Summer 8-11-2020

The Relationship Between the College Board AP Exam Registration Process and African- American Students' Mathematics AP Exam Participation Rates

Corey Williams
Georgia State University

ACCEPTANCE

This dissertation, THE RELATIONSHIP BETWEEN THE COLLEGE BOARD AP EXAM REGISTRATION PROCESS AND AFRICAN- AMERICAN STUDENTS' MATHEMATICS AP EXAM PARTICIPATION RATES, by COREY WILLAIMS was prepared under the direction of the candidate's Dissertation Advisory Committee. It is accepted by the committee members in partial fulfillment of the requirements for the degree Educational Doctorate in the College of Education and Human Development, Georgia State University.

The Dissertation Advisory Committee and the student's Department Chair, as representatives of the faculty, certify that this dissertation has met all standards of excellence and scholarship as determined by the faculty.

_____
Pier Junor Clarke, Ph.D.
Committee Chair

_____
Robert Hendricks, Ph.D.
Committee Member

_____
Christine Thomas, Ph.D.
Committee Member

_____
Date

_____
Gertrude Tinker-Sachs, Ph.D.
Chairperson, Department of Middle and Secondary Education

_____
Paul A. Alberto, Ph.D.
Dean College of Education and Human Development

AUTHOR'S STATEMENT

By presenting this dissertation as a partial fulfillment of the requirements for the advanced degree from Georgia State University, I agree that the library of Georgia State University shall make it available for inspection and circulation in accordance with its regulations governing materials of this type. I agree that permission to quote, to copy from, or to publish this dissertation may be granted by the professor under whose direction it was written, by the College of Education's director of graduate studies and research, or by me. Such quoting, copying, or publishing must be solely for scholarly purposes and will not involve potential financial gain. It is understood that any copying from or publication of this dissertation, which involves potential financial gain, will not be allowed without my written permission.

_____

Corey Williams

NOTICE TO BORROWERS

All dissertations deposited in the Georgia State University library must be used in accordance with the stipulations prescribed by the author in the preceding statement.

The author of this dissertation is:

Corey A. Williams
Middle and Secondary Education
College of Education and Human Development
Georgia State University

The director of this dissertation is:

Pier Junor Clarke
Department of Middle and Secondary Education
College of Education and Human Development
Georgia State University
Atlanta, GA 30303

CURRICULUM VITAE

Corey Williams

ADDRESS: 8184 Plantation Trace
Covington, Georgia 30014

EDUCATION:

Ed.D.	2020	Georgia State University Curriculum and Instruction
M.A.T.	2012	Georgia State University Teaching of Secondary Mathematics
B.S.	2007	Georgia State University Mathematics

PROFESSIONAL EXPERIENCE:

2017- Present	Assistant Principal/Assistant Director, Testing Coordinator Rockdale Magnet School, Rockdale County School District
2013-2017	Executive Director of School Services, Math Director National Academic Educational Partners, Miami Florida
2012-2013	STEM Mathematics Teacher Newton College and Career Academy, Newton County Schools
2008-2012	Mathematics Teacher Martin Luther King Jr. High School, Dekalb County School District

PROFESSIONAL SOCIETIES AND ORGANIZATIONS:

2019	Georgia Association of Student Council's Outstanding Administrator of the Year
2019	Outstanding STEM Student Program: Peer Mentor
2018	National Consortium of Secondary STEM Schools Board Member

THE RELATIONSHIP BETWEEN THE COLLEGE BOARD AP EXAM REGISTRATION PROCESS AND AFRICAN- AMERICAN STUDENTS' MATHEMATICS AP EXAM PARTICIPATION RATES

By

Corey Anthony Williams

Under the Direction of Pier Junor Clarke

ABSTRACT

College Board implemented a new Advanced Placement Registration Process (APRP) for the 2019-2020 school year. In this study, I argued that the change in the APRP would affect African American student's motivation to participate in mathematics AP exams more disproportionately than other racial groups due to earlier registration and mandatory fees if students change their minds. This quantitative study was grounded in Self-Determination Theory to examine if the APRP affects African American students' feeling of autonomy, competency in their mathematics AP course, and overall intrinsic motivation to register for a mathematics AP exam. The data collected from the survey were analyzed using a one-way ANOVA test, which identified that students who registered for an AP mathematics exam had a stronger sense of

competence versus students that did not register for the exam. The findings from this study suggest that while the College Board may be continuing to try to increase AP access to African American students, there needs to be a review of their new AP Registration Process and how it could disincentivize African American students to register for an AP mathematics exam.

INDEX WORDS: Autonomy, Competency, Relatedness, Advanced Placement

THE RELATIONSHIP BETWEEN THE COLLEGE BOARD AP EXAM REGISTRATION PROCESS AND AFRICAN- AMERICAN STUDENTS' MATHEMATICS AP EXAM PARTICIPATION RATES

By

Corey Anthony Williams

A Dissertation

Presented in Partial Fulfillment of Requirements for the

Degree of

Doctor of Education

In

Teaching and Learning

In

the Department of Middle-Secondary Education

In

the College of Education and Human Development

Georgia State University

Atlanta, Ga

2020

ACKNOWLEDGMENTS

First, I would like to thank each of the members of my Dissertation Committee, who have provided me fantastic guidance to be a better writer and researcher. I would especially like to thank Dr. Pier Junor Clarke, the chair of my committee. As my teacher and mentor, she has taught me more than I could ever give her credit for here. I deeply thank my parents Kelly and Ike Williams, for their unconditional trust, timely encouragement, and endless love. Finally, I thank the love of my life, Kimberly. She understands me better than anyone, and she has been my best friend, has loved, supported, encouraged, entertained, and helped me get through this long process in the most positive way. Finally, I want to thank my two wonderful children, Kourtney and Cody, who provide constant inspiration.

Table of Contents

LIST OF TABLES

ABBREVIATIONS

AP	Advanced Placement
APRP	Advanced Placement Registration Process
CCRPI	College and Career Readiness Performance Index

Chapter 1: Introduction

Introduction

The College Board Advanced Placement (AP) Program, initiated during the early 1950s, was a response to growing concerns regarding the educational needs of secondary school students who did not have access to high-level coursework. High school students have the opportunity to choose from 30 different AP courses and earn college credit by successfully completing AP exams. What distinguishes AP classes from general or accelerated courses is the option to take an end-of-course AP exam. When a student completes an AP examination, they can earn a score from 1 to 5 where a score of 3 or above is considered passing (College Board, 2014). Most higher tier colleges and universities now only accept scores of 4 or 5; however, many institutions still accept a 3 for course credit (College Board, 2018a). Students who attain scores of 3, 4, or 5 often have an advantage in admissions, and students who earn course credits will be allowed to graduate early, thus helping them to reduce the cost of acquiring an undergraduate degree (Moore, Combs, & Slate, 2012). Top colleges are looking to see if high school students are taking rigorous coursework during the admissions process. Studies have shown that students that take AP exams earn higher grade point averages, are more likely to earn a bachelor's degree, and have higher incomes than non-AP students (Flowers, 2008). Also, African American students taking AP courses can minimize the effects of low socioeconomic high schools on students' success and achievement in college (Cisneros, Holloway-Libell, Gomez, Corley, & Powers, 2014). When students were successful on the AP Calculus AB exam and other mathematics AP tests, students

were more likely to earn a degree in technology, engineering, or a science field (Sadler, Sonnert, Tai, & Klopfenstein, 2016).

Data from the U.S. Bureau of Labor Statistics (BLS) asserts that employment in occupations related to STEM, science, technology, engineering, and mathematics, is projected to grow to more than 8 million between 2018 and 2028 (U.S. Bureau of Labor Statistics, 2020). STEM jobs have a median annual wage of nearly $86,900, which is more than double the $38,160 median salary for all other workers (U.S. Bureau of Labor Statistics, 2020). High schools across the nation are now trying to offer advanced-level courses to meet the demand of college-level workers. Therefore, the College Board's AP program has become the standard for rigorous coursework in high school and is what colleges look for during the admissions process.

Between 1987 and 2012, the number of students participating in the AP program increased by 682%, from 258,442 in 1987 to 2,022,722 in 2012 (College Board, 2016a). This increase coincided with an increase in high school enrollment of only 22.3%. Over the past four decades, the AP program has experienced exceptional growth in the number of students participating and tested. For example, in 2000, approximately 844,741 students took AP exams; however, the graduating class of 2016 had 2,741,426 students who took AP exams with a total of 4,957,931 exams taken (College Board, 2016a). Incentives such as waivers to pay for exams for low-income students, AP classes graded on a 5-point average scale, and the opportunity to earn college credit by passing AP exams have been implemented to increase participation (Hallett & Venegas, 2011).

College Board piloted a new AP registration process for the 2018-2019 school year. Over 800 schools participated in the new process and rolled it out to all schools offering AP courses for the 2019 -2020 school year (College Board, 2018b). During the

pilot program, the College Board had four webinars throughout the school year to support school-based AP coordinators during the implementation. College Board has called this change the most significant change in the history of the company, which includes an overhaul to how students access resources, register for AP exams, and the financial cost for AP exams (College Board, 2018a). The most significant change for school-site AP Coordinators and students is that AP Exam orders must now be submitted by November 15th.

Problem Statement

In contrast, in previous years, the deadline for ordering AP exams was March 15th. Therefore, students have to decide about taking and paying for an AP exam while only being in the course one to three months, depending on their school's start date. College board has also implemented a $40 late registration fee for students that choose to wait after the new earlier deadline of November 15th to register compared to the previous deadline of March 15th.

Purpose of the Study

The purpose of this study is to assess if the College Board's new APRP affects African American students' intrinsic motivation to register for mathematics AP exams. The College Board advocates for equity and access for all minority students, and this study examines whether the new College Board registration policies have an adverse effect on African Americans students intrinsic motivation to register for AP mathematics exams. The study also looks to provide recommendations for building level leaders to promote advanced-level course for African American students that have been historically disenfranchised in the area of access to high-level coursework.

Research Questions

The overall research question that is driving the study is, what is the relationship between the College Board AP exam registration process and African American students' mathematics AP exam participation rates? This is further broken down into the following sub-questions:

1. How does student autonomy effect African American students' motivation to register for mathematics AP exams?
2. How does student competency effect African American students' motivation to register for mathematics AP exams?

Significance of the Study

College Board has implemented various initiatives to encourage AP course participation of minority students from low SES schools. Students that qualify for Free/Reduced Lunch receive $32 per exam reduction, and state Departments of Education provide these AP exam waivers for those students (College Board, 2018a). These reduced AP exam fees, along with training for teachers to teach AP courses and other school-site based initiatives have increased the number of African American students taking exams (College Board, 2014).

College Board is currently in the full implementation of the new AP Registration Process (APRP), where students must register and pay for their AP exams by November 15th. AP exams now take place during the first and second week of May. Students that choose not to register for their AP exam by the date mentioned above will incur a $40 fee per exam if they decide to register for an exam after the November 15th deadline. Students that also choose not to take an AP exam after the November 15th deadline are

charged a $40 cancellation fee. Previously, students had until March 15th to decide whether to register and pay their exam fees for an AP course. This change has moved the deadline up by four months, and students have 10-12 fewer weeks of instructional time to decide depending on the school district. College Board (n.d) states that under the APRP, "More students earn college credit and placement when they register in the fall and will improve students' chances of success" (para 1). Also, "students are more engaged and less likely to give up," and "students will be more likely to earn a score of 3 or higher "(College Board, n.d., para 3). There is currently no research on the implementation of the new process since 2018-2019 was the pilot year. This study possibly could indicate if the new APRP aligns with College Board's stance that "No matter a student's location, background, or socioeconomic status, all students have the right to fulfill their AP potential" (College Board, 2014, p. 4).

Summary

In this chapter, I introduced the problem to be investigated and how it is situated in the context of social justice for African American students. In the next chapter, I will examine and review the literature on African American students' success in mathematics, student access to advanced-level coursework, and student motivation. Research shows that African American students have fallen behind their White counterparts when comparing mathematics achievement. There is a lack of research on the new policies that the College Board implemented and how it affects students' motivation to participate in an AP mathematics course and take the AP exam. This review will set the stage to connect the problem statement to the theoretical framework of Self-Determination Theory.

Chapter 2: Review of the Literature

Introduction

A review of the relevant literature related to the College Board's AP program, particularly regarding participation among minorities, has identified a growing concern about the low participation rates of African American students and low success rates on AP exams (Clark, Moore, & Slate, 2012). Traditionally African American students have been underrepresented in AP courses due to a lack of access. Based on Burton, Whitman, and Yepes-Baraya's (2002) work, African American students were the most underrepresented group in AP classrooms and the lowest-performing AP exam test takers. Most schools will have students that are performing below grade level. Still, there also exists an achievement gap where high achieving students do not get the opportunity to participate in AP or honors courses (Taliaferro & DeCuir-Gunby, 2008). Ignoring this gap could have significant implications for disparities in college enrollment and retention.

In this chapter, I looked at three issues. First, I examined the cultural struggles and inequities African American students face in the mathematics classroom. Secondly, the history of African American students' access to College Board AP program courses and its significance in academic achievement for students of different racial, ethnic, and economic backgrounds were reviewed. Lastly, there was a focus on what the literature discussed regarding how student motivation is impacted by different factors such as teachers, peers, parents, curriculum, tracking in schools, and access to previous rigorous coursework.

African American Students in the Mathematics Classroom

Documenting the experiences of African American students' academic development in public schools is vital to improving their mathematics achievement (Gholson, 2016; Jett, 2015; Johnson, Pietri, Fullilove, & Mowrer, 2019; Murrell, 1994). Before African American students even walk into a classroom, they are fighting the uphill battle of stereotypes. The media demonizes Black boys as thugs and troublemakers (Jett, Stinson & Williams, 2015; Murrell, 1994), while Black women are stereotyped as masculine, angry, and welfare recipients (Gholson, 2016). Once in the classroom, African American students must overcome these stereotypes to try and fit into a "White" cultural class they then code switch to continue life at home within their communities and cultures (Jett, et al., 2015; Lim, 2008; Murrell, 1994).

Institutional prejudice has had a penetrating effect on both mathematics teachers and the Black students they teach. Placement mathematics exams, traditional mathematics content, and web-supported mathematics content administered to African American students are constructed within a White cultural context. This not only distances African American students' culture from the mathematics taught in the classroom but also stratifies African American students into hierarchical 'ability' groups with similar low achievement expectations (Jett, 2013). To become more powerful and dynamic educators, teachers must be aware of the various racial, ethnic, and cultural differences among our students (Jett, 2013; Lim, 2008). Educators that have been deemed as "good teachers" by students and colleagues must also tap into the brilliance of their Black students. African American students are challenged with dilemmas of acceptance from their peers, teachers, and the notion that if they succeed in mathematics, they are acting "White." The use of culturally relevant pedagogy is

imperative in disrupting this Whiteness of mathematics (Jett, 2013). In efforts to develop a curriculum that empowers and uplifts Black students, that being African American is not a monolithic experience, African American students have different experiences at the intersection of their many cultural identities.

The learning experiences of African Americans in a mathematics class is different from White people (Lim, 2008). Stereotypic societal views often influence how teachers and peers are treating African American students (Jett, 2013). Teachers having lower expectations from students of mixed race or religion hinders and not only stunts their educational growth but also causes students to not identify with the school. Researchers explain that the low mathematics performance of African American males is based on the contrast in cultural norms and beliefs between Black male students and their mostly Caucasian female teachers (Stiff & Harvey, 1988). "The mathematics classroom functions under a set of values, orientations, and expectations that are unlikely to be the same as those in the African American culture" (Snipes, 1997, p. 15). Current mathematics educational practices do not support the cultural identity of African American students; furthermore, robbing them of their mathematics identity (Jett, 2013). Coupled with the teacher workforce being comprised predominately of White Americans, many African American male and female students face marginalization of their ability to learn mathematics by teachers that do not understand or accept their cultural identity in the classroom (Corey & Bower, 2005; Jett, 2013; Lim, 2008).

