of difference in AP Statistics exam score appears to be one of the only exceptions based on gender and grant status. Finally, non-White students had significant and lesser odds of receiving a passing exam score on four of the seven exams, with Statistic, Biology, and Chemistry showing no difference based on ethnicity. Notably, the only significant difference in AP grade was in AP Language—in the six remaining subjects, there was no discernable difference in letter grade.

Outside of the aforementioned variables, a student's military mobility and the years in which a student took an AP exam were far less predictive. Military mobile students had lesser odds of passing the Statistics and Chemistry exam, and years in which a student took the exam and course were only predictive for Statistics grade and Physics Score. An overview of all the AP Score and AP Grade results are reported in Table 11 on the following page.

Table 11
Overview of Logistic Regression Results for AP Test Score and AP Grade

		Mil Mob (Yes)	Gender (Male)	FRL (Yes)	Ethnicity (Non-White)	Grant (Yes)	Location (Suburban)	Grant Years
Calculus	Score			-43.9%	-42.5%	-49.6%	111.6%	
	Grade			-59.1%				
Statistics	Score	-60.6%	75.2%				505.9%	
	Grade		62.6%					1*
Biology	Score		68.6%	-82.4%		-52.6%	119.5%	
	Grade			-67.1%				
Chemistry	Score	-58.5%	138.4%	-74.0%		-77.7%	278.7%	
	Grade*							
Physics	Score		71.5%		-55.1%	-61.8%	-41.6%	2*
	Grade*							
Language	Score		36.6%	-36.9%	-52.7%		51.7%	
	Grade		-28.1%	-40.9%	-35.8%	-33.5%	89.1%	
Literature	Score			-48.3%	-50.4%	-62.7%	186.5%	
	Grade*							

Note. A percentage denotes a significant result and the odds of a student in each category passing the AP exam or receiving an A or B in the AP course. The category being compared is in parenthesis under each variable. An asterisk next to grade or score in column two indicates the regression model was *not significant*.
Grant Years is coded: pre, grant, and post-grant. An asterisk denotes a significant result within the Grant Years variable; the number preceding the asterisk indicates how may differences exist, but the specific category is not specified. Complete results are available in Tables 4 through 10.

Conclusion

This chapter presented descriptive statistics for all variables in the study (Tables 2 and 3). After presenting descriptive statistics, results for all logistic regression models were presented by subject-area and course (Table 4 through 10), with emphasis placed on AP Calculus, AP Biology, and AP Language, and the most notable results for all other subjects. Finally, a summary of the overall pattern in the results was discussed (Table 11). In Chapter 5, I provide a summary of the study and relate the findings to previous theory and research. Once my findings have been cast in light of past theory and program evaluation studies, I move on to consider

implications for practice and future research, and make suggestions about how the results of my study and others might inform policymakers' decisions. Finally, I provide commentary on the theoretical implications and end with a brief conclusion, which encourages educational decision-makers to use their initiative and influence to increase outcomes for underserved students.

CHAPTER 5

CONCLUSION

Introduction

In this chapter, I first present a summary of the study, including the problem it addressed, its purpose, and a brief summary of the major findings based on the results in Chapter 4. I then move on to address how the results are situated in relationship to prior research on academic support systems and an ecological theory of human development. This is followed by how my results might inform future practice in schools attempting to address achievement gaps between student groups followed by implications for future research. This includes how future research on academic support systems might be designed to better isolate and measure the key variables in order to explore which have the most impact on student achievement outcomes. Following implications for practice and future research, I make policy recommendations and outline how my results relate to Bioecological Systems Theory. The chapter ends with concluding remarks and a call to action for educational decision makers who have the opportunity to design systems which may positively influence all students' academic achievement.

Summary of the Study

Educational researchers and practitioners have made numerous attempts to understand and reconcile the achievement gaps between student groups based on their race, class, transience, and other background characteristics. Some of this research emphasizes outside-of-school influences on students' achievement, while others address how inside-of-school resources, including the equity of human and material capital influences achievement. Further, much of this research has been done on student groups in the contiguous United States, which does not align well with Southcentral Alaska's demography and its attendant challenges. This includes

Multi-Ethnic students (*n*=330) outnumbering all other minority groups except for Asian (*n*=457) students. Additionally, Asian students taking exams in Alaska scored from one to two points lower on the AP Biology and Chemistry exam, and between two-tenths and seven-tenths of a point lower on all other AP exams when compared to Asian students nationwide. (AP National Summary, 2017).

In order to redress this gap in the research, this study aimed to further understand the relationship between the academic support systems associated with the National Math and Science Initiative's (NMSI) College Readiness Program (CRP) at two Alaska high schools and students' odds of receiving a passing AP exam score (3-5) and receiving a high letter grade (A or B) in an AP course based on their ethnicity, military mobility, gender, free and reduced lunch status, as well as a school's grant status and location as well as the years in which students took AP exams and courses.

To explore the relationship, a logistic regression model containing four student-level variables, and three school-level variables was developed. The model returned the odds of earning a qualifying score and higher letter grade based on a comparison between non-White, military mobile, female, and free and reduced lunch students, and their counterparts in the opposite group, which included White, non-mobile, male, non-free and reduced lunch students. Additionally, grant and non-grant schools were compared along with suburban and urban schools. Repeated contrasts were used in order to return a student's odds of earning a passing score and a higher letter grade based on taking an AP course and exam before, during, and after the academic support systems were implemented at the grant schools in the study.

The findings in this study were mixed. The most frequent significant predictors were a student's FRL status and the location of the school a student attended. This was followed by a

student's gender, the grant status of the school a student attended, and a student's ethnicity respectively.

Students receiving FRL had significant and lesser odds of passing five of the seven exams, and lesser odds of receiving an A or B in three of the seven courses. Notably, there were no differences in Statistics and Physics, although the model for Physics grade was not significant. Students attending suburban schools had significant and better odds of receiving a passing score on six of the seven exams, with urban students having better odds on only one exam, AP Physics. The solitary difference in AP grade based on location was in AP Literature where suburban students had better odds or receiving an A or B in the course.