There have been attempts to remove the oppressive limitations placed on African American students' mathematics brilliance through research of the effects of implementing culturally responsive pedagogy and researching the efficiency of online learning (Corey & Bower, 2005; Jett, 2013). Whether culturally responsive pedagogy or

online learning is a tool to help counter the oppressive classroom environment, equally important, is the discussion around the implicit bias and racism that is embedded in the minds of White American teachers about the mathematics identity of African American students. Frequently, the bias about African American students is displayed in the disproportionate recommendations of remedial level mathematics courses, low expectations of career attainability, and the expectations of assimilation to White American social norms (Corey & Bower, 2005; Jett, 2013; Lim, 2008). These recommendations display the lack of capital and power African American students have regarding the mathematics courses they are scheduled into and what content is being taught in those classrooms.

Capital in the Mathematics Classroom

Nasir and de Royston (2013) discuss how the lack of cultural capital, social capital, student identity, and power has affected African American students' success in the mathematics classroom. When addressing the mathematical needs of our students, we cannot separate the identities, cultures, and experiences of our students. Social capital is a valuation of an individual's network. It receives its valuation based on the potential gains that it may bring through relationships with individuals that have power in the dominant society (Bourdieu, 1986). An example of social capital is the phrase, "it's not what you do; it's who you know." Identity is developed by alignment to entities that deemed as cultural wealth (Nasir & de Royston, 2013). The capital that people of historically marginalized groups have is usually the capital that is not valued. As African American students participate in various forms of capital, the relationship between power and identity becomes more prevalent. Nasir and de Royston (2013) state that a focus on power is central for upper-class and middle-class families to maintain their

elevated position within the social hierarchy. The upper class wishes to maintain this power; therefore, there is a hesitation for teachers and White students to embrace how African American students learn. Davis (2018) states that to liberate the African American students' mathematics identity is to provide them with critical information about their ancestors' achievements and the significant contributions they made to mathematics. African American students are expected to dwell in a White world of mathematics that does not even attempt to value African American students' ways of knowing or to contribute to African American people economically, culturally, or historically (Jett 2013).

Davis (2018) reveals that learning mathematical theories to pass tests or achieve high paying jobs should not be the objective of African American students. Currently, a student's racial ideology is connected to their perceptions of other racial groups' success in mathematics. Shah (2017) discusses the prevalence of race, racism, and racial identity in the classroom and how mathematics is a subject that is often referred as being "race-neutral"; however, research has revealed that mathematics is not "race-neutral" (Chazan, Brantlinger, Clark, & Edwards, 2013; Davis 2018). As an education system, we continue to promote hierarchies by focusing on subcategories within standardized tests. This hierarchy persists because "test scores and grades of White students are usually situated as the standard for how Black student success and high achievement are judged" (Davis, 2018, p. 70). In many instances, African American students are comparing themselves to the group of students who came before them and believed that African American and Hispanic students couldn't be successful based on that data. As Shah (2017) points out, race can serve as building blocks in people's narratives. When

teachers accept or act on these narratives of different racial groups, prejudice sets in all students are not given equal access to a quality education.

Research has produced extensive evidence that shows a trend in the narratives about Asians and African Americans. Moreover, students identified the mathematics hierarchy as follows: Asians, then White Americans, and finally, African Americans and Latinos (Shah, 2017). For instance, Asian students' perceived identity is to be invariably proficient in mathematics, whereas African American and Latino students are perceived to have the least favorable mathematics identity. Many students tend to describe their perceptions of themselves based on what other people believe. Therefore, "racial hierarchies of mathematical ability are constituted by racial hierarchies in other domains of everyday life" (p. 35). Teachers have to recognize this inequity and not contribute to the narrative that African American students are mathematically inferior to other racial groups.

Martin (2006) suggests that teaching practices cannot be accepting of and motivated to close the achievement gap, and also, simultaneously, motivated by a belief in the brilliance of Black children. Once you accept the racial achievement gap, one is accepting the assumption that Black children are inferior academically, thus, from that point on, the ways in which you teach, interact with, engage in discourse, and frame Black children are faulty (Martin, 2006). The verbiage and entire concept of an "achievement gap" are incredibly problematic, and Ladson Billings (2006) states that instead of the existence of an "achievement gap," an "educational debt" is owed to Black students to account for the repeated historical maltreatment and resource deficiencies. Although teachers cannot change the curriculum, they can take steps to increase opportunities and encourage African American students in our classrooms. A barrier for

teachers of African American students is that it is hard to find proposed Black solutions for Black problems. "School curriculum suppresses multiple voices and perspectives while simultaneously legitimizing the dominant White male upper-class ways of knowing and being as the "standard" that all students should be required to emulate" (Davis & Martin, 2018, p. 52). If we are to believe in the brilliance of African American students, we cannot teach that their brilliance rests solely on a numerical number that represents their level of intelligence, by way of the white standard being the barometer, which subsequently promotes white superiority (Gould, 1981; Davis & Martin, 2018). To combat standardizing testing, teachers' instructional practices must take into account how students learn and change from the traditional way of teaching that has been implemented for years.

Documents such as the National Council of Teachers of Mathematics (1989) Curriculum and Evaluation Standards for School Mathematics reflect a growing body of work focusing on the importance of the nature of students' understandings and the mathematical meaning created by students as they participate in mathematical activities" (p. 214). Nasir (2002) points out that students learn mathematics in more of a disjointed and less natural fashion. Where school practices "proceed in a piecemeal fashion, with one set of skills building on prior ones" (p. 242). Nasir (2002) suggests that if we follow a more authentic approach to learning mathematics, students wouldn't just be solving problems created by a person hundreds of miles away who never laid eyes on the students. Students could solve real-world problems that connect with their culture and their interest "perhaps in the service of a non-mathematical goal" (p. 242).

African American Students Access to AP Courses

Advanced Placement testing began in 1955, and by the 1960s, schools in the South were told they had a choice of either integrated testing centers or being denied by the College Board to administer exams (Havis, 2015). By 1985 only 2,768 black students were taking AP courses in the United States, and at that time, African Americans made up just one percent of the more than 270,000 AP students (Cross, 2008). Rice et al. (2015) argue that the failure to allow access to high-quality education to all students hinders African American students in their individual career pursuits, weakens society, and threatens that our nation will not be able to maintain its economic strength. Solorzano and Ornelas (2004) discuss that parents of affluent White students argued that Black and Hispanic kids simply weren't ready for the rigors of AP and "they should be shielded from failure" (p. 4). This mode of thinking perpetuates the narrative that if African American students were allowed to take AP courses, then the AP program would be forced to reduce the rigor of the curriculum, or the teachers would have to go more slowly. These narratives have made it more challenging for the expansion of the AP program in African American schools across the nation.

Schools around the nation are implementing initiatives to reduce barriers for African American students to have access to AP courses. These actions taken by schools across the county could motivate African American students to take classes for the challenge and have an impact on whether students take the AP exam. When controlling for prior academic performance, current academic achievement, and economic background, students who participate in AP programs and take the exams consistently perform better on a range of college outcomes than their peers who do not take AP courses (Warne, Larsen, Anderson, & Odasso, 2015). Klopfenstein (2004) found that

schools with a high number of low-income students substantially increased their AP offerings from 1994 to 2000, and schools with a small low-income presence also increased their AP offerings even more over the same period. Nationally from 1987 through 2018, the number of students participating in the AP program increased 1055%, from 258,442 in 1987 to 2,727,480 in 2018 (College Board, 2018b). Over the past four decades, the AP program has experienced exceptional growth in the number of students participating and testing. This increase coincided with an increase in high school student enrollment of 22.3% (McFarland et al., 2018). Though there has been an increase in the number of students enrolling in AP courses, systems that track students into low-level course work have disproportionality affected African American students to limit access to high-level coursework.

Tracking

There have been strides to increase the number of African American students taking and succeeding on AP exams. Given that this study focuses on students in AP courses, we must discuss the reality that African American students make up a large portion of students placed into low-tracked courses and do not have access to AP courses. School structures such as tracking determine which students take advanced coursework and which do not. Tracking is the practice of dividing students into separate classes for high, average, and low achievers where different curriculum paths are offered for students headed for college and for those who are bound directly for the workplace (Oakes, 2005). Nearly all high schools track students in some form. Since tracking enables schools to match the curriculum to particular groups of students, it is believed to promote higher achievement for all students under conditions of equal educational opportunity (Oakes, 1985). However, instead of promoting higher achievement, tracking

contributes to low-quality education for most secondary students and particularly African American students (Oakes, 1986b).

In the early 1900s, policymakers, school practitioners, and the public turned their sites to achieve the goals of excellence and quality in education. In the attempts to "equalize" schooling, critics imply that trying to correct inequality may have compromised the central mission of the schools: teaching academics well (Oakes, 1986a). During this time, the United States was in a precarious position in the global competition for economic, technological, and military superiority, where they felt they could no longer sacrifice the quality of our schools to social goals. This view shifted the focus of education to spend resources on the best return on investment, which at that point in history was human capital. In 1908 the superintendent of schools in Boston articulated this shift: "Until very recently [the schools] have offered equal opportunity for all to receive one kind of education, but what will make them democratic is to provide an opportunity for all to receive education as will fit them equally well for their particular life work" (Boston Schools, 1908). Phrased in economic terms, special provisions for underachieving poor and minority students become a bad investment. In short, “equality is out; academic excellence is in” (Oakes, 1986b, p. 9).

Tracking helped to institutionalize beliefs about race and class differences regarding student intellectual abilities. Tracking has also facilitated the construction of obstacles to the future social, political, and economic opportunities of those who were not white and native-born (Oakes, 1986b). Historically remedial and vocational education were considered ideal pathways for minority students, while college preparatory courses were deemed to be appropriate for White students (Karlson, 2015). This was an early development of academic tracking with the intent to separate students

based on economics and race but was touted as placing students based on ability. Yet the research consistently shows that tracking itself significantly contributes to the racialized-achievement gap, and districts that have de-tracked have dramatically narrowed the achievement gap between white and minority students in their communities (Karlson, 2015). But, educators resist an end to tracking because they have had extensive experiences teaching heterogeneous groups at the secondary level and "they cannot imagine mixing what they believe to be two or three distinctly different groups of students and maintaining the high quality of instruction that they now see high-ability groups receiving" (Oakes, 1986a, p. 5). This lack of belief in all students' abilities has perpetuated the narrative that certain racial groups are higher performing than others and that by separating students, schools are able to give is equal quality education.

Curriculum tracking is the way students are sorted to pursue particular programs of study and is generally a secondary school practice (Meier, Stewart, & England, 1989). However, grouping students by ability or interest begins long before they enter middle or high school. Tracking in American schools often contains a racial and socioeconomic element. Black students are more likely to be tracked in the vocational curriculum, Hispanic students in the general curriculum, and Asian and White students in academic or advanced placement curricula (Oakes, 1990). It is also well documented that Black and Hispanic boys are overrepresented in special education programs. Often these students are placed in special education programs not because they have been diagnosed as having special learning needs but because they may have behavioral problems (Kotok, 2017). Even as schools voice their commitment to equality and

excellence, the practice of tracking organizes and delivers curriculum in ways that do not advance equality or academic excellence (Kotok, 2017).

Tracking in mathematics, or separating students into classes by ability level, exists in some form in schools across the nation and is a system that perpetuates existing racial and class inequities (Oakes, 2005). Interestingly, African American students are among a large subgroup that is disproportionately placed into the lower tracked mathematics classes due to cultural assumptions of ability (Sneyers, Vanhoof, & Mahieu, 2018) or lack of prior math opportunity from living in a low-income area. Not only does placement into a low-level track limit future mathematics opportunity, but the literature also shows that teachers of low-track classes use lower-level instructional methods (Oakes, Muir, & Joseph, 2000), and students are psychologically impacted by their low placement (Karlson, 2015). Students, who are tracked to low-level courses, do not have access to the same high-quality content, high expectations, or challenging teaching provided to students in our more traditional academic programs (Oakes, 2005). Therefore, students in the less challenging courses are not prepared to take, much less pass, required state-mandated tests, which hold increasingly high stakes for them and their future. Many African American students are excluded from the academic curriculum that contains the gatekeeper courses (Algebra, Chemistry, and Advanced English), which prepare students to pass the tests (Oakes, 2008). In other words, because of tracking, students are being tested on content they have not had the opportunity to study, much less learn. Further, this stands out as a complete contradiction for the call for higher and more rigorous standards while maintaining a tracking system that systematically denies many African American students'

opportunities to learn what they need to meet the academic requirements mandated by their state.

Tracking is exacerbated by the inflexibilities and idiosyncrasies of master schedules by school administrators, which can create unplanned tracking, generate further variations among tracking systems, and affect the courses taken by individual students as well (Oakes, Muir, & Joseph, 2000). Despite the variations of tracking, Oakes (1986a) discusses the common and predictable characteristics:

- Classes and tracks are labeled according to the performance levels of the students in them (e.g., advanced, average, remedial) or according to students' postsecondary destinations (e.g., college-preparatory,).
- The curriculum and instruction in various tracks are tailored to the perceived needs and abilities of the students assigned to them.
- The groups that are formed are not merely a collection of different but equally-valued instructional groups. They form a hierarchy, with the most advanced tracks (and the students in them) seen as being on top.
- Students in various tracks and ability levels experience school in very different ways (p. 4).

These practices could send the message that some students cannot learn at all and that less-capable students will suffer emotional as well as educational damage from daily classroom contact and competition with their brighter peers (Oakes 1986a; Oakes 198b). It is necessary to have a system that matches students to appropriate courses, so students are not overwhelmed with the rigor of high-level coursework. Though tracking serves diverse needs but does not guarantee the same quality of learning for all students.

Klopfenstein (2003a) argues the accelerated pace and rigorous college-level curriculum of AP classes are not appropriate for all students. Based on this thinking, schools must have a process to decide which students are prepared to take an AP class. The downside is when tracking denies students access to rigorous coursework and quality teachers. Taliaferro and DeCuir-Gunby (2008) state explicitly that "early tracking was responsible for the lack of African American student success in AP courses and advisors did not believe that the students could perform in those higher-level courses" (p. 175). Since tracking has historically prevented African American students from enrolling in AP courses, this could have an effect on students' motivation to enroll in AP mathematics courses if students do not see their peers taking AP courses or being successful on AP exams.

Another form of tracking is "laissez-faire" tracking where students and their parents have more influence on what classes they take. In high schools, students have more options for courses and pathways they can take, which requires parents and students to be active in the course selection process. African American parents were found not to be as informed as other parents of different ethnicities when it comes to access to AP programs and to match the correct course to their child's ability (Taliaferro & DeCuir-Gunby, 2008). Ainsworth (2012) found that White parents were more likely to push school administrators to place their students in advanced classes while African American students struggled with their sense of social and academic belonging in advanced courses in ways that White students were not forced to deal with. This continuous tracking process in our schools sets low expectations for African American students and makes it more difficult for them to succeed in AP courses if they have not had previous experience with advanced coursework (Ainsworth, 2012). Even when

minority students attend more racially and economically diverse schools, they are more likely to be enrolled in lower track courses (Archbald, 2012). Further, Lee (2012) suggests the notion of advanced courses as "White classes" is almost non-existent in predominantly minority schools since the tracking does not take on this racialized identity. Students in majority-minority schools could still feel the effects of tracking into low-level courses when outside perceptions could assume that White students being picked for AP courses and African American students are not. This is critical because this could affect students' perceptions of their achievement in advanced-level coursework, where African American students are not motivated to excel. After all, if students feel like they do not belong, the opposite also could occur where students in low-level classes are underperforming because they think they are not challenged and have lower expectations. Schools are continuing this system of tracking, which could have implications on student achievement as African American students matriculate through high school and go to college.

Lee's (2012) study showed that the correlation between 12th-grade mathematics achievement and 4-year college completion was high, whereas the relationship between 8th-grade mathematics achievement and four-year college completion was relatively weaker. The results concluded that this pattern was true when using elementary or middle school mathematics achievement to predict the end of 8th-grade proficiency for college readiness. A teacher at a high school in the study said:

> It has to start early. Students have to be challenged at an early age. Because if you try and wait until high school to jump into an honors course or an advanced-level course, the student will probably be lost. The danger of tracking students to low-level coursework based on elementary and middle school

> performance could deny a student access to advantages mentioned above of advanced courses and could widen the achievement mathematics achievement gap (Taliaferro & DeCuir-Gunby, 2008, p. 7).

Therefore, the lack the experience in advanced coursework in 8th grade could make it harder for students to succeed in secondary school. Most schools will have students that are performing below grade level, but there also exists an achievement gap where high achieving students do not get the opportunity to participate in AP or honors courses (Taliaferro & DeCuir-Gunby, 2008). Ignoring the difference between high achieving students and enrollment in AP courses could have significant implications for disparities in college enrollment and retention.

Oakes (2005) and (Kotok, 2017) reiterate that teachers and school administrators are under the assumption that tracking promotes overall student achievement. In other words, the academic needs of all students in their building will be better met when students are grouped in classes with students of similar capability es or prior levels of achievement. Tracking in schools is seen as the best way to address individual needs and to cope with individual differences. This way of thinking stems from the belief that "students' capacities to master schoolwork are so disparate that they require different and separate schooling experiences" (Oakes 1986a, p. 6). Though teachers may think it is easier, it is a fallacy to conclude that the instruction for any group of students should not require considerable variety in instructional strategies, tasks, materials, feedback, and guidance. A profound ethical concern emerges when individual differences in aptitude, ability, or interest as the basis for curricular variation deny students equal access to the knowledge and understanding available to humankind (Oakes,1986b).

To combat the effects of tracking, Berry (2003) suggests that NCTM Process Standards are consistent with African American student learning preferences and serves as a backbone to quality mathematics teaching. Similarly, Hale (2016) also suggests that the learning preferences of African American students need to take into consideration when planning lessons, such as holistic learning, inferential reasoning, approximation, and freedom of expression. Finally, Eglash and Bennett (2009) present a great example of a culturally situated design tool (CSDT) that teachers can use for African American students to invite greater depth in mathematical discourse. Along with increasing the quality of pedagogical strategies, teachers of African American students in the low-track math courses need to be aware of methods to help increase self-concept and mathematical identity. Additionally, if teachers implemented the NCTM Process Standards and valued the learning preferences of African American children, their mathematical achievement and success will naturally follow, thereby improving their mathematics identity (Berry, 2003; Hale, 2016).

To conclude, the unfortunate reality is that the current system of mathematics tracking often leads to a disproportionate amount of African American students in the low-tracked courses, where they suffer from lower self-esteem along with low-quality teaching. To avoid a self-fulfilling prophecy where African American students are stuck in a cycle of placement in low tracked classes which leads to low self-concept and therefore, low math achievement, teachers can take recommendations from the literature to change instructional practices. By using researched-based classroom strategies, teachers can counter the negative impacts of mathematics tracking by improving their pedagogical practices to be more culturally situated and therefore allowing African American students to achieve in mathematics.

Opportunity to Learn

The AP program offers the opportunity for some students to overcome barriers such as low SES schools and lack of access to rigorous coursework that prevents them from going to college. College Board implemented an Equity and Access Initiative in 2002 to encourage diversity in AP courses and to drive the inclusion of lower ability students. The Equity and Access Initiative states that:

> The College Board strongly encourages educators to make equitable access a guiding principle for their AP programs by allowing all willing and academically prepared students to participate in AP. We encourage the elimination of barriers that restrict access to AP for students from ethnic, racial, and socioeconomic groups that have been traditionally underrepresented. Schools should make every effort to ensure their AP classes reflect the diversity of their student population. (College Board, 2014, p. 1).

In support of this initiative, school districts around the US have aimed to increase the number of students who participate in AP courses as part of a larger strategy to improve education equity for traditionally underrepresented students (Rice et al., 2015). With a charge to increase participation for minority students, there is no mention in the Equity and Access statement directed toward student achievement on the AP Exam. All efforts have been to increase participation in the courses. The connection between students' success on AP exams and whether they are motivated to take the AP exam once in the course might have been overlooked by College Board.

Continued access to AP courses for African American students aligns with Schmidt et al. (2001) and Floden's (2002) definition of Opportunity to Learn (OTL), which is student exposure to effective teachers, curriculum, and time spent on teaching.

The conception of opportunity to learn (OTL) is based on work by Carroll (1963) and grounded on the assumption that students' ability to learn a subject depends on how long they are exposed to it in school. Carroll's model of student learning was dependent on student factors such as aptitude, ability, perseverance, and elements controlled by teacher, i.e. time allocated for learning and the quality of instruction. Carroll's definition of OTL seeks equality of "opportunity" and not necessarily equality of attainment of knowledge (Carroll, 1963). Work by Schmidt et al. (2001) defines OTL in terms of specific content, and Schmidt et al. (2011), dove deeper to conclude that greater OTL in mathematics was related to higher student achievement in mathematics. The definition of OTL has evolved over the years to include teacher quality, resources, and peers. Floden (2002) added that OTL included the time teachers plan to spend teaching a topic in addition to the time teachers spent teaching a topic or the time a student is present when learning a topic is measured. What more closely aligns OTL with this study is the work by Schmidt et al. (2001) and Floden (2002), who associated OTL with the implemented curriculum. The intended curriculum includes the content standards used to guide instruction, whereas the implemented curriculum represents the percentage of instructional time spent. Schmidt and McKnight (2012) argued the existence of inequalities in OTL and by schools systematically offering weaker implemented curriculum to lower socio-economic students, schools were increasing the inequality gap. Thus, OTL might explain the variations in student mathematics achievement across the nation.

Previous studies have found that students in advanced curricular tracks have greater OTL than students in general courses, where access to courses is one explanation for racial differences in achievement (Minor, 2016). Riegle-Crumb, Moore,

and Ramos-Wada (2011) found that African American students benefit less than their White peers from upper-level mathematics courses, possibly because there may be differences in students' exposure to OTL. Through the implementation of Common Core and other state standards, the requirement for all schools to align their curriculum to these state-mandated standards, in theory, should allow no variation in classes with the same title. The standardization should ensure that any student in the state of Georgia that is take courses required to graduation should experience the same rigor and access to a viable curriculum. However, the implementation of mandatory state standards does not guarantee that all teachers and schools are implementing instructional standards in the same manner and with the same rigor. Also, students who are falling behind may not get the support they need to catch up.

African American Student Achievement Challenges in AP

Experts have raised questions about the effectiveness of AP courses. Some teachers believe that enrolling students in AP courses promote self-esteem and self-efficacy. Researchers have found that students may bully or harass students in low-ability classes, and students placed in low-level classes may develop low self-concept (Oakes, 2008). Burton and Campbell's (2019) study showed that students in low ability classes are disadvantaged by inadequate curriculum and negative class labels that influence students' self-esteem. In that study, students who believed they had limited ability took pride in knowing that they were enrolling in a high-level mathematics class with their "smart" friends. Duffett and Farkas (2009) argue that the rapid expansion of the AP program has resulted in many students enrolling in AP courses, who are not well prepared for advanced coursework. Thus, there has been a reluctance of an increasing number of universities to grant AP credit for a test score of 3 or 4 (Warne et al., 2015).

"Even when scholars recognize the benefits of AP courses, it is sometimes due to characteristics of the classes, and not the AP program itself because it is possible that any benefits of the AP program may be merely due to more prepared students and more experienced teachers" (p. 402). This means that the AP program and its curriculum itself could not be the reason for student success, and the environment of the classroom is a significant factor in student learning. Examples of environmental factors include small classroom sizes where the College Board recommends a limit (23) on the number of students in a class, longer tenured and trained teachers, and having students that want to take the course for the challenge.

Though there has been a push for increased access for African American students, school districts are starting to feel that increased access is not enough due to the discrepancy in the quality of AP courses that exist in urban schools (Klopfenstein, 2004). One possible explanation of the disparity may depend upon the quality of teacher preparation, school resources, and prior knowledge of the students (College Board, 2014; Klopfenstein & Thomas, 2009). In a study in an AP Calculus AB class, students averaged a course grade of 3.90 (C+/B-) on a 5-point scale, which was significantly different than the exam score of 2.56 (D+) (Hallett & Venegas, 2011). According to Stanley and Baines (2002), the idea of celebrating the fact that these students made it through a year of an AP course without receiving the college credit is a celebration in mediocrity. It is an egalitarian view at its core. Egalitarianism is the view that all students should get the same educational experience and that there is a one-size-fits-all model for all students. Stanley and Baines believe in equity but advocated for challenging and pushing students to meet their academic needs and to excel in their classes. Equity in access, ensuring all students can take all classes offered, should not

mean lowering the quality of teaching. Researchers have examined the relationships between AP and college success. Still, there has been little investigation into how teachers utilize academic freedom provided by the College Board to prepare their students for secondary institutions (Klopfenstein, 2003b)

Teacher Preparation

There have been strides to increase African American student participation in AP courses and their success on AP exams. The teacher is a significant factor in a student's confidence in the classroom and has the most substantial effect on student learning. The literature showed that there are four significant factors involving African American students' perceptions of AP teachers: teacher competency in the AP subject, teacher expectations for African American students, support structures that assist with academic success for African American students, and prior mathematics achievement of African American students (Burton et al., 2002). Teachers are responsible for implementing the AP curriculum and meeting the needs of their students. Teachers have to submit their syllabus to the College Board for approval, but that is the extent of their oversite of the curriculum. Given the rigor of the material taught in AP classes, it is critical that AP teachers have a deep conceptual understanding of their subject matter, but many AP teachers do not have a college major or minor in the AP subject in which they teach (Klopfenstein, 2003b). Furthermore, Rice et al. (2015) state that poor working conditions and low wages often dissuade teachers from working in urban and rural schools. An environment where teachers feel they are not valued can make it difficult for school administrators to find quality teachers that are experts in their content area to teach AP courses in urban and rural schools. In many ways, teachers make or break the AP experience, but unfortunately, many urban and rural districts

already strapped by limited resources do not designate enough funding to recruit, develop, support teachers in AP curricula (Rice et al., 2015).

Students have expressed that the teachers in some AP courses were not prepared, motivated, and lacked the content knowledge to teach the class effectively (Klopfenstein & Thomas, 2009). College Board requires all AP teachers to attend professional development to teach AP courses. The professional development, which the College Board calls Summer Institutes, takes place over three days to a week, and costs can range from $700 - $1,200. College Board (2018a) states that the Summer Institutes offer the most intensive professional development available for AP educators and that attendees engage in 30 or more hours of training designed to strengthen how teachers teach their AP courses. During the Summer Institute teachers are guided through the AP framework, the exam, and AP classroom resources. Klopfenstein (2003b) states that it is critical that "AP teachers have a deep conceptual understanding of their subject and suggests that AP teachers have considerable experience, and usually an advanced degree in the discipline, before undertaking an AP course" (p. 3). Therefore, AP teachers must not only have a deep understanding of their content knowledge but also understand how to reach students of different ability levels and cultural backgrounds to meet their needs when academic gaps are present. To meet the needs of African American students due to their achievement gap on mathematics AP exams (Duffett & Farkas, 2009; Hallett & Venegas, 2011; Klopfenstein, 2003b; Klopfenstein, 2004; Taliaferro & DeCuir-Gunby, 2008), professional development should extend beyond a few days in the summer to better prepare teachers for the diverse learners in their classroom. Burton et al. (2002) explained that along with gaining strategies to teach the content, a professional development for AP teachers should emphasize high expectations and hard work, a

group spirit, strong parental support, and a very high degree of commitment on the part of the teacher and the students. The areas covered in this type of professional development prepares teachers to build a sense of community in the classroom and a support system to help the students through challenging times.

African American Student Motivation in Mathematics

The strongest predictors of mathematics achievement in high school are prior achievement, student motivation, and high school mathematics course rigor (Riegl-Crumb, 2006). Thus, interventions that elevate intrinsic motivation, such as teaching teachers and parents to be more supportive, should be further developed and applied in the realm of high school mathematics (Froiland, 2011). Research suggests that there are four important spheres of influence that impact the schooling experiences and achievement of urban African American students: (a) parents (b) peers, (c) teachers, (d) student self-concept (Bempechat & Shernoff, 2012). By engaging with each over time, students develop the behaviors and attitudes that signal their acceptance and value of the norms and beliefs that guide the sphere (Boykins & Toms, 1985).

Parents

Parent involvement is an essential contributor to students' achievement and development of mathematics skills (Powell, Son, File, & Froiland, 2012). Numerous studies have found that parents' expectations for their children's long-term educational attainment were a predictor of student development and achievement (Froiland & Davison, 2014). Parent expectations have the most considerable effects out of any parent involvement variables in numerous longitudinal studies. While parental involvement has shown to serve a vital function in the educational experiences of students, such a relationship tends to decline during high school as students get older

(Ferrara, 2011). With this decline, coupled with school tracking, this could have affected students taking low-level course work and not being scheduled into AP mathematics courses. Research suggests that this decline is precipitous for families in urban centers, as many more parents are engaged in the workforce with jobs that lack the freedom and mobility to take time off (Jeynes, 2016). Consequently, other researchers argued that children in urban areas might be influenced by a perceived lack of parental involvement more than any other group in this country (Gladstone, Häfner, Turci, Kneibler, & Muenks, 2018). With the implementation of the new APRP, which solely focusses on high school students, the lack of parental effect on high school students' motivation could play a part in whether students decide to register for their AP mathematics exam.

Parent expectations for students' long-term educational attainment, student expectations, students' intrinsic motivation for mathematics, and taking intellectually rigorous mathematics courses all contributed positively to the development of mathematics achievement between 9th and 11th grade. McNeal (1999) determined that parents with a lower SES and of minority status made fewer strides to be involved in schools as compared to their White and higher SES counterparts. Such actions, one could argue, speak to the differing levels of social and cultural capital that parents from low-income communities and communities of color possess, as compared to their White and higher SES counterparts.

Peers

Research has demonstrated that peers have a profoundly positive effect on the social behavior, academic aspirations, and academic achievement of the youth of color (Goldsmith & Goldsmith, 2011). However, the prevailing discourse on peer-group effects stigmatizes students of color as hindrances, or liabilities, to the peers with whom they

interact (Holland, 2011). Goldsmith and Goldsmith (2011) defined such conceptualizations as peer effects, where students become more like the peers surrounding them. Many policymakers hope that low-ability academic ability students would find support from higher-ability peers in AP classes. However, studies have shown that students see themselves struggling more with challenging content than their high-ability peers who grasp that content more quickly and easily (Burton & Campbell, 2019). When students recognize their ability is below that of their peers in the same class, this can result in diminished self-esteem and self-concept. These comparisons occur most frequently within a class and rarely with peers in different classes (Burton & Campbell, 2019). The effect of peers is not static and there is increasing evidence that peer effects vary by student ability, race, socioeconomic status, and gender. In addition, research shows that peer effects for the same students with the same class arrangements can differ in different subjects (Sacerdote, 2011).

Recent studies have shown that peer effects cannot be generalized, as peers might affect some subgroups more than others (Díaz & Penagos, 2018). Studies of peer effects have examined whether different types of individuals affect individual outcomes. Díaz and Penagos (2018) concluded that if students are very high achieving and their peers have high median ability, then the median ability students benefit most from peers who are very high achieving.

Perceptions of peer tutors' motivation predicted the interest and enjoyment of participants in a study, indicating that intrinsic motivation can spread among students because intrinsically motivated peers communicate about learning in a supportive autonomous way and exhibit more positive emotions while learning (Burton & Campbell, 2019). If peers, who may or may not be friends, can influence each other's

intrinsic motivation, there is an even greater potential for friends to influence each other's intrinsic motivation, due to friends more strongly meeting the need for relatedness, according to self-determination theory (Ryan & Deci, 2000).