Beyond a student's FRL status and the location of the school, the next most predictive variables were a student's gender, a school's grant status, and a student's ethnicity. Males had significant and better odds of passing five of the seven exams, but the results based on letter grade were mixed, with males more likely to receive an A or B in AP Statistics, but less likely to receive a higher grade in AP Language. Students attending grant schools had universally lesser odds of receiving a passing AP score and a higher AP letter grade; however, lesser odds were far more frequently associated with AP exam score and than grades. Students attending grant schools had lesser odds of receiving a passing score in five of seven subject exams, but lesser odds of receiving a higher grade in only one subject, AP Literature. Finally, a student's ethnicity was predictive of significant and lesser odds of receiving a passing score on four of the seven exams, and a lower letter grade in only one of the seven subjects—there were no differences in the remaining outcomes. Notably, lesser odds were most frequent in the AP Language subjects in comparison to AP mathematics and science, where differences were detected on Calculus and Physics Scores only.

Finally, a student's military mobility and the years in which a student took an AP exam and course were far less predictive than the aforementioned variables. Military mobile students had lesser odds of passing two of the exams, Statistics and Chemistry, but in the remaining 12 academic outcomes, there was no difference. Likewise, the year in which a student took an AP exam and course was predictive in only three of the 14 outcomes, and these differences were confined to Statistics grade and Physics score.

Findings

The major findings in this study were that a student's free and reduced lunch status (FRL) and the location of the school a student attended were the two most frequent, significant predictors of AP Score and Grade. However, these predictors yielded almost exact opposite results—students receiving FRL had significant and lesser odds in eight of the 14 academic outcomes, including five exams and three course grades. Lesser odds held across all three subject-areas in the study. On the other hand, students attending suburban schools had significant and greater odds in seven of the 14 outcomes, including six of the seven exams and AP Language grade. Suburban students experienced lesser odds in only one outcome, AP Physics exam score.

Although FRL status and the location of the school were two distinct independent variables in this study, the urban schools on the Northeast side of Anchorage are both Title I high schools and enroll over 75% economically disadvantaged students and 3% of students are homeless. On the other hand, the suburban schools enroll between 20-30% economically disadvantaged (ED) students and less than 1% of students are classified as homeless (data.asdk12.org). This suggests that FRL status and attending an urban school are related and have a large and negative impact on academic achievement in advanced courses. These

outcomes appear to align with larger scale studies of student achievement across the United States. Although not a direct comparison, the achievement outcomes on AP exams echo the 30-point gap in 12th grade reading achievement between students who attended a high poverty school and those who did not on the 2015 National Assessment of Educational Progress (NAEP) (nces.ed.gov). It is also worth noting that based on NCES's *Condition of Education 2017* report, minority students tend to be enrolled in higher poverty schools with less qualified teachers, and achieve at lower rates when compared to their White and more affluent counterparts (Hanushek et al., 2016; Lankford et al., 2001). Based on the results of this study, students in Alaska appear to face similar challenges to their disadvantaged peers in the lower 48 states. However, a closer examination of the AP achievement outcomes provides reason for hope.

A student's FRL status and the school location have a larger effect on AP Exam scores than on AP course grades. Students receiving FRL experienced lesser odds on five exams, but just three course grades—there were no differences in the remaining four subjects. Students attending suburban schools only showed significant and better odds of earning an A or B in a single course, there was no grade-based difference in six of the seven subjects, yet their odds were greater on six of the seven exams.

The lack of difference in AP course grades suggests that students who are less advantaged and who attend higher poverty, urban schools may be able to achieve at a rate comparable to their more advantage peers who do not experience near as much poverty in suburban schools. Further, enrollment in AP courses has been shown to give students long term, distal benefits and there is reason to believe student-groups who took AP courses will experience better post-secondary outcomes than their counterparts who did not participate in AP course work or take an AP exam while in high school (Morgan & Klaric, 2007).

At one of the urban schools, enrollment was two to three times higher during the grant years than the pre-grant years (Table 1), which means that more students likely experienced the kind of classroom instruction that is associated with better post-secondary outcomes. This achievement pattern also illustrates Bronfenbrenner's observation that students who are placed in environments in which they are given access to resources and experiences to which they were not normally exposed tend to demonstrate greater development than students who were more routinely exposed to those same resources (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006). Although students receiving FRL and attending urban schools experienced almost universally lesser odds in terms of positive academic outcomes on exams, the lack of difference in AP letter grade suggests that students who tend to have less resources may have closed the gap to their more affluent peers in terms of classroom performance as measured by letter grades and GPA.

The same achievement pattern observed amongst FRL recipients and urban students holds for the predictive power of gender and grant status, which were the next most frequent predictors of academic outcomes. Males experienced significant and better odds on five of the seven exams, excluding Calculus and Literature. There were only two differences based on grade and these were split, with males more likely to receive an A or B in Statistics and females more likely to receive an A or B in Language. This achievement pattern on AP exams and in AP courses reflects outcomes across the United States on all AP exams, where males earn a mean score of 2.94 and female students earn a mean score of 2.75 (AP National Summary, 2017). The gap is approximately two-tenths of a point, which mirrors the narrow gap in exam results in most courses in this study. As noted above, there was far less difference in terms of letter grades, where males are more likely to receive an A or B in AP Statistics, and females are more likely to

receive an A or B in AP Language. There was no significant difference between letter grades in the other five courses.

Similar to the achievement outcomes based on gender, students at the grant schools experienced significant and lesser odds of receiving a passing exam score on five of the seven exams—three was no significant difference on the AP Statistics or Language exams. There was only one significant difference in letter grade, with grant students less likely to receive an A or B only in AP Language. Although there does not seem to be an effect on a student's exam score based on the presence of the academic support systems, the less frequent differences in AP course grade provide hope that schools which design academic support systems for underserved student groups can begin to counteract the heavy influence of outside-of-school factors, including a student's social background, and begin to close achievement gaps in terms of GPA and course grades (Black et al., 2008; Contreras, 2011; Gandara & Bial, 2001; Huerta & Watt, 2015; Stanton-Salazar & Spina, 2005). It also suggests schools may be able to support high academic achievement in terms of AP grades despite what type of knowledge and experiences students bring to school and to learning (Bourdieu, 1986; Bourdieu & Passeron, 1990; Huang & Liang, 2016; Jaeger, 2007).