Teachers

Jett (2013) argues that teachers enter the classroom with preconceived notions about the abilities of African American students in mathematics. This narrative has created a paradigm where schools and teachers feel African American students are intellectually inferior to their White counterparts, as evidenced by standardized testing (Jett 2013). This concept has caused some preservice teachers to enter our nation's classrooms with preconceived notions about the mathematical (dis)abilities of African American students. With this deficit thinking, there needs to be a shift in mindset that African American children require the same high-quality education as their White counterparts and the focus needs to adjust to what children can do versus what they cannot do. School administrators should probe preservice and practicing teachers from all racial groups concerning their ideological paradigms regarding the mathematical abilities of African American students to determine if teachers truly believe in African American students

Leonard and Martin (2013) advocate for reformed-based teaching practices where instruction is inquiry-based and culturally sensitive where the teacher is not the sole source of information, and the student's background and experiences are used in designing a lesson. Work form Ladson-Billings (2009) highlight culturally responsive teaching as an instructional practice to meet the needs of African American students. In Jett's (2013) study, teachers and professors are identified as an "Identity Thief" if they chose not to recognize the cultural background of the students while teaching

mathematics. “Professors who lack culturally responsive tenets are consciously and subconsciously stealing the identifies of African American students, thereby causing some students years to recover their natural mathematical states” (p. 104). Jett discusses that culturally relevant pedagogy affirms students’ cultural backgrounds and empowers students intellectually. Hale (2016) calls this innovative pedagogy where teachers seek to find support for students from African American cultures. This is key because teachers must reach for the correct pedagogies to practice in schools and classrooms to address the cultural disconnect between the planned and implemented curriculum. There is a lack of a district-wide framework to look at the cultural nuances when analyzing achievement data to understand the impact of culture in the classroom. Therefore, school districts must lead the charge to change assessment and teaching practices through thorough research and implementation of professional development to help motivate students to unlock their brilliance.

Student Self-Concept

Students have a need to belong, be accepted, and feel connected to something greater, which plays a key role in the course selections of African American students considering Advanced Placement courses (Havis, 2015). Motivation is an essential prerequisite for learning that has been shown to be predictive of, among other things, school achievement, transfer of knowledge, and persistence in learning over time (Laine & Gegenfurtner, 2013). As students navigate academic contexts, changes in the self-concept of mathematics ability, mathematics task value, and mathematics achievement have been linked to teachers' practices and social interactions (Urdan & Schoenfelder, 2006). Student-teacher interactions can play a promotive or corrosive role in motivating students and enhancing achievement (Eccles & Roeser, 2011). Student perception of

their teacher could have an effect on a student's perceived competency of the content and may affect whether they feel they will be successful on the AP exam in an AP mathematics course. I advocate that educators need to understand better the racial identity development of African American students to improve their academic achievement. I present an overview of the issues facing gifted African American students and make suggestions to enhance the educational conditions for this unique student population.

Comparing African American Students AP Exam Scores against Other Racial Groups

Over the past several years, the increase in African American participation in AP courses has been encouraging. However, African American students' performance on AP tests remains far below that of other racial groups. A review of the relevant literature related to the College Board AP program, particularly regarding participation among minorities, has identified a growing concern about low success rates on AP exams for African American students (Clark, Moore, & Slate, 2012).

Nation-wide in May of 2018, African American students took 308,791 AP exams and had an average AP exam score of 2.07 compared to White students that had an average score of 3.04 (College Board, 2018b). These numbers mean that the average African American students scored almost a full letter grade below the average score of White students. Native American, Hispanic, Asian, and the sub-group listed as Other all had higher mean AP exams than African American students, which were 2.22, 2.44, 3.31, and 2.40, respectively (College Board, 2018b). In 2018, 64.7% of the 2,443,317 White students who took AP exams received a qualifying grade of 3 or above, compared to 31.2% of African American students (College Board, 2018c). Therefore, White

students are more than twice as likely to receive credit for an AP course compared to African American students. The AP exam scoring gap is the greatest at the highest end of the AP test scores. Approximately 14.6% of White students taking an AP exam received a score of 5, which is equivalent to a grade of A in a college course (College Board, 2018b). Only 3.7 % of African American test-takers received a score of 5 (College Board, 2018b). Thus, White students are almost four times as likely to score a 5 on any given AP exam. There is a large discrepancy in the success rate for African American students on the different subject tests. The AP course in which African American students achieved the most success was AP Studio Art 2-D design. In this course, 64 percent of African American students received a qualifying grade of 3 or above (College Board, 2018b). This is the only AP course where there is no written examination, and students are graded by an assessment of their drawing portfolios (JBHE Foundation, 2005). The most substantial scoring gap on an AP subject test is in Environmental Science, where White students score 1.17 points higher than African American students (College Board, 2018b).

Summary

Overall the literature has detailed that tracking, teacher quality, socioeconomic status, and parental support have been factors in an African American student's experience in the classroom. This has led to an inequity in the quality of education that African American students are receiving and has affected their perceptions of their success in the classroom. I hypothesize that the APRP may be another event that affects African American student's perceptions of their ability to succeed in the classroom, and the APRP may disproportionally affect African American students who take AP courses. For this reason, my research questions are as follows:

1. How does autonomy affect African American students' motivation to register for mathematics AP exams?
2. How does student competency affect African American student motivation to register for mathematics AP exams?

Chapter 3: Methodology

Introduction

This chapter describes the methodology and quantitative methods used for this descriptive survey research study. First, the research design section defined the type of research design, the population and sample, instrument, and the procedures used for the study. Second, the data analysis section defines all the variables used in the study, as well as the statistical analysis process of the study. Finally, the validity section focuses on the reliability and validity of the instruments, as well as the research study as a whole.

The purpose of this study was to determine whether the new College Board AP exam registration process influenced African American students to register for mathematics AP exams. Using the theoretical perspectives of Ryan and Deci's Self Determination Theory (SDT), this study assessed if students' intrinsic motivation is affected by the implementation of the new AP exam registration process. The areas identified by SDT that affected student motivation and were measured in this study are autonomy (student choice and agency) and competency (student's perceived mastery). The following research questions guided the study:

1. How does student autonomy affect African American students' motivation to register for mathematics AP exams?
2. How does student competency affect African American student motivation to register for mathematics AP exams?

In answering these questions, Self-Determination Theory (SDT) was chosen as an appropriate theoretical framework that grounded the research findings. SDT looks to

assess participants' level of motivation in reaction to an external influence. This study looks to measure African American students' motivation to register for a mathematics AP exam with the new APRP being identified as the external influence.

Theoretical Framework

Self-Determination Theory

A method to analyze how a student's mathematics competency and autonomy affect a student's motivation to register for a mathematics AP exam can be rooted in the framework known as Self-Determination Theory (SDT). Intrinsic motivation is the foundation of Deci and Ryan's theoretical framework SDT. According to Deci and Ryan (2000b), the source of intrinsic motivation is an innate pattern of development and assimilation. Historically intrinsic motivation was viewed as an inherent quality (Riley, 2016), but the maintenance and enhancement of intrinsic motivation are dependent on social and environmental conditions surrounding the individual (Deci & Ryan, 2000a). With the College Board implementing the new APRP under the premise of motivating students to engage in class and increasing access to AP exams, SDT asserts the importance of intrinsic motivation under these conditions where the new APRP is an external factor.

Motivation is the reason one acts or behaves in a particular way. Motivation researchers seek to understand what moves people to action, specifically what energized and gives direction to human behavior (Ryan & Deci, 2017). Motivation can be defined as a force that activates, directs, and sustains goal-directed behavior (Liu, Wang, & Ryan, 2016). In contrast, intrinsic motivation is grounded in the needs of a person to be self-determining, autonomous, and competent in the world in which they live (Deci & Ryan, 1985). SDT emphasizes a person's perception of freedom rather than the presence

or absence of constraints in the real world. Self-determination means a student feels free, even if the student is also operating within certain external constraints i.e., the new APRP. In theory, a student can experience self-determination even if the student must, for example, live within rules or restrictions imposed by a school. To achieve a feeling of self-determination, however, the student's basic needs must be met, which includes the need for autonomy and competency.

Advocates of SDT assume that people are inclined to engage in their environment by nature, assimilating new knowledge and skills and integrating them into a coherent psychological structure (Deci & Ryan, 2000b). This study looks to assess if students under the new APRP are African American students able to assimilate and whether their decisions are altered to register for AP mathematics exams. Researchers such as Ryan and Deci (2017) and Niemiec and Ryan (2009) have used SDT to study the affordances of the school environment that support student motivation through addressing students' needs for autonomy and competency. SDT is not concerned with the causes of intrinsic motivation, but how it increases, or decreases based on external factors (Ryan & Deci 2006). Deci and Ryan's (1985) research focuses on the conditions, which facilitate the increase or decrease of intrinsic motivation. SDT was developed with the assumption that all individuals have natural and constructive inclinations to establish a more unified self. The theory suggests that when the three basic psychological human needs of autonomy, competency, and relatedness are fulfilled, an individual's integrating tendency will increase along with motivation, growth, and well-being. SDT posits that intrinsic motivation is sustained by satisfaction of the basic psychological needs for autonomy and competency. Therefore, in this study relatedness is not explore or measured. SDT differentiates between autonomous motivation, i.e., regulated by

personal interest or valuing of the task at hand, and motivation that is controlled, i.e., governed by feelings of pressure by others or obligation to perform a task (Ryan & Deci, 2006). A prerequisite for any motivation, whether autonomous or controlled, is that a student must feel competent to perform the task. On the other hand, SDT assumes that there can be a wide range of developmental outcomes depending on the social and environmental factors that either support or hinder the two essential human needs. Supporters of SDT argue that conditions to support the individual's experience of autonomy and competency foster motivation and engagement, including enhanced performance and persistence (Ryan & Deci, 2000). Further, proponents of SDT propose that social settings that undermine students' experience of autonomy and competency are detrimental to wellness in that setting (Ryan & Deci, 2000).

Researchers have used SDT to study education extensively. Researchers have examined students' intrinsic motivation in education or SDT in relation student choice in a particular class regarding assignments. However, the effects of the new policies from a private outside institution i.e. the College Board on African American students' intrinsic motivation, usually takes time before it manifests in studies. Through this study, the effects of African American students' motivation were identified through the concepts of autonomy and competency from SDT in an AP mathematics classroom environment. The decline in student motivation in high school has been shown to correlate to the reduction autonomy (Corpus, McClintic-Gilbert, & Hayenga, 2009). Autonomy is considered pivotal to students' learning, as it has been linked with, among other things, creativity, adaptive coping strategies, in-depth conceptual learning strategies, and academic achievement (Meece, Blumenfeld, & Hoyle, 1988). Some have

argued that the fulfillment of competency is essential for developing intrinsic motivation and well-being regardless of ethnic or cultural background.

According to SDT, intrinsic motivation to learn involves engaging with learning opportunities student find enjoyable or exciting. Students are most likely to experience intrinsic motivation when their needs for autonomy and competency are met by parents, peers, and other adults (Froiland & Worrell, 2016; Ryan & Deci, 2000). Another important aspect of intrinsic motivation is integration, which involves synthesizing a pursuit with one's sense of self (Ryan & Deci, 2000). Seeing oneself as a mathematics person is an example of integration. Both integration and intrinsic motivation have strong, positive relationships with each other, and both are associated with many positive outcomes (Ryan & Deci, 2000). SDT proposes that any event that affects a person's perception of self-determination and competency can change intrinsic motivation (Deci, 1971). This study identifies the new College Board APRP as an event or external factor as identified by SDT. Additionally, SDT affirms that intrinsic motivation is affected by a student's competency in a given situation (Deci & Ryan, 2000).

Competency

Competency reflects a student's dedication to the work and how a student is naturally driven by the need for understanding (Deci & Ryan, 1985). For students to exhibit competency, students must demonstrate a level of mastery in an area and be recognized for such expertise. The need for competency refers to feeling confident, capable, and self-efficacious. Evidence suggests that when students are trusted for undertaking a challenging task, are assigned responsibilities, and when they feel capable of producing a change in their environment, this supports their need for competency

and students report intrinsic motivation to engage in academic tasks (Sansone & Harackiewicz 2000).

Observable behaviors such as students seeking out challenges in the classroom and the joy of figuring out a complex problem are examples of optimal student competency (Deci, 1971). When a student has an increase in their perceptions and feelings of competency, this produces an increase in intrinsic motivation (Vallerand & Reid, 1984). This effect held when performance was unconstrained by the difficulty of a task, further strengthening the argument that student performance must be viewed as being internally caused (i.e., resulting from competency) to have a substantial impact on intrinsic motivation (Phillips & Lord, 1980).

Interestingly, several studies found that African Americans enjoy mathematics more than their White peers (Riegle-Crumb, Moore, & Ramos-Wada, 2011). Notably, Riegle-Crumb et al. (2011) found that "...mathematics self-concept and enjoyment were more important than prior achievement in predicting if students pursued a STEM career" (p. 462). Nonetheless, the interest in mathematics and student enjoyment left when students did not feel capable of performing well in their mathematics courses (Riegle-Crumb et al., 2011). Though competency will give students the feeling of success, competency will not enhance intrinsic motivation unless accompanied by a sense of autonomy (Riley, 2016). This study assesses whether African American students felt competent in their AP mathematics course and is there a relationship between the feeling of competency and students registering for the AP exam.

Autonomy

When a teacher considers a student's perspective, it supports their sense of choice and is responsive to their ideas. This attention to students' needs is what Deci

and Ryan (1985) called autonomy (Kasser & Ryan, 1996). The need for autonomy refers to a student's experience of choice and agency Research has shown that when students experience agency and choice in the classroom, they report self-determination and intrinsic motivation for engaging in academic activities (Niemiec & Ryan 2009). Research in SDT verifies that school environments can facilitate a sense of positive autonomous motivation in students. In their work on SDT, Ryan and Deci (2017) state that school environments can support individuals flourishing such that they feel empowered, confident in their learning, and feel a sense of belonging to the school and larger community.

This study labels the new APRP as an external influence on a student's freedom to choose whether to take an AP mathematics exam. All students that registered for an AP mathematics exam had to make their decision to register four months earlier under the new APRP compared to the previous process. If a student waits until after the deadline or changes their mind past the deadline, they will incur a $40 fee. I argue in this study that the movement of the deadline forward and the fee affects a student's autonomy and competency in the registration process, thus affecting a student's intrinsic motivation. Riley (2016) states that students can feel autonomy while complying with an external demand or influence, provided the student fully concurs with or endorses doing so. Therefore, "...autonomy is not restricted to "independent" initiatives but also applies to acts reflecting full consent to external inputs or inducements" (Deci & Ryan, 2000, p. 1520). The data collected from the study deduced whether students had a feeling of a lack of autonomy, and if so, did it affect a student's motivation to register for an AP mathematics exam.

Summary

Because this is the first year of implementation of the new APRP, there exist gaps in the literature on how this process will affect African American students. By measuring students' levels of autonomy and competency, this study will fill the aforementioned gap in current literature while making a unique contribution to knowledge around African American students and access to AP exams. In order for school administrators and teachers to address the motivational effects of the new APRP registration process, they first must be able to recognize the mandates of the new APRP. There was also a need to understand the importance of the effects of the new APRP on student motivation as teachers' approaches to motivation can support or harm student learning (Ryan & Deci, 2017). The findings of this study have implications for teaching practices in other contexts and school-site policies to address optimal student intrinsic motivation.

Research Design

This study is grounded in survey research and is a non-experimental survey research design. The purpose of survey research is to survey a sample or the entire population of people to describe the attitudes, opinions, behaviors, or characteristics of the population (Guyette, 1983). Survey research measures, collects, and analyzes participant responses so researchers can assess the statistical relationship between survey items. A non-experimental survey research design was chosen because the implementation of the AP registration process (independent variable) cannot be manipulated. Based on the work by Deci and Ryan (1980) on Self-Determination Theory, the new AP registration process is an external process that could influence students in AP mathematics courses. The survey questions where close-ended where a respondent was asked to select an answer from among a list provided by the researcher.

Self-Determination Theory's concepts of autonomy and competency drove the data collection. In this study, autonomy is identified as a student's perception of choice when registering for an AP mathematics exam and competency defined by a student's self-determination of mastery of the AP mathematics curriculum at a specific point in time. The study assessed if there was a difference in African American student's perception of their autonomy and competency self-reported levels who registered for an AP mathematics exam compared to African American students that did not register for an AP mathematics exam.

Study Context and Participants

Context

In the state of Georgia 97,571 students took an AP exam with 57.7% passing, which consists of making a 3 or higher (College Board, 2014). Georgia's graduating class consisted of 35.6% African Americans, where 25.9 % of African American students took an AP Exam, but only 13.3% of those students scored a 3 or higher. One of the worst-performing exams for students is AP Calculus AB, which has the 5th highest percentage of students scoring a one (the lowest score possible) at 20.4% compared to the other 36 AP exams offered nation-wide.