A course grade reflects a student's work over the course of a 36-week academic year and measures effort expended over time, whereas an exam score is a measurement taken on a single day. While exam scores should reflect a student's ability in the tested subject area, grades are more reflective of persistence and other traits associated with academic success in the long term. This aligns with Bronfenbrenner and Ceci's (1994) and Bronfenbrenner and Morris's (2006) arguments about the duration and intensity of exposure to beneficial experiences correlating with the degree of development. In this case, the longer a student spends in a program which provides

academic supports that would have otherwise been unavailable, the more achievement a student is likely to exhibit. The fact that students exposed to the academic support systems were limited to two years of additional support late in their high school years may help explain the disparate outcomes on exam scores for students attending the grant schools, and still help explain how throughout a school year, urban students were able to achieve at a level that was not significantly different than suburban students

After FRL status, a school's location, gender, and grant status, a student's ethnicity is the next most frequent predictor in all models, explaining differences on four of the seven exams and one of the seven letter grades. Non-White students experienced between 30-60% lesser odds of receiving a passing score and a higher letter grade in AP Language and a higher AP score in AP Literature. Significant and lesser odds also resonate on the AP Calculus and Physics exams. On the contrary, in Statistics, Biology, and Chemistry, there are no significant differences in either exam score or letter grade. The grouping of lesser odds in the AP English subjects may suggest that a student's English language fluency matters less in mathematics and science than it does in language-based courses. On aggregate, despite a wide array of second languages and diverse racial demographics, underserved students who live in the most diverse neighborhoods appear to achieve at levels approximately equal to their peers in terms of letter grades, and the same result holds for AP mathematics and science exams for the most part. This provides hope the persistent achievement gaps between racial groups, ELL students, and students receiving free and reduced lunch may be closing in Southcentral Alaska.

Additionally, while a student's English Language Learner (ELL) status was not addressed in this study, students at the Urban schools predominantly reside on the East and Northeast side of Anchorage and live in the most diverse and high poverty neighborhoods in the city (District

Overview: Race and Language, www.asdk12.org). Both Urban high schools in this study are Title I schools. Students at these schools are also more likely to speak one of the top five second languages: Spanish, Samoan, Hmong, Filipino, and Yupik. According to the same source, the district is over 50% minority and 20% speak a language other than English at home (District Overview: Race and Language, www.asdk12.org). A student's ethnicity appeared to wield a stronger effect on exam scores than grades. In six out of the seven courses there is not a significant difference between White and non-White students in terms of receiving a higher letter grade (A or B). This finding suggests that minority students may be closing the gap noted in the NCES High School Transcript Study (2011) and in Adelman's (2009) study of high school rigor, in which it was reported that White and Asian students tended to earn higher GPAs and Test Scores.

Beyond the aforementioned measures, the year in which a student took an AP exam and his or her military mobility were significant predictors of academic outcomes far less frequently. Military mobile students were less likely to earn a passing exam score in AP Statistics and Chemistry. The lack of significant difference in the remaining academic outcomes suggests that military dependent students may be able to perform in advanced coursework despite the differing expectations they routinely experience as they move between different states (Bradshaw et al., 2010; Williams, 2013). One purpose of the support systems associated with the grant was to address uneven expectations and curriculum in advanced mathematics and science courses that military mobile students experience as they move from school to school and state to state. With a student's military mobility influencing only two significant differences in AP exam score, it appears these students may have been able to reach the levels of their less mobile peers with

additional support and the kind of standardized expectations the College Board embed in their AP Course Descriptions.

The results were mixed based on the year in which a student took an AP exam. Odds of receiving a higher letter grade in AP Statistics were better during the grant years than pre-grant years. The only other significant difference based on the years in which a student took an exam and course was in AP Physics, where students attending during the grant years were over 140% more likely to receive a passing score compared to the pre-grant years, and in the post-grant years over 128% more likely to achieve a passing score when compared to the grant years. Collectively, the year in which a student took an exam does not appear to be highly predictive of a student's potential for academic success or failure. This study did not track the same students over an extended period of time, which precludes any comparison to the beneficial outcomes of being in an academic support program over an extended time, which in other states, appears to have a significant and positive effect on achievement for underserved students both in the short and the long term (Huerte & Watt, 2015; Huerte et al., 2013).

Collectively, the results of the logistic regression models indicate that AP Exam score is more heavily influenced than AP letter grade. Across all academic outcomes and predictors, there were 40 total significant differences (see Table 11). Of these 40 differences, 31 are on AP exams, and nine of the differences are in AP courses. The pattern holds when looking at the most frequent, significant predictors: students receiving FRL were less likely to pass *five* exams and earn a higher letter grade in *three* courses; suburban students were more likely to pass *six* of the seven exams and earn higher grades in only *one* subject; males had better odds on *five* exams, and only *one* course grade; and grant students had lesser odds on *five* exams and just *one* course

grade. This pattern is visually evident in Table 11, which contains an over view of all significant results.

While students attending urban schools, who receive FRL, who are female and non-White have significantly lower odds of receiving a passing score, based on the pattern outlined above, it appears the grant may have helped them achieve at level comparable to their peers in terms of course grade. The lack of difference in course grades may indicate the grant supports allowed students to perform in more rigorous courses even though this lack of difference did not persist in terms of exam scores.

NMSI Results in Alaska and Elsewhere

Although program evaluation studies have not used the same methods to measure academic outcomes for students, some comparisons can be made using studies completed on the College Readiness Program (CRP) backed by the National Math and Science Initiative in Colorado and Indiana (Sherman, Darwin, Mengli, Yibing, & Statchel, 2015), a ten-year study in Texas where the CRP program was initiated (Jackson, 2007) as well as a study of 287 CRP schools across different states (Brown & Choi, 2015). The aforementioned program studies included thousands of schools and many more thousands of students than the logistic regression models in this study, which incorporated four schools and 3289 cases. This may also help explain why the grant students in this study did not appear to gain a significant benefit in terms of AP exam score in response to the support systems. However, for the purposes of placing AP exam results in Alaska in context of other states, I have disaggregated each school's percent change in pass rate from 2011 through 2017, which is displayed in Table 12 on the following page.

Table 12
Percent Change in AP Exam Pass Rate 2012 to 2017 by School

	2012	*2013*	*2014*	*2015*	2016	2017
Urban Grant		-11.0	**+5.6**	**+3.6**	+6.3	-0.6
	36.4%	25.4%	31.0%	34.6%	40.9%	40.3%
Urban Comp		+0.9	-4.1	-4.2	-2.7	-3.8
	69.3%	70.6%	66.5%	62.3%	59.6%	55.8%
Suburban		**+7.0**	+0.3	-9.7	-1.0	**+2.7**
Grant	69.7%	76.7%	77.0%	67.3%	66.3%	69.0%
Suburban		+4.2	+0.9	-12.4	**+13.3**	-14.7
Comp	75.2%	79.4%	80.3%	67.9%	81.2%	66.5%

Note: The second column contains each school's AP Exam passing rate one year prior to grant implementation, and the starting point for successive percent change comparisons through two years post-grant. Grant schools and grant years are italicized. The highest percent increase in passing rate is bolded in each year.

In their study of 60 schools in Indiana and Colorado, Sherman et al. (2015) cited a 5.77% increase in AP exam taking at grant schools compared to a 1.12% increase in exam taking at the comparison schools. In another study of 1600 schools in Texas from 1994 to 2005 Jackson (2007) found an 8.2% increase in AP enrollment and a 2.55% increase in exam taking in CRP schools. The author attributes the increases in achievement at the grant schools to opening AP enrollment to all students and reducing barriers to academically rigorous courses, which shifted the culture within the school. In a third study conducted by Brown and Choi (2015), on average between 70 and 100 more exams were taken at 287 CRP schools, which included increases for both female and minority students. The overall effect size of exam taking was 0.941, and slightly less for passing, 0.628. These findings align with the pattern of enrollment at the grant and comparison schools in Alaska, where there was a mean increase in exam taking of 5.9% for grant schools and a mean increase of 1.9% at the comparison schools over the same time period.

The results of this study appear to extend the findings in the earlier studies in the Lower 48 United States even though demographics are markedly different in the two locations.

Sherman et al. (2015) also reported an increase in passing rate of 2.91% for Colorado and Indiana grant schools and a 0.48% decrease at comparison schools. Similarly, Brown and Choi (2015) found that across all schools in their study, students earned a passing score on between 23 and 32 additional exams based on the existence of additional academic support compared to schools without the grant where students earned a passing score on 4 to 10 additional exams. The contrast in academic outcomes at the grant and comparison schools in Alaska was less clear.

In the first year of the grant, the Urban Comparison School's passing rate dropped by 11% while the comparison school increased by less than one percent. On the other hand, the Suburban Grant School had the largest percent increase amongst all schools at 7% whereas the Suburban Comparison School increased their pass rate by 4.2%. In the second year of the grant, the pattern shifted. Through 2014 and 2015, the Urban Grant School had the largest increases in passing rate, at 5.6% and 3.6% respectively. One year post-grant, the Urban Grant School sustained their growth in passing rate (6.3%) even though it was not the largest growth amongst all schools. The Urban Comparison rate consistently dropped over the same years. While the Urban Grant School showed gradual increases from 2014 to 2016, the comparison school showed gradual declines. The Suburban schools in the study were within a single percentage point increase in 2014 and both dropped in 2015. Thereafter, the two Suburban schools alternated which one demonstrated an increase in the two years post-grant.

In contrast, the Urban Grant School maintained an increase in passing rate one-year post grant (+6.3%). Two years post-grant, the Urban Grant School's pass rate was 15% higher and enrolled over 100 additional students when compared to one year pre-grant. In the final year of

the grant (2015), the Urban Grant School was the only school to show positive growth in passing rate while all other schools dropped between four and 13%. Collectively, the Urban Grant School outperformed the Urban Comparison School in terms of percent growth in passing rate while consistently increasing enrollment. Trends for all schools' percent increase in passing rate and total passing rates are displayed in Table 12. Taken together, the passing rate increase at the Alaska grant schools is consistent with the findings reported in Sherman et al. (2016) and Brown and Choi (2015). Schools where additional academic support systems were implemented showed greater percent increases in the grant years when compared to non-grant schools, and in some instances, maintained growth after the grant was no longer in place.

Most notably, the Urban Grant School, which serves a diverse student body made up of a large percentage of students who are economically disadvantaged (75.5%) and who speak a second language at home (16.2%) demonstrated the most consistent increase in passing rate amongst all schools in the study, and increased enrollment almost threefold (Data Dashboard, www.asdk12.org, 2018). Not only is this trend consistent with other research on the College Readiness Program, but it also lends evidence to Bronfenbrenner and Morris's (2006) third hypothesis, which states that individuals who experience processes that encourage development who have not otherwise experienced them in other environments, such as those outside of school, will show stronger achievement gains than those who have been consistently exposed to those processes in multiple environments. This observation also helps explain the different patterns in passing rate between the Urban and Suburban schools. The Suburban schools tend to be populated by students who are less likely to receive free and reduced lunch and whose home language is much more likely to be English. Historically, they also tended to enroll more students in AP courses and have higher passing rates.