Table 1

Georgia 2019 AP Student Participation and Mean Scores by Race

		AP Calculus AB	AP Calculus BC	AP Statistics
White	Number of students taking the exam	3912	1931	4056
	Mean AP Score	2.97	3.82	3.05
Black	Number of students taking the exam	1107	301	1189
	Mean AP Score	2.09	3.11	1.93
Hispanic	Number of students taking the exam	813	360	824
	Mean AP Score	2.36	3.18	2.49
Asian	Number of students taking the exam	1180	1343	1422
	Mean AP Score	3.18	4.00	3.42

The participating district in this study has a pseudonym of District A. African American students comprise the largest segment of the student body in District A; however, they have achieved the second-lowest level of mathematics proficiency out of the five ethnic groups represented in the district (Greater Schools, 2017). Only 26% of African Americans have been proficient on mathematics state assessments in District A, and only 28% of African Americans pass an AP Exam (Greater Schools, 2017).

The research sites are two high schools located in the Southeast of the USA in District A. The schools are labeled as high and low performing schools based on their grade from their College and Career Ready Performance Index designated by the state of Georgia. Each school participated in the new AP registration process and was a part of the pilot program during their 2018-2019 school year. District A is a 1-to-1 technology district where all students have laptops that are checked out to students at the beginning of the year. The total population of the schools is 3,536 students consisted of 58% Black,

25% White, 11% Hispanic, 3% Asian, and 3% other. Table 2 illustrated the number of participants in the study. College Board (2016) reported that AP Calculus AB has the second widest gap between Black and White students when comparing the average score on the AP Calculus AB test and AP Statistics has the widest. The schools chosen for this study are a representative sample of the gap defined by the College Board. Each school offers at least one AP Statistics and one AP Calculus AB course. One school also offers AP Calculus BC.

Table 2

Participants and Setting

	School A	School B
Student Population	1894	1642
Student Population in AP Mathematics Courses	121	53
Number of Student Participants	38	17

Participants

Approximately 110 African American high school students from two high schools in seven AP Calculus AB classes, one AP Calculus BC class, and 2 AP Statistics class were recruited for the study. This study implemented a volunteer sample sampling technique where participants self-selected to become part of a study because they volunteer when asked or responded to the advertisement. Trochim (2006) stresses that the problem with basing a study on a group of volunteers is that there is no evidence that this sample is representative of the wider population. Therefore, the purpose of this study is not to make generalizations about all students but to share the relationships found in this

study. To be included in this study, students had to be enrolled in AP Calculus AB, AP Calculus BC, or AP Statistics. Students were selected to enroll in these courses based on specific criteria such as taking AP classes throughout their high school career, needing AP courses to bolster their chances of getting into college or teacher recommendations. Students under the age of 18 were given student consent and parental consent to opt into the study.

Methods and Procedures

Each course at each school had a designated time where the survey was promoted for students to sign up to participate voluntarily. Parental consent was necessary for students to complete the survey if a participant is under the age of 18. Consent forms were turned in to their teacher of record at a specified due date, and the researcher collected the forms and verified parental consent. The two high schools were scheduled at times after school hours to conduct the voluntary survey. There was no time limit for students to complete the questionnaire. Students were released at the end of the session when the survey was collected. Students had the right to stop at any time during the survey.

Instrument

The instrument that was the basis of the survey included background information regarding the students' age, gender, grade level, living situation, parent's education level, and performance on End of Course tests. Information was also obtained regarding whether they had taken AP Calculus AB, AP Calculus BC, or AP Statistics. There was a provision for collecting data on non-background variables. Non-background variables in the study were adapted from Ryan's (1982) Intrinsic Motivation Inventory (IMI) and are a multidimensional measurement instrument intended to assess participants' subjective

experience related to an external factor in a survey. The instrument assesses participants' interest/enjoyment, perceived competency, effort, value/usefulness, felt pressure and tension, and perceived choice while performing a given activity, thus yielding six subscale scores. The perceived choice and perceived competency concepts are theorized to be positive predictors of both self-report and behavioral measures of intrinsic motivation (Ryan,1982). McAuley, Duncan, and Tammen (1989) did a study to examine the validity of the IMI and found strong support for its validity. Several research studies have referenced or used the IMI related to intrinsic motivation and self-regulation (e.g., Mims & Koestner, 1983; Plant & Ryan, 1985; Ryan, 1982; Ryan, Connell, & Plant, 1990). Past research suggests that the effects of the order of the questions in the survey's presentation appear to be negligible, and the inclusion or exclusion of specific subscales have no impact on the others. Thus, experimenters have chosen the subscales that are relevant to the issues they are exploring (Ryan, Koestner, & Deci, 1991). Educators and researchers commonly create several Likert-type items, group them into a subscale, and then calculate a total score or mean score for the scale items. Often this practice is recommended, particularly when researchers are attempting to measure non-abstract concepts, such as motivation, satisfaction, and confidence, where a single survey item is unlikely to be capable of fully capturing the idea being assessed (McAuley, Duncan, & Tammen, 1989). This study only used items that produced subscales related to perceived student choice (autonomy) and perceived student competency.

For this study, Likert scale items related to competency and autonomy were chosen for this study to observe if there is a relationship between the new AP registration process and students' intrinsic motivation to register for a mathematics AP

exam. The Likert scale was developed in 1932 by Rensis Likert to measure attitudes. A typical Likert scale is a 5- or 7-point ordinal scale used by respondents to rate the degree to which they agree or disagree with a statement. Likert questions are on an ordinal scale where responses can be rated or ranked, but the distance between responses is not measurable. Thus, the differences between "not at all true," "somewhat true," and "very true" on a Likert scale are not necessarily equal. This is different from interval data, in which the difference between responses can be calculated, and the numbers do refer to a measurable. In other words, the researcher cannot assume that the difference between responses is equidistant even though the Likert items can be converted to numbers assigned to responses. Ordinal-level Likert scales are being used for non-background questions in the data collection process, and examples of the ordinal scale responses are shown in Figure 1.

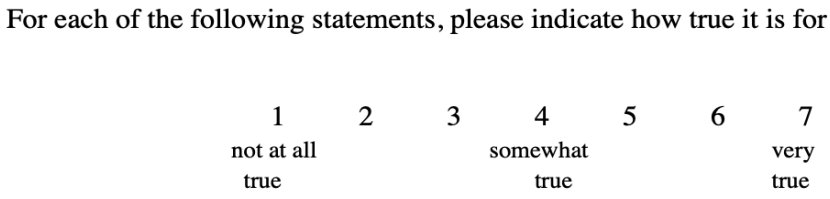


Figure 1. Intrinsic Motivation Scale, Adapted from Intrinsic Motivation Inventory, June 29 209, retrieved from https://selfdeterminationtheory.org Copyright 2003 by Center of Self Determination Theory.

The survey collected data from six areas of focus which included background and non-background variables.

Socioeconomic status. Background information was determined from using three factors, namely: whether students live in a single or two-parent home, whether a student receives free/reduced lunch, and the education level of the student's parents.

This measure was collected using multiple-choice type questions where students identified the correct item.

Ethnicity and Gender. Each student self-identified their race/ethnicity and were scaled as follows: Black or African descent = 1; Asian American =2 Latino American = 3; European American = 4. Gender is coded as follows: Female = 0, Male = 1, I wish not to answer = 2.

Mathematics Prior Achievement. This section is composed of three self-report questions students. Students were asked their grade in their previous mathematics course (A = 4, B = 3 , C = 2, D = 1, F = 0), grade on their Coordinate Algebra End of Course Test (Distinguished = 3, Proficient = 2, Developing = 2, Beginning = 0), grade on their Analytic Geometry End of Course Test (Distinguished = 3, Proficient = 2, Developing = 2, Beginning = 0).

Interest in Mathematics. Students self- reported their interest in mathematics using the scale in Fig 1. Students were asked the following: I enjoyed doing mathematics very much, I would describe mathematics as very interesting, While I was doing mathematics, I was thinking about how much I enjoyed it, Mathematics does not hold my attention at all.

Competency. This variable was measured with self-reported questions that asked students whether or not they felt competent about their knowledge in their current AP course. The items used the scale from Fig 1. The questions are as follows: Taking this course up until now I feel pretty competent, I am satisfied with my performance in this class, I think I am pretty good in this class compared to my peers, I feel I am on the right track to pass the AP exam for this course as of today. On a scale of 1 to 5, students reported their level of expectation for passing the AP exam (earning a 3

or higher). Then a competency subscale was created by summing all of the denoted competency Likert-scale questions into on value per participant.

Autonomy. Student autonomy was measured with self-reported questions that asked students whether or not they felt they have a choice in registering for the AP exam. The questions used the scale from Fig 1. The questions are as follows: I felt that it was my choice to register for the AP exam, I felt pressured to register for the AP exam because of the deadline, The College Board late fee affected my decision to register for the AP exam, The College Board registration deadline is too early to make a decision about registering for my AP exam. Mirroring competency, an autonomy subscale was created by summing all of the denoted competency Likert-scale statements into on value per participant.

Statistical Analysis

Descriptive Statistics. Descriptive statistics were generated for all of the questions in the survey and then separated under three main headings; student background, autonomy, and competency. These descriptive statistics included the mean scores for each question, standard deviations as well as the frequency distributions for each response. The demographics for the study are listed so readers can compare different subgroups (i.e. gender and socioeconomic). This will allow readers at a glance to see the differences in responses to the survey.

Inferential Statistics. The study looked to see if students' characteristics (if any) that might causally influence a student's response on each of the two components of intrinsic motivation, which are autonomy and competency. In other words, how much variability existed in the means of the sources of intrinsic motivation across groups of

students needed to be determined (i.e., Students that registered for an exam, Female students, low-income students, etc.).

In statistical analysis literature, there has been debate and controversy whether ordinal data (Likert scale) can be converted to numbers and treated as interval data. That is, is it possible to use parametric statistics, such as means and standard deviations, which depend upon data that is normally distributed to analyze ordinal data? Parametric tests make assumptions about the population where the population data is normally distributed. Nonparametric tests do not make this assumption about the shape of the population. Nonparametric tests are less powerful than parametric tests. They usually require a larger sample size (n value) to have the same power as parametric tests to find a difference between groups when a difference actually exists. Because of these observations, experts over the years have argued that the median should be used as the measure of central tendency for Likert scale data. Thus, the Mann-Whitney *U* test has been recommended for analysis instead of parametric tests, which require interval data (e.g., *t-tests*, analysis of variance, Pearson correlations, regression). However, other experts assert that if there is an adequate sample size (at least 5–10 observations per group) and if the data are normally distributed (or nearly normal), parametric tests can be used with Likert scale ordinal data.

For this study, we used using parametric tests with our ordinal data. Norman (2010) provided evidence, with actual examples using real and simulated data, that parametric tests not only can be used with ordinal data, such as data from Likert scales but also that parametric tests are generally more robust than nonparametric tests. That is, parametric tests tend to give “the right answer” even when statistical assumptions—such as a normal distribution of data—are violated, even to an extreme degree (Norman,

2010). Thus, parametric tests are sufficiently robust to yield largely unbiased answers that are acceptably close to "the truth" when analyzing Likert scale responses. In these cases, experts suggest using the Cronbach alpha technique to provide evidence that the components of the scale are sufficiently intercorrelated and that the grouped items measure the underlying variable.

ANOVA. A one-way ANOVA (also referred to as ANOVA) would determine whether there are statistical differences in the mean subscale scores for autonomy and competency based on the groups defined by one of the independent variables (Warner, 2008). In other words, an ANOVA would determine if the new APRP affected whether students registered for an AP exam by testing whether there was a statistical difference in answer choices between students that chose to register for an AP mathematics exam. ANOVA comes with assumptions. One assumption of ANOVA is that the variances of the dependent variable are the same across the groups being studied. The data used within this study addressed this assumption through the stabilization of the sample size utilizing the whole collection of students as the base as opposed to breaking it into individual school results, which would have skewed the results due to the differences in the mean. Next, a Welch or a Brown-Forsythe was conducted because variances were not assumed to be equal. In this case, the F test of the ANOVA would not be robust enough to be used by itself.

Ethics

In my research study, ethical principles centered on protecting the participant's identity, minimizing the risks (physically, psychologically, and socially) and respecting their values and interests. Since the study has voluntary participation, informed consent was used. The consent form ensured that all respondents are choosing to participate in

the survey of their own free will and that they have been fully informed regarding the procedures of the research project and any potential risks. An introductory statement was used to introduce the survey and provide information regarding the purpose, intent, motivation, possible use of data, and methods of data collection. Issues of confidentiality wer also be covered in this introduction. Therefore, the prospective participant is fully informed before completing the survey. Potential participants also must be competent to decide on participation and must be free from any coercion.

Validity

Threats to the reliability and validity of the survey instrument are possible, but measures were taken to reduce that possibility. Changes made to the IMI were validated by the work from Ryan (1982) and Ryan, Mims & Koestner (1983), where external influences can be changed (i.e., AP registration process) from the original inventory to measure intrinsic motivation and the survey will still give valid measures. Changes were made cosmetically to the survey to appeal to high school students, and it was doubtful that it would have affected the validity of the survey instrument. Threats to reliability are low because of the response rates of the participants. Out of the 92 eligible students in AP mathematics courses across two participating institutions, 55, or 60%, responded. The small sample size and low response rate can result in a response bias where "the responses do not accurately reflect the views of the sample and the population" (Creswell, 2008, p. 403). The data appears to be comparable with the exception of a higher percentage of African American male participants when compared to the demographics of the entire population of students.

All participating students were informed that their responses would not be known to the researcher, which lessens the possibility of response bias. Additionally, the

responses of the participants were analyzed as one whole group without breaking down the analysis per high school, which would also lessen the issues with reliability. Even though the researcher took every opportunity to make sure the data collected did not have issues with reliability and validity, they are not completely negated. This, combined with the small sample size, will limit the generalizability of the results.

Summary

This chapter discussed the methodology and theoretical framework for this study. The study was designed from a positivist point of view with survey research methods. The data was collected over two days, with each school having a designated day for surveys to be conducted by the students. The student data was put together from both schools to be analyzed to allow for a direct examination of student intrinsic motivation while not focusing on different variables of the individual schools that could not be controlled. The limitations that are present in the study have been acknowledged and were addressed in the limitations section of this report in Chapter 5.

Chapter 4: Findings

Introduction

The objective of this research is to discover if the AP Registration Process (APRP) affected students' intrinsic motivation to register for an AP mathematics exam. This study's methods took the following basic approach: Find the means and standard deviation of the non-demographic variables and use the ANOVA test to determine if there are differences in the mean autonomy and competency subscale scores and individual Likert-scale items from the adapted Intrinsic Motivation Instrument (IMI) between students that registered and did not register for an AP mathematics exam. All Likert-Scale items were categorized as autonomy or competency based on the literature from Ryan (1982) related to Self-Determination Theory. The included instrument (Appendix A) indicated how each Likert-scale item was categorized. The results of the survey were used to identify and analyze patterns in student responses to determine how students perceived the APRP influenced their decision to register for an AP mathematics exam. All the necessary protocols needed to ensure participant confidentiality were followed as prescribed by the Institutional Review Board. Subject participation was voluntary. Any student who participated was verified to be either eighteen years or older or given a parental consent form to be signed and returned (see Appendix B for parent consent form) if not of the age of consent.

Demographic Data

Many researchers feel that demographic measures are critical to include in research involving adolescent development and motivation (Rice & Dolgin, 2005; Ryan, 1982). Constructs such as race, gender, and socioeconomic status (SES) are essential when looking at processes that affect students emotionally or academically within a

school (Rice & Dolgin, 2005). The survey provided a source of data to examine the differences between African American students that registered and did not register for an AP mathematics exam. The student characteristics listed do not necessarily speak on the participant's AP qualification since it was already established based on teacher recommendations, PSAT scores, or mathematics track. Though the survey was a volunteer sampling, the students represented are a homogeneous and economically varied population. They also reflect different parental living situations and education levels.

Student Characteristics

The population N= 112 represented African American students enrolled in an AP mathematics course across two high schools. Students showed up to participate in the study on the designated date for each school. After verifying parental consent from all students under 18, two students did not have proper parental consent and were removed from the study. Thus, the sample N=55 represented the number of African American students (51%) that volunteered to be a part of the study. The breakdown of the number of students enrolled per course are as follows: 41 students in AP Calculus AB, 8 students in AP Calculus BC, and 6 students in AP Statistics. Students are allowed to take AP mathematics courses in 11^{th} or 12^{th} grade depending on previous mathematics courses taken, standardized test scores, and teacher recommendations. Among the students that participated in the study, 8 students were in 11^{th} grade, and 47 students were in 12^{th} grade, with 37 identifying as male and 18 identifying as female.

Socioeconomic Status

Students were asked to identify who they live with, their parent's education level, and the purchase price of their school lunch. Literature has increasingly shown that

parent's educational level and student social-economic status is a predictor of academic achievement in their children. In this study, 38 (69.2%) students reported living with both parents, 16 (29%) students reported living with one parent, and 1 (1.8%) student said they were living with a grandparent. Regarding parent/guardian education level, 83.6% of student households had a least one parent that attended college, with 16.4% not having a parent attending college. There were three options available for students to identify the purchase price of their lunch; Full Price, Reduced Price, and Free Lunch. From the survey, 27 (49%) students indicated the paid full price, 12 (21.8%) paid a reduced price, and 14 (25.45%) received a free lunch from school based on their family's reported income. The study showed that 51% of the students that participated in were on free/reduced lunch, which is a statewide indicator of students from low-income families (Georgia Department of Education, 2018). Forty-one students in this study were from School #1, which has 62.8% of students on free/reduced lunch. Fourteen students volunteered form School #2 that has an almost identical percentage at 51.5%.

Prior Mathematics Success

Students reported their mathematics grade in their previous mathematics course along with their grade in their current AP Mathematics course. The survey data indicated that 34 (61.8%) students earned an A, 17 (30.9%) students received a B, 4 (7.3%) earned a C, and no student earned a D or an F. In the students' current AP mathematics course, 37 (67.3%) students currently have an A, 13 (23.6%) students have a B, 3 (5.5%) students have a C, and 2 (3.6%) student have D.

ANOVA Hypothesis and Test Results

To determine whether the mean autonomy and competency subscale scores from the IMI differ overall for African American students that registered or did not register for as

AP mathematics exam, an ANOVA model is appropriate (Norman, 2010). The ANOVA model indicates if the mean autonomy and competency subscales are statistically different based on whether a student registered for an AP mathematics exam. The research question that drives the study is; What is the relationship between the College Board AP exam registration process and African American students' mathematics AP exam participation rates? Based on the sub-research questions below, formally, the null hypothesis for each research sub-question is as follows:

1. How does autonomy effect African American students' motivation to register for mathematics AP exams?

   H_0 (null): There is no difference in the mean autonomy subscale scores between students that registered for an AP mathematics exam and students that did not.

   H_1 (alternative): There is a difference in the mean autonomy subscale scores between students that registered for an AP mathematics exam and students that did not.

2. How does student competency effect African American student motivation to register for mathematics AP exams?

   H_0 (null): There is no difference in the mean competency subscale scores between students that registered for an AP mathematics exam and students that did not.

   H_1 (alternative): There is a difference in the mean competency subscale scores between students that registered for an AP mathematics exam and students that did not.

If H_o (null) is accepted, then on average, there was no effect on whether a student registered or not for an AP mathematics exam based on their mean autonomy or competency subscale scores. If the null hypothesis is rejected, then the results indicate that the mean autonomy or competency subscale scores differ based on if a student registered or not for an AP mathematics exam. The autonomy and competency subscale scores are sums of the items on the survey related to autonomy and competency from the work of Ryan (1982) on Self-Determination Theory. The survey included in this study (see Appendix A) denotes which questions measure autonomy and competency.

Autonomy Subscale Results

The first research question explored how autonomy affected whether African American students registered for a mathematics AP exam. The descriptive statistics in Table 3 provides the number of students who registered and did not register for an AP mathematics exam, the standard deviation for each group of students, and the 95% confidence intervals for each group. The highest autonomy subscale score possible on the survey instrument is 35 (5 questions). Each question could be scored from 1-7 with a score of 1 indicating high student autonomy and 7 indicating low student autonomy. Table 4 indicates the average mean autonomy score for each autonomy question in the survey. Students that registered for an AP mathematics exam have a mean autonomy score of 23.2143, while the students that did not register for had a mean autonomy score of 22.6296.

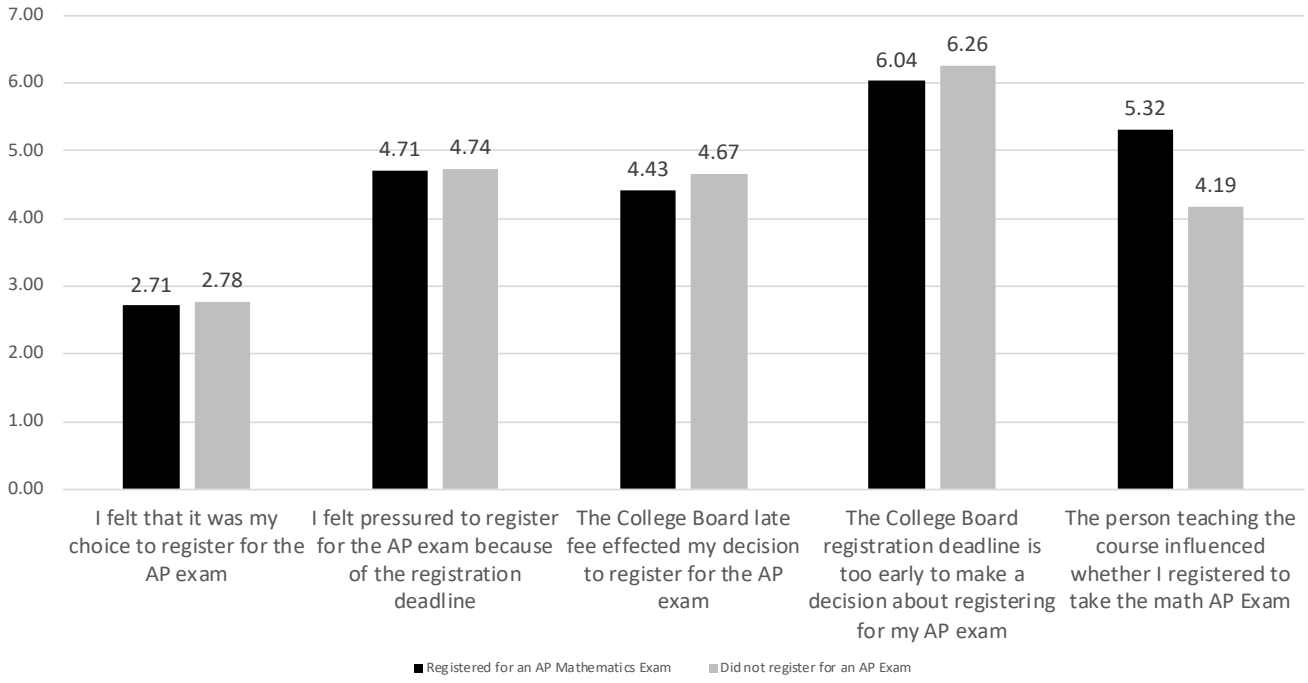
Table 3

Descriptive Statistics Autonomy Subscale

				95% Confidence Interval for Mean			
	N	Mean	SD	Lower Bound	Upper Bound	Minimum	Maximum
Registered for an AP Exam	28	23.2143	6.04524	20.8702	25.5584	13	33
Did not register for an AP exam	27	22.6296	5.9726	20.2659	24.9934	11	32
Total	55	22.9273	5.96240	21.3154	24.5391	11	33

Table 4

Mean Autonomy Score Per Question



The midpoint is for each student on the autonomy subscale is 20. Therefore, the mean autonomy subscale scores suggest that both groups of students felt they had a

somewhat low sense of autonomy when registering for their AP mathematics exams. An essential aspect of the descriptive statistics reveals there was close to an equal amount of African American students that registered and did not register for an AP exam. Also, the standard deviation (a measure of variation from the mean autonomy subscale score for each group) is virtually the same for each group. It is not surprising that the standard deviation of autonomy subscale score for each group is close to the same due to the close number of students in each group.

Exhibit 1

Mean Autonomy Subscale Test Results

ANOVA

Autonomy	Sum of Squares	df	Mean Squares	F	Sig.
Between Groups	4.699	1	4.699	.130	.720
Within Groups	1915.011	53	36.132		
Total	1919.709	54			

Test of Homogeneity of Variances

Autonomy	Levene Statistic	df	df2	Sig.
Based on Means	.525	1	53	.472
Based on Median	.649	1	53	.496
Based on Median with adjusted df	.649	1	51.412	.496
Based on trimmed Mean	.558	1	53	.458

Robust Test of Equality of Means

	Statistic	df	df2	Sig.
Brown-Forsythe	.130	1	52.966	.720

a. Asymptotically F distributed.

Exhibit 1 shows the ANOVA test, the test of homogeneity of variances, and the Brown-Forsythe results for the autonomy subscale score mean for each group of students. The result of the ANOVA procedure shows no statistical difference between

the mean autonomy subscale score for each group of students (significance of .720). Thus, we accept the null hypothesis that there is not a statistical difference between the mean autonomy subscale score based on a student's decision to register for an AP mathematics exam.

Table 5

Teacher Influence ANOVA Test

Autonomy	Sum of Squares	df	Mean Squares	F	Sig.
Between Groups	17.746	1	17.746	4.746	.034
Within Groups	198.181	53	3.739		
Total	215.927	54			

The ANOVA procedures assume homogeneous (similar) variances in the data. The test for Homogeneity of Variances confirms that homogeneous variances were not present (significance .472) therefore, the Brown-Forsyth test was performed. The Brown-Forsyth test results also showed no statistical differences (significance of .720). in mean autonomy subscale scores for both groups of students. When assessing individual autonomy questions, Teacher Influence (Table 5) was the only question that showed a significant difference in between the means of both groups. Table 2 shows that students who registered for an AP mathematics exam identified that the classroom teacher had an influence in whether the students registered for the AP exam.

Competency Subscale Results

The second research question looked to see if student perceived competency was a factor in whether African American students registered for a mathematics AP exam. Table 6 displays the descriptive statistics which included; the number of students registered, who registered and did not register for an AP mathematics exam, the

standard deviation for each group of students, and the 95% confidence intervals for each group. The highest competency subscale score possible on the survey instrument is 42 (6 questions). Each question could be scored from 1-7 with a score of 1 very low student competency and 7 indicating high student competency. Table 7 indicates the average mean competency score for each competency question in the survey. Students that registered for an AP mathematics exam have a mean competency subscale score of 29.0357, while the students that did not register for had a mean competency subscale score of 23.8148.

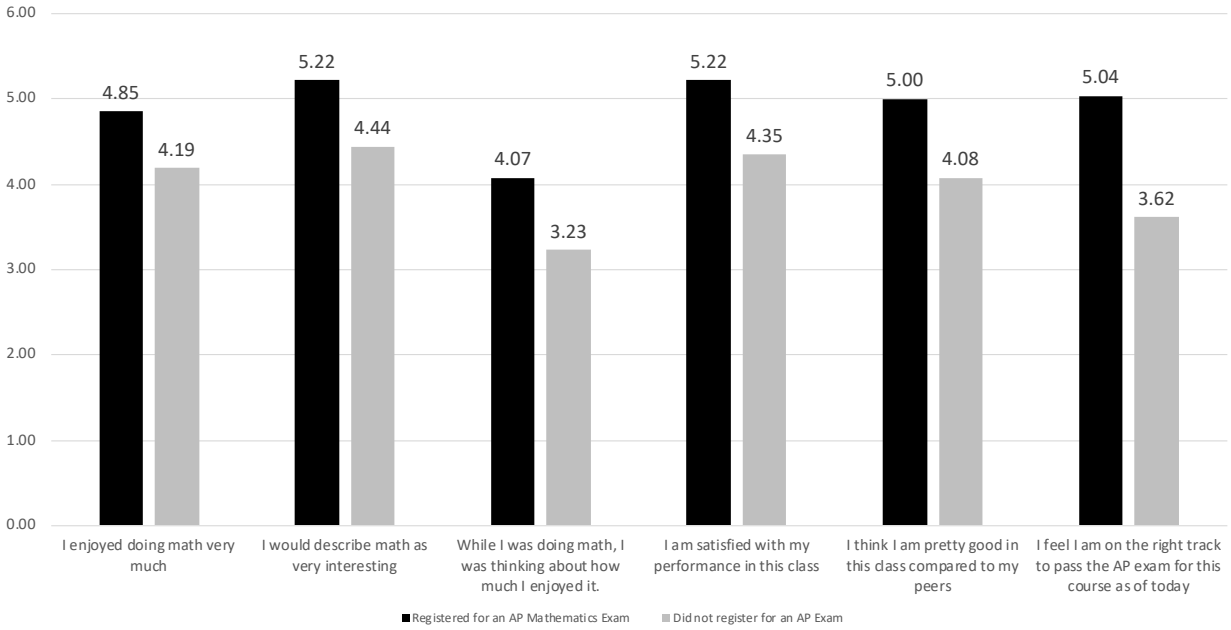
Table 6

Descriptive Statistics Competency Subscale

				95% Confidence Interval for Mean			
	N	**Mean**	**SD**	**Lower Bound**	**Upper Bound**	**Minimum**	**Maximum**
Registered for an AP Exam	28	29.0357	7.05787	26.2990	31.7725	13	39
Did not register for an AP exam	27	23.8148	5.90982	21.4770	26.1527	10	36
Total	55	26.4727	6.97576	24.5869	28.3585	10	39

Table 7

Mean Competency Score Per Question



The midpoint is for each student on the competency subscale is 24. The difference in competency scores shows that students on average who did not register for an AP mathematics had less perceived competency versus students that did register for an AP mathematics exam. When comparing the standard deviations of both groups, the students that registered for an exam had a higher variation of scores compared to students that did not register for an exam.

Exhibit 2

Mean Competency Subscale Test Results

ANOVA

Competency	Sum of Squares	df	Mean Squares	F	Sig.
Between Groups	374.671	1	374.671	8.814	.004
Within Groups	2253.038	53	42.510		
Total	2627.709	54			

Test of Homogeneity of Variances

Competency	Levene Statistic	df	df2	Sig.
Based on Means	.607	1	53	.439
Based on Median	.398	1	53	.531
Based on Median with adjusted df	.398	1	48.574	.531
Based on trimmed Mean	.556	1	53	.459

Robust Test of Equality of Means

	Statistic	df	df2	Sig.
Brown-Forsythe	8.871	1	51.993	.004

a. Asymptotically F distributed.

Exhibit 2 shows the ANOVA test, the test of homogeneity of variances and the Brown-Forsythe results for the competency subscale score means for each group of students. The result of the ANOVA procedure shows a statistical difference between the mean competency subscale score for each group of students (significance of .004). Therefore, we reject the null hypothesis and accept the H1 (Alternative) hypothesis and conclude decision to take the exam was based on their perceived competency in their mathematics course. The ANOVA procedures assume homogeneous (similar) variances in the data. The test of homogeneity of variances showed that the variances were not similar (significance of .439). A Brown-Forsyth test was also performed. The Brown-

Forsyth test results also showed statistical differences (significance of .004) in mean autonomy subscale scores for both groups of students.

Three questions in the competency subscale had significant differences in the means between both student groups when an ANOVA test was run. The statements were; I am satisfied with my performance in this class, I think I am pretty good in this class compared to my peers, and I feel I am on the right track to pass the AP exam for this course as of today. All three of these statements as a measure of a student's competency in their AP mathematics course. Students that registered for an AP mathematics exam had a higher mean (more competency) than students that did not register for an AP exam (Table 7).

Table 8

Significant Individual Competency ANOVA Test

Mathematics Performance		Sum of Squares	df	Mean Squares	F	Sig.
	Between Groups	9.008	1	9.008	4.136	.047
	Within Groups	115.429	53	2.178		
	Total	124.436	54			
Compared to Peers		**Sum of Squares**	**df**	**Mean Squares**	**F**	**Sig.**
	Between Groups	9.245	1	9.245	4.439	.040
	Within Groups	110.392	53	2.083		
	Total	119.636	54			
Passing an AP Exam						
	Between Groups	23.192	1	23.192	6.080	.017
	Within Groups	202.153	53	3.814		
	Total	225.345	54			

Summary

The driving research question of this study is, "What is the relationship between the College Board AP exam registration process and African American students' mathematics AP exam participation rates?" An ANOVA indicated that there is a significant difference in competency subscale scores, which shows that students on average who did not register for an AP mathematics had less perceived competency versus students that did register for an AP mathematics exam. This argument was strengthened by finding significance in the individual competency questions that make up the competency subscale score.