Across all studies, there was increased AP enrollment and exam taking as a result of the National Math and Science Initiative's College Readiness Program. While enrollment notably increased across all schools, the rate of students passing exams was more pronounced at the Urban than the Suburban schools. While the passing rate was less responsive to the existence of the academic support systems associated with College Readiness Program in the Suburban schools, all students who enroll in AP courses and take AP exams appear to benefit in other ways. Jackson (2010) found that students' long-term outcomes were better based on enrollment in AP courses in terms of SAT/ACT score increases, college persistence, college readiness, and graduation. In particular, Hispanic and Black students' enrollment rates and academic outcomes were more significantly influenced than their White counterparts. Other studies find similar, positive distal effects, including increased odds of enrolling in a four-year college (Mattern, Marini, & Shaw, 2013) and similar to Jackson's findings, a greater chance of persisting to college graduation (Dougherty, Mellor, & Jian, 2006; Hargrove, Godin, & Dodd, 2008). Taken together, this suggests that increasing enrollment and exam taking, even if students do not earn qualifying scores, still yields better academic outcomes in the long run (Huerte & Watt, 2015; Jackson, 2007). Based on the consistent increases at the Urban Grant School across the grant and non-grant years, additional academic support may have both short and long-term benefits, including earning college credit while still in high school and being better prepared for post-secondary academic work, which results in a greater likelihood of persistence to graduation. Future research tracking students' post-grant academic outcomes in post-secondary academic work would be needed to substantiate these effects.

Although the study of NMSI schools in Alaska does not include an analysis of the indirect outcomes as a result of exposure to academic support systems, based on the similarities

in achievement patterns at grant and comparison schools in Alaska and in the other studies, there is reason to expect that students who enrolled in an AP course and who took an exam likely experienced better long-term academic outcomes as well as more immediate success after high school. As noted before, students who experienced the additional academic support experienced it in the last two to three years of their high school career. Despite only experiencing additional academic support within the last years of high school, students at the grant schools did demonstrate growth that suggests support systems can make a difference even later in a student's academic career. Considering students increased their academic outcomes as late as high school, it is worth pondering what Alaskan students' academic outcomes would be if they had experienced additional support starting in middle school.

Implications for Practice

The research on academic support systems associated with the National Math and Science Initiative's College Readiness Program in high schools has demonstrated positive outcomes for underserved students in the states in which it has been studied. Additionally, other programs, like AVID, have also been shown to make a difference for students who have not had routine access to academic rigor and the support necessary to meet higher academic expectations. Amongst those studies, those by Huerte and Watt (2015) and Huerte et al. (2013) found that students who enrolled in the program in middle school and continued through their high school years had better short and long-term academic outcomes than those who did not. Ultimately, these findings suggest that educational decision makers should consider what kind of academic support systems are in place as early as sixth grade, and how consistent and congruent they are with the kinds of systems which exist in high schools to which these students will matriculate. Reducing disparities in the kind of academic language and support that is available to

underserved students throughout their secondary education is a good first step in beginning to close achievement gaps that have persisted for certain racial groups and students who are living in poverty. Based on grant students experiencing less differences in terms of letter grades, but far lesser odds of passing an AP exam, integrating a process of consistent professional development and collaboration for teachers, and providing additional time and tutoring for students across their middle and high school years, would likely help underserved students begin to close the gap based on AP exam outcomes and help sustain their academic outcomes based on letter grade in AP courses.

Beyond improved outcomes for underserved students, the academic support systems also positively influenced students who attended more advantaged schools. While the percent growth in passing rate was not as robust as it was for underserved groups at more urban schools, progress was still made, and high levels of achievement were sustained. When academic support systems are put in place and intentionally aligned with rigorous and consistent curriculum, it appears that all students benefit, which is yet another reason to begin to evaluate how academic support systems beginning in earlier grades are aligned to those available in high school. As a result, students are more likely to earn college credit while still in high school and develop the academic skills necessary to attend college and succeed once there.

Jackson's (2007) work on the distal effects of exposure to AP coursework and exam taking along with Huerte and Watt's (2015) work on immediate college outcomes for students who experienced academic support starting in middle school lends support to early integration of academic support systems. Doing so provides all students, but particularly underserved students, more time to achieve at the levels of their more advantaged peers on AP exams by providing

them with resources associated with academic achievement to which they might not otherwise have consistent access.

Implications for Future Research

The findings reported in this study are limited to a student's odds of receiving a passing AP Exam score and a higher letter grade in an AP course based on a student's social background as well as exposure to the academic support systems associated with the National Math and Science Initiative's College Readiness Program in two Alaska high schools. Due to the limited number of schools, the lack of random assignment, and the low numbers of certain ethnic groups precluded measuring outcomes based on a student's specific racial category. Therefore, ethnicity was coded dichotomous, White or non-White, in order to make the model more parsimonious. Further, the academic support systems were not specifically measured. That is, the number of hours of professional development and collaboration for teachers was not tracked closely enough to be included, just as the number of hours of additional tutoring and exam practice were not tracked for specific students. Hence, the results of this study demonstrate a student's odds of passing and earning a grade based on membership of a larger non-White ethnic group and attending a school where the academic support systems were present, but not necessarily equally taken advantage of by all students.

To extend and improve upon the findings of this study, future research on academic support systems should ideally include larger numbers of non-White students so that academic outcomes for specific ethnic groups can be identified. In Southcentral Alaska, more research is needed on how Native Alaskan and Pacific Islander student groups perform when given access to academic support systems. Furthermore, the degree to which students engage with the additional support systems needs to be measured. For instance, the Saturday Study Sessions associated

with the CRP amount to 18 additional instructional days in each AP subject, and weekly tutoring amounts to approximately 32 additional instructional days. Knowing how many sessions of each a student attended would allow for a more precise relationship between support systems and outcomes to be established. Likewise, teachers were given the opportunity to attend an AP Summer Institute, to score mock exams in collaboration with other AP subject-level teachers, to attend Saturday Sessions with Teacher Experts in their disciplines, and to attend a three-day refresher course as an extension of the AP Institute in the second two years of the grant. The degree to which teachers engaged in professional development and collaboration with other teachers and reported the benefits of doing so is not present in this study, and should be considered in future research. Doing so may allow future program evaluation studies to isolate what kinds of support have the largest impact for specific student groups and for teachers.