Autonomy subscale scores were low for both groups indicating that no matter whether students registered or did not register for an AP mathematics exam, students on average had less perceived autonomy. Teacher influence was the only significant question in the autonomy subscale score where students who registered for the AP mathematics exam perceived that their mathematics teacher influenced whether they registered for the exam. In the following chapter, I will layout the implications of these findings.

Chapter 5: Discussion

Introduction

The goal of this study was to determine if the new AP Registration Process (APRP) influenced African American students' intrinsic motivation to register for the AP Mathematics exam. For the first research question, there was no statistical difference in a student's perception of autonomy based on the autonomy subscale related to registering for an AP mathematics exam under the new APRP between students that register for an AP exam and students that did not. Only one individual autonomy question had a significant difference between both groups. When assessing the second research question, there was a statistical difference between students that registered for an AP mathematics exam and students that did not register when students were asked about their perceived competency of mathematics in their course based on the competency subscale. Neither the autonomy or competency subscales showed a significant difference based students' socioeconomic status, prior mathematics achievement, or current grade in the class. Even though the demographic variables were not statistically significant between the groups within this study, it is not definitive proof that they are not contributors to in student's decision making in other circumstances. The findings obtained in this study have been organized under the SDT components of autonomy and competency. Relevant literature around SDT and AP access has been taken into consideration in each section.

Autonomy

Autonomy refers to students' need to self-regulate their experiences, to be the causal agent of their actions, and to act in harmony with their own integrated selves (Ryan & Deci, 2017). For autonomy to be present, students need to perceive that they

have choice, agency and that they can self-determine what to do in their self-interest. In the previous years, the College Board allowed students to register for the AP exam up until March 15th. This allowed teachers to cover a majority of the content in the AP course, and students had a choice whether they wanted to register in the Fall or in the Spring. During the 2019-2020 school year, the new APRP changed the registration deadline to November 15th and charged a $40 fee if students register after the deadline or decide not to take the exam after they register. This new process, therefore, forces students to decide whether they will succeed on an exam that is six months away and charges students with a $40 fee if a decision is made or changed after November 15th. Deci, Ryan, and Williams (1996) state the when students have a choice in the decisions that make according to their best interests as causal agents in their learning experience, student autonomy and motivation improve. This study hypothesized that students who did not register for an AP mathematics exam would have a perceived lack of autonomy in the registration process; thus, the requirements to registering for the exam at that point in time are not in students' best interest. Deci and Ryan (2016) and Reeve (2016) assert that autonomous environments allow students to generate their own intentions and with an authentic sense of motivation and purpose. The results of this study offered evidence that students who registered and did not register for an AP mathematics exam indicated low levels of autonomy from the autonomy subscale score (Table 4). This study also found from the mean autonomy subscale statements, students from both groups stated that they felt it was their individual choice to register for the AP exam. Overall there was not a significate difference between students that registered and students that did not because both groups felt a lack of autonomy (agency and choice) during the new APRP.

The survey in this study enabled students to voice whether the ARPR affected their sense of choice to register for an AP mathematics exam. Reeve (2016) identified that, in order to support student autonomy, you must be willing and able to see students' perspectives during and activities or process and to solicit student input. Since the College Board is a private organization apart from the school district, the students that participated in the study were not asked their opinion of the new APRP by College Board. In addition, Ryan and Deci (2006) found that teachers could provide conditions to support student autonomy and motivation by encouraging students and responding to students' opinions. Overall this study found there was no significate difference between students that registered and students that did not because both groups felt a lack of autonomy during the new APRP.

Agency

The definition of student agency is fluid depending on the context, but for this study, we will define it as referring to students' ability to define and act on their own goals (Vaughn, 2018). Agency is strongly related to issues of power, which allows for an analysis of students who miss out on opportunities offered and how these opportunities may be restored. With this in mind, agency has to do with understanding one's social, cultural, and historical environment (Vygotsky, 1978) and deciding how to take action in that context. The participants' context in this study was registering for an AP mathematics exam under the College Board's changes related to the deadline to register and pay fees. The two survey items where students self-identified feeling the least amount of autonomy fell under agency, categorized under the need for autonomy. The two questions in the survey asked in different ways if the deadline affected their decision to registered for the exam. For both of these questions, students indicated that it did

affect their decision, thus altering whether they were able to choose with their own self-interest.

The only autonomy variable within this study that was found to be significant between both groups was teacher influence. The study showed a positive relationship between students that registered for the AP exam and students indicating that the teacher of the course influenced their decision to register for the AP exam. Teacher influence was explicitly used for this study because previous studies concluded that high teacher expectations for African American students lead to academic success (Burton et al., 2002). These findings are also consistent with Rice et al. (2015), who concluded that teachers make or break the AP experience for African American students and their confidence. The four teachers who taught the AP courses across the two schools had 37 years of combined experience teaching AP mathematics, with the most inexperienced teacher having only three years of experience. The importance of teacher understanding of their subject matter aligned with many works of Klopfenstein (2003a, 2003b, 2004), who stresses that teachers need a deep understanding of their content knowledge to reach students of different backgrounds to address achievement gaps. Interestingly the teacher with the least number of students to participate in the survey and the least number of students to register for the exam was a teacher from School #1 with only three years of experience.

Choice

The second subtheme under the need for autonomy was the concept of choice. Students indicated that when asked whether they felt like it was their choice to register for the AP, the average score for students that registered and students that did not were 2.71 and 2.81 respectively with no significant difference. Since this scale is on an inverse

scale, this showed that students had a high perception of autonomy when it came to who was making a choice for them. Based on student responses, you can conclude that students experienced choice in selecting to register for the AP exam. The results of the statistical analysis showed that student background variables (i.e., socioeconomics and mathematics performance) had little influence on either groups' feeling of autonomy when registering for an AP mathematics exam during the new APRP. In the review of the literature, socioeconomic factors have been previously shown to affect students coming from lower-income families where students have weaker levels of self-efficacy and confidence overall (Flowers, 2008). This was not found to be true in this study.

Summary

When assessing autonomy, you have to look at it through the lens of agency and choice. In this study, students from both groups identified as having a lack of agency; therefore, the College Board had the "power" in this context to affect student's ability to act on their own. College Board reiterates that the APRP's purpose is to engage students earlier in the classroom and to support teachers in preparing students to pass the AP exam (College Board 2018a). The unforeseen effects of this policy may have caused students who had a feeling of a loss of power to do what was in the best interest of themselves. Though students identified that it was their choice to register or not to register for an AP exam, it cannot be ignored that the context and environment they were put during the APRP had an effect on African American students' sense of autonomy.

Competency

Competency is the need to interact effectively with one's environmental surroundings, to seek out optimal challenges, take them on, and exert persistent effort

and strategic thinking to make progress in mastering them (Reeve, 2016). For competency to obtained, students need experiences and an environment that supports mastery in their learning (Niemiec & Ryan, 2009). This section breaks competency into two subthemes based on the data collected: Confidence and challenge. In this investigation, we explored the association between African American students' perceived competency in their mathematics course and if they registered for their AP mathematics exam. Overall, there was statistical support that students' perceived competency affected whether they registered for an AP mathematics exam. The competency subscale score was found to be statistically different between students that registered and students that did not register for an AP mathematics exam. Every question that compiled the competency subscale score indicated that students who registered for an AP mathematics exam had more perceived competency and intrinsic motivation than students that did not register for an exam.

Confidence

The most prominent aspect of competency is students' confidence in their academic ability in the classroom. Under the new APRP, students were in school eights week for a total of 20 days school days on an A/B black schedule in their AP mathematics course when registration started. Students had to make a decision based on their academic performance at that point in time and project whether they would have mastery of the content six months to pass the exam. This is different from the previous registration process when students could register up until March 15th without penalty, which was seven weeks before the examination. The reduction in face-to-face time with teachers was measured to assess if it affected student confidence. When analyzing the individual competency statements, there was a statistical difference when

students were asked how they viewed their mathematics performance in the classroom, how students compared themselves to their peers, and if they felt they were on track to pass their AP exam. Student competency scores were lower for every subscale question from students that did not register for the AP exam. From this data, we can say that there is a relationship between student confidence in their performance in an AP mathematics class and whether students registered for an AP mathematics exam. Notably, two of the most reliable indicators were a student's perceptions of success compared to their peers and if they were going to pass the AP exam. Taken together, these findings may suggest that students were more intrinsically motivated to register for an AP exam if they felt they were going to succeed in the class (Vallerand & Reid, 1984).

Challenge

The data indicated that being in an optimally challenging AP course was enjoyable for students. Student interest and enjoyment of mathematics was high for both groups of students but was not statistically different between both groups. Oakes (2008) found that the partnership between teacher and student required to engage students with the material was a not only intellectually stimulating but very fulfilling experience. In other words, most students like being in their AP mathematics classes and enjoy math instruction. Then why does this not translate to more students registering for the AP exam? Riegle-Crumb et al. (2011) explain that both interest and enjoyment left when students did not feel capable of performing well in their mathematics courses or assessment. So, the students enjoy and are interested in their mathematics until they feel a lack of competency in their mathematics ability to pass an exam. With the new APRP advocating for students to register for the AP exam, which

serves as an end of course exam, 27 of 55 students chose not to register for the exam in an environment where the cost of the exam is free for low-income students. Of the students that participated in the study, 50 of the 55 students reported that they have an A (37 students) or B (13 students) in the course. Students have evidence from assessments in their AP mathematics class that they can be successful on an assessment. Therefore, there is a disconnect between actual success in class (i.e., their current grade) and their perceived success on the AP mathematics exam. One explanation could be is that students still feel need more time in the course to feel competent about taking the AP exam. This aligns with the concept of opportunity to learn (OTL) based on work by Carroll (1963).

Carroll's work concluded that students' ability to learn depends on how long they are exposed to it in school. Therefore, the APRP reduces all students' OTL when compared to the previous registration deadline of March 15th when compared to the new deadline of November 15th. Instructional time has been characterized as core elements of OTL, along with a number of instructional quality indicators. Across the United States, teachers have been given 180-190 days each year to deliver instruction. This seems like a lot of time dedicated to learning, but recognize that it represents the maximum allocated time, not the actual time used for instruction nor the amount of that instructional time where a majority of students are actively engaged in learning (Elliott & Bartlett, 2016). Elliott, Kurz, Tindal, and Yel (2015) reported that that instructional time is likely to average 81% of the allocated time across an entire school year. Understanding the difference between allocated time and actual time, opportunities to learn at school are less frequent than expected for many students. Under the new APRP, students have far less actual instruction time when you factor in ritual and procedures

conducted at schools across the nation during the first week or two of school to get students to adjust from coming off of summer break. Therefore, in facilitating competency as quickly as possible, teachers should allow students to navigate challenges, making mistakes as they learn (Ryan & Deci, 2013).

Discussion Summary

SDT states that the satisfaction of both autonomy and competency needs is essential to maintain intrinsic motivation. Students who feel competent, but not autonomous, will not be intrinsically motivated. Numerous researchers have applied the SDT framework to intrinsic motivation in educational contexts. Based on the finding and the works by Deci and Ryan (1980), Deci and Ryan (1985), Deci and Ryan (2000b), Deci and Ryan (2002), and Ryan and Deci (2017), the APRP positions itself as a type of extrinsic motivation called external regulation.

Extrinsic motivation refers to behaviors performed to obtain some outcome separable from the activity itself (Ryan and Deci, 2000a). In this context, the APRP adjusted the deadline and fee structure to get a desired outcome of increased student registrations and student engagement in AP courses (College Board 2018a). Contrary to the College Board's intent, external regulation is the least autonomous type of extrinsic motivation whereby behaviors are enacted to obtain a reward or to avoid punishment. Niemiec & Ryan (2009) states that these behaviors are not maintained once the controlling contingencies (e.g., deadline and fees) have been removed or the time has passed. In our case, a student might register for the exam to avoid the $40 late or change fee and be engaged in the course because they registered for the exam. Based on the characteristics of external regulation, this engagement from students and teachers will dissipates as the school year progresses and cannot be sustained. Niemiec & Ryan

(2009) discusses that students' autonomy can be supported by teachers' minimizing the salience of any sense of coercion in the classroom, as well as by maximizing students' perceptions of having a voice and choice. The issue AP teachers will face is that they do not have the control to minimize the sense of coercion the new APRP implements. Districts and states have distributed funds to districts to cover the cost of the exam, which was present in this study. Even with this financial system available, still less than half of the African American students registered for an AP mathematics exam compares to 65% of all African American students in AP mathematics courses registering for an AP exam at both school sites. In conclusion, teachers must provide students with the appropriate tools and feedback to promote success and feelings of efficacy during the AP registration process and after its completion. Access to AP courses has been going in an upward trend, and we must be proactive to ensure that we do not reverse course.

Recommendations

Student intrinsic motivation data could help school districts, principals, and teachers be proactive about increasing African American students' participation in AP mathematics exams. The findings from this study suggest that while the College Board may be continuing to try to increase AP access to African American students, there needs to be a review of their new AP Registration Process (APRP) and how it could disincentivize students to register for an AP mathematics exam. College Board continually discusses the elimination of barriers that limit access to AP courses for African American and low-income students (College Board, 2014, 2015, 2016a, 2018b). Initiatives and policies such as reduced pricing for students on free/reduced lunch and more teacher training were developed to create equity in a space where White and Asian

students dominated all statistical measures such as AP course participation rates, AP exam passing rates, and college credit acquisition (College Board, 2018b).

This study makes the argument that new APRP could have an adverse effect on African American participation rates due to African American students not feeling intrinsically motivated to register for an AP mathematics exam due to a lack of competency of the coursework when registering for the exam. When College Board moved up the registration deadline, students had four fewer months in their course, which could lead to students feeling uncomfortable with their current content knowledge and familiarity with their teacher, therefore reducing their opportunity to learn. Also, the $40 fine that College Board has imposed on students that choose to register for the AP exam after November 15th could create a financial barrier for students that wish to register for the exam after the deadline.

Being Proactive about the AP Registration

It is recommended that AP teachers and principals are proactive with letting students know about the AP registration deadline. Early communication with students and parents is key in helping students understand the new ordering deadlines and fees. During the class scheduling process, counselors should let students know of the costs associated with taking an AP exam and create a timeline before the start of the school year so parents can plan for the expense of paying for exam fees. Another recommendation is that the AP coordinator and AP teachers have two AP Parent Nights where parents of AP students are invited into the school. The first AP night should be held during the first month of school with a focus on the College Board's new APRP. This first AP night would also allow teachers to introduce themselves in a more intimate setting compared to a traditional Open House the schools offer at the beginning of the

school year. AP teachers should discuss the expectations, course content, and supports the students will have while in their specific course. The second AP Night needs to take place in the spring when master scheduling takes place for the following school year. This meeting should be dedicated to informing parents and students of the AP course offerings for the coming school year and what course would be a good fit for each student based on their college or career interests. This process goes beyond just grades and allows a school to make a connection with parents and students to boost students' self-esteem that they can succeed in AP Courses.

Teachers' Pedagogical Practices: Culturally Responsive Pedagogy

There continues to exist a mathematics achievement gap between Black and White students. Over the years, the achievement gap has continued to grow, and researchers have used quantitative and qualitative studies to try to identify the factors that maintain or grow the achievement gap. When it came to their peers, students in this study indicated that they compared themselves to their peers, and students that did not register for an AP mathematics exam felt less competent when compared to their peers (Table 2). Furthermore, "negative messages about one's ethnic group membership maybe even more salient and consequential during the period of adolescence when individuals are forming their ethnic identity" (Phinney, 1990, p. 5). The findings of this study also show that students do not feel confident that they will be successful in the class or on the AP exam. Thus, teachers need to reaffirm their African American students of their own greatness within and that they will assist them in unmasking their brilliance so that they would be able to manifest their identity and mathematical skills. In other words, African American students would develop more confidence,

shred/dismantle the false armor of incompetence, and wear their shield of brilliance like their forefathers in mathematics as Martin (2012) indicated in his work.