There are two other areas which future research should also consider. First, the secondary effects of exposure to the academic support systems associated with the grant were not included in this study. Incorporating a student's GPA, SAT or ACT score, as well as other post-secondary measures of academic achievement, like persistence in college, may help identify what other effects arise from more rigorous coursework. This study was unable to definitively extend the findings of other studies which document the secondary benefits of rigorous coursework with additional support (Huerte and Watt, 2015; Jackson, 2007; Lozano, Watt & Huerte, 2009) because the information was not available. Second, this study was limited to a quantitative analysis of the program, and did not include measurement of students' and teachers' attitudes based on the existence of the program nor how the school culture may have shifted in response to more inclusion of all students in AP programs. Future research which takes a mixed-methods approach may be able to investigate the relationship between the measurable academic

gains and how students' and teachers' behaviors changed over the life of a grant system that aims to provide access to those who have been traditionally underserved. Doing so may help extend the findings on how peer relationships affect achievement (Brown & Larson, 2009; Kinderman, 2007; Stanton-Salazar & Spina, 2005), how students transition to more rigorous coursework (Newman et al., 2000), and how students' sense of self-efficacy is influenced by academic support systems (Pugh & Tschannen-Moran, 2016).

Policy Implications

The National Math and Science Initiative partners with a limited number of schools and does not administer state and district-level policy nor influence the way in which courses are sequenced or what type of additional support is offered. However, policymakers at the state and district level do have the option to implement the features of the College Readiness Program without the necessity of a formal partnership. The primary expenses of the program are professional development for teachers, personnel costs at the school level, subsidizing exam fees for students, and providing incentives for test scores for students and teachers. Although the academic support systems associated with the CRP did not appear to positively influence AP exam scores, the number of students in the study was limited, and more information is needed on how specific support systems influence outcomes. As suggested, this would require further research on schools once they implement the systems.

However, The lack of disparity in AP course grades along with the long-term benefits documented by multiple researchers (Huerte & Watt, 2015; Jackson, 2007; Morgan & Klaric, 2007) make academic support systems a potentially worthwhile expense for schools that have discretionary funds to support student achievement. For instance, the urban schools in this study have access to Title I funds and might consider using their resources to create a system of

academic supports, which reduces barriers to rigorous courses, provides tutoring for students, especially in terms of test-taking, and offers subsidized professional development and collaboration to teachers in relationship to clearly defined curricular expectations. Furthermore, based on the results of this study and other evaluation studies on academic support programs that start in middle school, policymakers should consider establishing consistent academic supports throughout secondary school. Doing so would extend the length of time students are exposed to academic rigor with the support needed to meet high expectations. In turn, students would likely demonstrate an increased likelihood of attending post-secondary education and persisting to graduation, and may start to achieve at levels similar to their more affluent and well-represented peers in terms of AP exam scores and continue to sustain similar performance levels in terms of AP grade.

Theoretical Implications

Bioecological Systems Theory provided a useful lens through which to understand the achievement patterns in this study. The first and second propositions are particularly applicable. They state first that development is the product of reciprocal interactions over time, and second that the form, power, and content vary as a function of the person and environment (Bronfenbrenner, 1999; Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2006). The four schools in this study varied depending on whether academic support was present or not. The grant changed the form, power, and content of the interactions in AP classrooms based on extended time, tutoring, mock exams, and interacting with more than one teacher in a single content area. However, the change in interactions did not appear to positively influence exam scores. This raises more questions than answers. In particular, whether receiving academic support within the final two years of high school can make a significant difference for students.

Since the specific support systems associated with the grant were not tracked, one major question is what specific resources were directed to exam taking, and how many students at the grant schools took the opportunity to take the mock exam, and then act specifically upon their challenges once they received their scores on the multiple choice and open response sections. Although the regression models indicated universally lower odds of a grant student passing an exam, when the schools' percent change in pass rates were disaggregated, in all three years in which the academic support systems were present, the grant schools showed the most percentage growth in AP Exam passing rate (Table 12).

Additionally, Bronfenbrenner's (1999) third hypothesis helps explain the Urban Grant School's notable growth in comparison to other schools. The hypothesis states that development will be greater amongst those who experience interactions that encourage development who have not otherwise experienced them in other environments. In other words, students who are underserved will show more growth once given access to the interactions that underlie academic achievement. The Urban Grant School had the lowest AP enrollment and lowest pass rate among the four schools as well as serving students who were more likely to speak a second language at home, receive free and reduced lunch, and be members of an underrepresented ethnic group. Once the grant was in place, the percent growth in exam pass rate exceeded all other schools, and in 2015 the Urban Grant students were the only group to show growth; all other passing rates showed declines. Based on this observation, students who were the most disadvantaged or who were not routinely enrolled in AP courses showed more growth once exposed to academic support systems when compared to students who had been exposed to AP content more regularly. The school's pass rate grew by almost 15% while the school enrolled over 100 more students by the end of the grant years. The demographically similar students at the Urban

Comparison school experienced a steady decline of 15% over the same time period without the benefit of additional interactions over time in relationship to academic content.

Conclusion

My findings and the findings in other research illustrate that academic support systems are beneficial to students' academic outcomes, and especially effective for underserved students' academic success. Yet, achievement gaps persist for students of certain racial groups, for students who live in poverty, and others. The promise of closing these achievement gaps will depend on the willingness of educational decision-makers to provide the kind of academic supports, which will allow these underserved groups to achieve at a rate similar to their more advantaged peers. This not only empowers students, but is good for the economy of ideas, the productiveness of communities, and the future well-being of our world. Making decisions to positively influence the education of all students embodies the observation that Nelson Mandela made at the opening of the Nelson Mandela Institute for Education and Rural Development when he remarked that, "It is not beyond our power to create a world in which all children have access to a good education. Those who do not believe this have small imaginations" (Mandela, 2007). As Mandela suggests, the future success of all students will depend on educators' imaginations, and their intent and willingness to create educational environments where all students are given the resources necessary to fulfill their potentials.

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APPENDIX

Table 2
Student and School Demographics for AP Mathematics, Science, and English Enrollment 2011-2017

	N	Percent
Gender		
Female	1905	62.6
Male	1384	37.4
Ethnicity		
White	1978	60.1
Non-White	1311	39.9
Free and Reduced Lunch		
No	2782	84.6
Yes	507	15.4
Military Mobile		
No	2845	86.5
Yes	444	13.5
Grant Status		
Urban Grant	728	22.1
Urban Comparison	938	28.5
Suburban Grant	794	24.1
Suburban Comparison	829	25.2
Grant Implementation		
Pre-Grant (2011-2012)	770	23.4
Grant (2013-2015)	1423	43.3
Post-Grant (2016-2017)	1096	33.3

Note. Each variable in the table reflects the 3289 students in the sample

Table 3
AP Subject-Level Exam Scores and Letter Grades 2011-2017

Subject	Variable	N	Min	Max	M	SD
Calculus	Score	821	1	5	3.56	1.42
	Grade	869			4.02	.93
Statistics	Score	333	1	5	2.97	1.31
	Grade	375			3.90	1.07
Biology	Score	496	1	5	2.69	1.02
	Grade	550			3.84	.91
Chemistry	Score	319	1	5	2.17	1.14
	Grade	338			4.05	1.02
Physics	Score	410	1	5	2.78	1.14
	Grade	472			4.00	1.02
Language	Score	1622	1	5	2.89	1.04
	Grade	1634			3.89	.92
Literature	Score	794	1	5	2.88	1.04
	Grade	868			4.23	.83

Note. AP Grade is coded 1=F, 2=D, 3=C, 4=B, 5=A. AP Composite Scores fall between 1 and 5 with a 3 or better constituting a qualifying score.

Table 4
Student and School Relationship to Odds of Passing the AP Calculus Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-.533**	8.169	0.575	-42.5%
	-.0.104	0.311	0.901	-9.9%
Military Mobile	0.219	0.394	1.245	24.5%
	-0.379	1.610	0.684	-31.6%
Gender	0.333	3.707	1.395	39.5%
	-0.211	1.769	0.810	-19.0%
FRL	-0.579*	5.314	0.561	-43.9%
	-0.895***	12.862	0.409	-59.1%
Grant Status	-0.685***	14.356	0.504	-49.6%
	-0.127	0.585	0.880	-22.0%
Location	0.759***	13.311	2.116	111.6%
	-0.154	0.721	0.857	-44.3%
Pre-Grant Years		1.322		
		2.547		
Grant Years	-0.145	0.419	0.852	-13.5%
	-0.210	1.131	0.811	-18.9%
Post-Grant Years	0.231	1.248	1.260	26.0%
	-0.150	0.574	0.861	-13.9%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: $X^2(8, N=821) = 76.281$, p<.001
Nagelkerke R^2=13.3%
% Correct=76.7%

Grade: $X^2(8, N=869) = 19.997$, p<.05
Nagelkerke R^2=3.3%
% Correct=74.5%

Table 5
Student and School Relationship to Odds of Passing the AP Statistics Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.319	1.247	0.727	-37.3%
	-0.289	1.252	0.263	-83.7%
Military Mobile	-0.931*	4.365	.394	-60.6%
	-0.083	0.040	0.842	-15.8%
Gender	0.561*	4.459	1.752	75.2%
	0.486*	4.215	1.626	62.6%
FRL	-0.340	0.808	.712	-28.8%
	-0.586	2.858	.557	-44.3%
Grant Status	-0.199	0.460	0.820	-28.0%
	-0.444	3.076	0.641	-35.9%
Location	1.802***	34.990	6.059	505.9%
	0.537*	4.069	1.711	71.1%
Pre-Grant Years		0.859		
		5.172		
Grant Years	0.310	0.744	0.388	21.2%
	0.668*	4.637	1.950	95.0%
Post-Grant Years	-0.197	0.319	0.536	-46.4%
	-0.403	1.929	0.668	-33.2%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: $X^2(8, N=333) = 73.714$, p<.001
Nagelkerke R^2=27.3%
% Correct=73.6%

Grade: $X^2(8, N=375) = 28.327$, p≤.001
Nagelkerke R^2=10.1%
% Correct=68.5%

Table 6
Student and School Relationship to Odds of Passing the AP Biology Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.394	3.197	0.675	-32.5%
	-0.091	0.171	0.913	-8.7%
Military Mobile	0.162	0.293	1.176	17.6%
	0.129	0.182	1.138	13.8%
Gender	0.522*	6.138	1.686	68.6%
	-0.255	1.585	0.775	-22.5%
FRL	-1.531***	16.724	0.216	-78.4%
	-1.110***	14.539	0.329	-67.1%
Grant Status	-0.747***	11.510	0.474	-53.6%
	0.365	3.185	0.694	-30.6%
Location	0.786***	12.681	2.195	119.5%
	0.334	2.300	.1.396	39.6%
Pre-Grant Years		4.365		
		2.074		
Grant Years	-0.199	0.539	0.820	-28.0%
	0.324	1.551	1.382	38.2%
Post-Grant Years	-0.414	2.730	0.661	-43.9%
	-0.255	1.107	0.775	-22.5%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: $X^2(8, N=496) = 96.150$, p<.001
Nagelkerke R^2=23.7%
% Correct=69.0%

Grade: $X^2(8, N=550) = 35.513$, p<.001
Nagelkerke R^2=8.9%
% Correct=72.2%

Table 7
Student and School Relationship to Odds of Passing the AP Chemistry Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.448	2.334	0.639	-36.1%
Military Mobile	-0.880*	4.076	0.415	-58.5%
Gender	0.869**	9.899	2.384	138.4%
FRL	-1.348**	7.284	.0.260	-74.0%
Grant Status	-1.501***	19.409	0.223	-77.7%
Location	1.332***	11.486	3.787	278.7%
Pre-Grant Years		1.596		
Grant Years	0.068	0.036	1.071	7.1%
Post-Grant Years	0.368	1.268	1.445	44.5%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***
The model for AP Chemistry Grade was not significant: $X^2(8, N=338) = 35.904$, p=.122

Score: $X^2(8, N=319) = 78.181$, p<.001
Nagelkerke R^2=29.9%
% Correct=71.5%

Grade: $X^2(8, N=338) = 35.904$, *n.s.*
Nagelkerke R^2=5.5%
% Correct=76.0%

Table 8
Student and School Relationship to Odds of Passing the AP Physics Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.801**	9.108	0.449	-55.1%
Military Mobile	0.358	1.325	1.430	43.0%
Gender	0.540*	5.344	1.715	71.5%
FRL	-0.103	0.068	0.902	-9.8%
Grant Status	-0.962***	17.175	0.382	-61.8%
Location	-0.539*	4.430	0.584	-41.6%
Pre-Grant Years		19.968		
Grant Years	0.882*	4.198	2.416	141.6%
Post-Grant Years	0.826***	11.035	2.283	128.3%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***
The model for AP Physics Grade was not significant: $X^2(9, N=472) = 13.925$, p=0.184

Score: $X^2(8, N=410) = 77.009$, p<.001
Nagelkerke R^2=23.0%
% Correct=69.8%

Grade: $X^2(9, N=472) = 13.925$, *ns*
Nagelkerke R^2=4.0%
% Correct=73.3%

Table 9
Student and School Relationship to Odds of Passing the AP Language Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.748***	38.889	0.473	-52.7%
	-0.443***	11.255	0.642	-35.8%
Military Mobile	-0.012	0.005	0.988	-1.2%
	-0.027	0.020	0.974	-2.6%
Gender	0.312**	7.854	1.366	36.6%
	-0.330**	7.525	0.719	-28.1%
FRL	-0.461**	8.549	0.631	-36.9%
	-0.525***	10.784	0.591	-40.9%
Grant Status	-0.174	2.437	0.841	-15.9%
	-0.407***	11.236	0.665	-33.5%
Location	0.417***	11.984	1.517	51.7%
	0.637***	22.411	1.891	89.1%
Pre-Grant Years		7.831		
		4.288		
Grant Years	0.234	2.837	1.264	26.4%
	-0.243	2.655	0.784	-21.6%
Post-Grant Years	0.196	2.300	1.217	21.7%
	-0.090	0.386	0.914	-8.2%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***

Score: $X^2(8, N=1622) = 148.944$, p<.001
Nagelkerke R^2=11.9%
% Correct=67.3%

Grade: $X^2(8, N=1634) = 106.536$, p<.001
Nagelkerke R^2=9.3%
% Correct=74.2%

Table 10
Student and School Relationship to Odds of Passing the AP Literature Exam and Receiving an A or B in the AP Course

	B	**Wald**	**Exp(B)**	**% Change**
White_Non-White	-0.701***	16.899	0.496	-50.4%
Military Mobile	-0.377	1.237	0.686	-31.4%
Gender	-0.104	0.392	0.902	-9.8%
FRL	-0.660**	8.171	0.517	-48.3%
Grant Status	-0.987***	35.967	0.373	-62.3%
Location	1.053***	31.586	2.865	186.5%
Pre-Grant Years		8.335		
Grant Years	-0.387	3.580	0.679	-32.1%
Post-Grant Years	-0.286	1.930	0.751	-24.9%

Note. Results for Score are listed first, followed by Grade for each variable. Repeated contrasts are used for Grant Years. Ethnicity: White=0, Non-White=1; Military Mobile: No=0, Yes=1; Gender: Female=0, Male=1, FRL: No=0, Yes=1, Grant Status: No Grant = 0, Grant = 1, Location: Urban = 0, Suburban = 1. For AP Score, fail=0, pass=1, and Grade: CDF=0, AB=1. p≤.05*, p≤.01**, p≤.001***
The model for AP Literature Grade was not significant: $X^2(8, N=868) = 12.668$, p=.124

Score: $X^2(8, N=794) = 150.154$, p<.001
Nagelkerke R^2=23.3%
% Correct=72.4%

Grade: $X^2(8, N=868) = 12.668$, *ns*
Nagelkerke R^2=2.4%
% Correct=83.4%

Table 11
Overview of Logistic Regression Results for AP Test Score and AP Grade

		Mil Mob (Yes)	Gender (Male)	FRL (Yes)	Ethnicity (Non-White)	Grant (Yes)	Location (Suburban)	Grant Years
Calculus	Score			-43.9%	-42.5%	-49.6%	111.6%	
	Grade			-59.1%				
Statistics	Score	-60.6%	75.2%				505.9%	
	Grade		62.6%					1*
Biology	Score		68.6%	-82.4%		-52.6%	119.5%	
	Grade			-67.1%				
Chemistry	Score	-58.5%	138.4%	-74.0%		-77.7%	278.7%	
	Grade*							
Physics	Score		71.5%		-55.1%	-61.8%	-41.6%	2*
	Grade*							
Language	Score		36.6%	-36.9%	-52.7%		51.7%	
	Grade		-28.1%	-40.9%	-35.8%	-33.5%	89.1%	
Literature	Score			-48.3%	-50.4%	-62.7%	186.5%	
	Grade*							

Note. A percentage denotes a significant result and the odds of a student in each category passing the AP exam or receiving an A or B in the AP course. The category being compared is in parenthesis under each variable. An asterisk next to grade or score in column two indicates the regression model was *not significant*.
Grant Years is coded: pre, grant, and post-grant. An asterisk denotes a significant result within the Grant Years variable; the number preceding the asterisk indicates how may differences exist, but the specific category is not specified. Complete results are available in Tables 4 through 10.

Table 12
Percent Change in AP Exam Pass Rate 2012 to 2017 by School

	2012	*2013*	*2014*	*2015*	2016	2017
Urban Grant		-11.0	**+5.6**	**+3.6**	+6.3	-0.6
	36.4%	25.4%	31.0%	34.6%	40.9%	40.3%
Urban Comp		+0.9	-4.1	-4.2	-2.7	-3.8
	69.3%	70.6%	66.5%	62.3%	59.6%	55.8%
Suburban		**+7.0**	+0.3	-9.7	-1.0	**+2.7**
Grant	69.7%	76.7%	77.0%	67.3%	66.3%	69.0%
Suburban		+4.2	+0.9	-12.4	**+13.3**	-14.7
Comp	75.2%	79.4%	80.3%	67.9%	81.2%	66.5%

Note: The second column contains each school's AP Exam passing rate one year prior to grant implementation, and the starting point for successive percent change comparisons through two years post-grant. Grant schools and grant years are italicized. The highest percent increase in passing rate is bolded in each year.