Bonner and Adams (2012) use the lens of a Culturally Responsive Mathematics Teacher (CRMT) to address the issues of teachers working in high-poverty, predominantly African American schools. The four cornerstones of CRMT are knowledge, communication, relationships/trust, and constant reflection and revision. These areas are identified as practices of a highly successful teacher of African American students and exemplify the structure of the mathematics classroom (Bonner & Adams 2012; Ramsay-Jordan, 2017). The implications of the study call for change in classroom practice, teacher education programs, and future research in mathematics education. "The realization of these cornerstones as foundations of practice may serve to shift dominant ways of thinking about one-size-fits-all and scripted curricula and high-stakes assessment practices that do not take into account the localized cultural knowledge of students" (Bonner & Adams, 2012, p. 9). Aspects of this study and other works related to culturally responsive pedagogy should be used by AP teachers who want to connect with their African American students to build up their self-esteem and confidence in mathematics. Ortiz, Capraro, and Caprarp (2018) proclaimed that culture is captured in the mathematics class through the use of language, the structure of the class, and the racial identities and expectations. Teachers have to expect that our African American students will be successful and implement instructional strategies that meet students where they are and closes the achievement gap. This does not imply that teachers must lower the standard for African American students but instead states that teachers must have different methods to get their students to meet that predetermined standard.

Students of this study indicated that their teachers could influence them to take an AP mathematics exam. Teachers who lack culturally responsive tenets are consciously and/or subconsciously "stealing the identifies of African American students, thereby causing some students years to recover their natural mathematical states" (Jett, 2013, p. 104). Jett discusses that culturally relevant pedagogy affirms students' cultural backgrounds and empowers students intellectually. Examples of these practices include spreading the brilliance of African American students, soliciting information from students about their cultural heritage, and listening and valuing the student voices. Thus, a teacher's reputation, high expectations, hard work, and a very high degree of commitment willingness to challenge them could influence their decision to take an AP exam (Havis, 2015). Teachers' feeling about their students' success matters. AP teachers must have the confidence that all of their students can succeed and implement instructional practices that will aid in their success.

Limitations and Future Studies

The primary limitations of this study are that it was conducted in only two high schools in a suburb in Georgia. The schools were chosen because they offered multiple AP mathematics courses, more than 50% of the student population was African American, and it was in close proximity to the researcher. Both schools have similar demographics, but with different school comes difference in school cultures that cannot be controlled. Also, the teachers' methods for general instruction were not controlled in this study.

Conclusion

The conclusions in this study can promote recommendations for educators, counselors, administrators, and the African American community. The data from this

study is not meant to conclusively establish a norm for African American students' participation in AP mathematics exams across the nation but rather to provide a lens and perspective for College Board look through when planning how to increase equity and achievement for African American students. Autonomy and competency were the only variables test related to intrinsic motivation. Thus, other variables should be explored, such as the correlation between parental beliefs and the connection with the teaching practices on African American students. Secondly, student interviews in a qualitative study would better answer the "why" behind a student's choice to register for an AP mathematics exam. Thirdly, another way to establish more information regarding achievement is by collecting information about specific courses students took in addition to their AP mathematics and previous mathematics courses. In addition, student GPA could be obtained by self-reporting in a future study. The researcher recommends that qualitative studies related to African American students in AP courses be done on African American students and other minority from varying socioeconomic backgrounds. Concerning the APRP the researcher recommends that schools and administrators continue to promote and foster equity and access to AP courses.

References

Ainsworth, J. W. (2012). Integration interrupted: Tracking, black students, and acting white after brown./kids don't want to fail: Oppositional Culture and the Black-White Achievement Gap. *American Journal of Sociology, 118*(1), 235-238.

Archbald, D., & Farley-Ripple, E. (2012). Predictors of placement in lower level versus higher level high school mathematics. *The High School Journal, 96*(1), 33-51. Retrieved April 1, 2020, from www.jstor.org/stable/23275423

Bempechat, J., & Shernoff, D. J. (2012). Parental influences on achievement motivation and student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), *Handbook of research on student engagement,* 315–342. https://doi.org/10.1007/978-1-4614-2018-7_15

Berry, R. Q., III. (2003). Mathematics standards, cultural styles, and learning preferences: The plight and the promise of African American students. *Clearing House*, 76(5), 244-249.

Bonner, E.P., & Adams, T.L. (2012). Culturally responsive teaching in the context of mathematics: a grounded theory case study. *J Math Teacher Educ.* 15, 25–38. https://doi.org/10.1007/s10857-011-9198-4

Boston Schools, School Documents, No. 7, 1908.

Bourdieu, P. (1986). The forms of capital. In: Richardson, J., Handbook of Theory and Research for the Sociology of Education. Westport, CT: Greenwood: 241–58.

Boykin, A. W., & Toms, F. D. (1985). Black child socialization: A conceptual framework. In *Black children: Social, educational, and parental environments.* 33-51. Thousand Oaks, CA, US: Sage Publications, Inc.

Burton, L. M., & Campbell, B. D. (2019). Fostering self-efficacy and engagement: a case of alternative teaching and learning in high school mathematics. *Journal of Ethnographic & Qualitative Research*, 13(4), 272–288.

Burton, N., Whitman, N., & Yepes-Baraya, M. (2002). Minority student success: The role of teachers in advanced placement program courses. *College Board Annual Report*.

Carroll, J. B. (1963). A model of school learning. Teachers college record, 64(8), 723–733.

Chazan, Daniel & Brantlinger, Andrew & Clark, Lawrence & Edwards, Ann. (2013). What mathematics education might learn from the work of well-respected african american mathematics teachers in urban schools. *Teachers College Record, 115*(3), 45-53.

Cisneros, J., Holloway-Libell, J., Gomez, L. M., Corley, K. M., & Powers, J. M. (2014). The Advanced Placement opportunity gap in Arizona: Access, participation, and success. *AASA Journal of Scholarship & Practice, 11*(2), 20-33.

Clark, D., Moore, G. W., & Slate, J. R. p. a. c. (2012). Advanced placement courses: gender and ethnic differences in enrollment and success. *Journal of Education Research, 6*(3), 265-277.

College Board. (n.d). *2019-20 Changes to AP: A Path to Success for All Students*. *https://apcentral.collegeboard.org/about-ap/news-changes/ap-2019*

College Board. (2012). *Equity and Access in AP*. New York, NY: Author

College Board. (2014). *The 10th Annual Report to the Nation*. New York, NY: Author Retrieved from https://research.collegeboard.org/programs/ap/data/nation

College Board. (2015). AP Calculus AB/BC Course and Exam Description Retrieved from https://secure-media.collegeboard.org/digitalServices/pdf/ap/ap-calculus-ab-and-bc-course-and-exam-description.pdf

College Board. (2016a). *Annual AP Program Participation Rates*. 1955-2017. New York, NY: Author. Retrieved from https://research.collegeboard.org/programs/ap/data/participation/ap-2018

College Board. (2016b). *AP Score Distribution 2016*. New York, NY: Author. Retrieved from https://research.collegeboard.org/programs/ap/data/archived/ap-2016

College Board. (2018a). *AP Coordinator's Manuel*. New York, NY: Author. Retrieved from https://apcentral.collegeboard.org/pdf/ap-coordinators-manual-part-1-2019-20.pdf

College Board. (2018b). *National Report In-Nation-Summary-2018*. New York, NY: Author. Retrevied form https://research.collegeboard.org/programs/ap/data/archived/ap-2017

College Board. (2018c). *State Report In-State-Summary-2018*. New York, NY: Author. Retrevied form https://research.collegeboard.org/programs/ap/data/archived/ap-2017

Corey, D., & Bower, B. (2005). The experiences of an african american male learning mathematics in the traditional and the online classroom--A case study. *The Journal of Negro Education, 74*(4), 321-331. Retrieved March 1, 2020, from www.jstor.org/stable/40026732

Corpus, J. H., McClintic-Gilbert, M. S., & Hayenga, A. O. (2009). Within-year changes in children's intrinsic and extrinsic motivational orientations: Contextual

predictors and academic outcomes. *Contemporary Educational Psychology, 34*(2), 154-166. doi:10.1016/j.cedpsych.2009.01.001

Creswell, J. W. (2008). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research (3rd ed.)*. Upper Saddle River, NJ: Pearson Education, Inc.

Cross, T. (2008). More Blacks are competing in Advanced Placement programs, but the racial scoring gap is widening. *Journal of Blacks in Higher Education, 59*, 42-63.

Davis, Julius. (2018). Redefining Black students' success and high achievement in mathematics education: Towards a liberatory paradigm. *Journal of Urban Mathematics Education, 11,* 69-77.

Davis, J., & Martin, D. B. (2018). 2008 -- Racism, assessment, and instructional practices: Implications for mathematics teachers of African American students. *Journal of Urban Mathematics Education*, *11*(1-2). https://doi.org/10.21423/jume-v11i1-2a358

Deci, E. L. (1971). The effects of externally mediated rewards on intrinsic motivation. *Journal of Personality and Social Psychology, 18*, 105-115.

Deci, E. L., & Ryan, R. (1980). The empirical exploration of intrinsic motivational process. *Advances in Experimental Social Psychology, 13*.

Deci, E. L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York: Plenum.

Deci, E. L., & Ryan, R.M. (2000a). Self determination theory and the facilitation of intrinsic motivation, social development, and well being. *American Psychologist*, 55, 68-78. doi:10.1037//0003-066X.55.1.68

Deci, E. L., & Ryan, R.M. (2000b). Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemporary Educational Psychology,* 25, 54-67. doi:10.1006/ceps.1999.1020

Deci, E. L. and Ryan, R. M. (2002) 'The paradox of achievement: The harder you push, the worse it gets', in J. Aronson (ed.), Improving Academic Achievement: Contributions of Social Psychology , pp. 59–85. New York: Academic Press.

Deci, E.L., Ryan, R.M., & Williams, G.C. (1996). Need satisfaction and the self-regulation of learning. Learning and Individual Differences. 8(3), 165-183.

Díaz, A. M., & Penagos, I. (2018). It's not what you know but who you know: Heterogeneous peer effects at a Colombian University. *Desarrollo y Sociedad,* 80, 53–88. https://doi.org/10.13043/DYS.80.2

Duffett, A., & Farkas, S. (2009). *Growing Pains in the Advanced Placement Program: Do Tough Trade-offs Lie Ahead?* Retrieved from Washington, DC: http://www.edexcellence.net/foundation/publication/index.cfm

Eccles, J. S., & Roeser, R. W. (2011). Schools as developmental contexts during adolescence. *Journal of Research on Adolescence, 21*(1), 225-241. doi:10.1111/j.1532-7795.2010.00725.

Elliott, S., & Bartlett, B. (2016). Opportunity to Learn. Oxford Handbooks Online. Retrieved 22 Mar. 2020, from https://www.oxfordhandbooks.com/view/10.1093/oxfordhb/9780199935291.001.0001/oxfordhb-9780199935291-e-70.

Elliott, S. N., Kurz, A., Tindal, G., & Yel, N. (2015, April). Predicting end-of-year mathematics achievement of students with and without disabilities: The role of

opportunity to learn and CBM measures. Paper presented at the National Council on Measurement in Education, Chicago.

Eglash, R., & Bennett, A. (2009). Teaching with hidden capital: Agency in children's computational explorations of cornrow hairstyles. *Children, Youth & Environments,* 19(1), 58-73.

Ferrara, M. (2011). Family involvement and teacher education curriculum transformation: Making steps toward powerful change. *Action in Teacher Education, 33*(4), 374-388.

Floden, Robert. (2002). The Measurement of Opportunity to Learn. *National Academy of Sciences*. 19(5), 231-266.

Flores, A. (2007). examining disparities in mathematics education: Achievement gap or opportunity gap? *The High School Journal, 91*(1), 29-42.

Flowers, L. A. (2008). Racial differences in the impact of participating in advanced placement programs on educational and labor market outcomes. *Educational Foundations, 22*(1-2), 121-132.

Froiland, J., & Davison, M. (2014). Parental expectations and school relationships as contributors to adolescents' positive outcomes. *Social Psychology of Education, 17*(1), 1-17. doi:10.1007/s11218-013-9237-3

Froiland, J., & Worrell, F. (2016). Intrinsic motivation, learning goals, engagement, and achievement in a diverse high school. *Psychology in the Schools*. 53. 10.1002/pits.21901.

Gholson, M. L. (2016). Clean corners and algebra: A critical examination of the constructed invisibility of black girls and women in mathematics. *The Journal of Negro Education, 85*(3), 290-301. doi:10.7709/jnegroeducation.85.3.0290

Gladstone, J. R., Häfner, I., Turci, L., Kneißler, H., & Muenks, K. (2018). Associations between parents and students' motivational beliefs in mathematics and mathematical performance: The role of gender. *Contemporary Educational Psychology, 54*, 221-234. doi:https://doi.org/10.1016/j.cedpsych.2018.06.009

Goldsmith, B., & Goldsmith, E. (2011). Social influence and sustainability in households. *International Journal of Consumer Studies, 35*(2), 117-121. doi:10.1111/j.1470-6431.2010.00965

Gould, S. J. (1981). *The mismeasure of man*. New York, NY: W. W. Norton & Company

Guyette, S. (1983). *Community-based research: A handbook for native Americans*. Los Angeles: American Indian Studies Center, University of California.

Hale, J. E. (2016). Learning styles of African American children: Instructional implications. *Journal of Curriculum and Teaching*, 5(2), 109-118.

Hallett, R. E., & Venegas, K. M. (2011). Is Increased Access Enough? Advanced Placement Courses, Quality, and Success in Low Income Urban Schools. *Journal for the Education of the Gifted, 34*(3), 432-438.

Havis, C. (2015). *The Underrepresentation of Black Students in Advanced Placement Courses: Student Perceptions of Peers, Teachers and School*. Dissertation thesis, Georgis State University.

Hodges, T., & Conner, E. (2011). Reflections on a technology-rich mathematics classroom. *Mathematics Teacher, 104*(6), 432-438.

Holland, N. E. (2011). The power of peers: Influences on postsecondary education planning and experiences of African American students. *Urban Education, 46*(5), 1029-1055. doi:10.1177/0042085911400339

]

JBHE Foundation. (2005). The surge in African-American enrollments in advanced placement courses. *Journal of Blacks in Higher Education (Theodore Cross Family Charitable Foundation), 47*, 70-75. Retrieved from http://ezproxy.gsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eue&AN=507797161&site=ehost-live&scope=site

Jett, C. (2013). Culturally responsive collegiate mathematics education: Implications for African American students. *Interdisciplinary Journal of Teaching and Learning, 3*(2), 102–116.

Jett, C., Stinson, D. W., & Williams, B. A. (2015). Communities for and with Black Male Students. *The Mathematics Teacher, 109*(4), 284-289. doi:10.5951/mathteacher.109.4.0284

Jeynes, W. H. (2012). A meta-analysis of the efficacy of different types of parental involvement programs for urban students. *Urban Education, 47*(4), 706-742. doi:10.1177/0042085912445643

Jeynes, W. H. (2016). A meta-analysis: The relationship between parental involvement and latino student outcomes. *Education and Urban Society, 49*(1), 4-28. doi:10.1177/0013124516630596

Johnson, I. R., Pietri, E. S., Fullilove, F., & Mowrer, S. (2019). Exploring Identity-Safety Cues and allyship among black women students in STEM environments. *Psychology of Women Quarterly*, 43(2), 131–150. https://doi.org/10.1177/0361684319830926

Karlson, K. (2015) Expectations on track? High school tracking and adolescent educational expectations. *Social Forces*, (41)1, 115-141 https://doi.org/10.1093/sf/sov006

Kasser, T., & Ryan, R. M. (1996). Futher examing the american dream: Differential correlates of intrinsic and extrinsic goals. . *Personality and Social Psychology Bulletin, 22*, 280-287.

Kasten, D. (2013). Modern Day School Segregation: Equity, Excellence, and Equal Protection. *St. John's Law Review, 87*(1).

Klopfenstein, K. (2003a). Recommendations for maintaining the quality of advanced placement programs. *American Secondary Education, 32*(1), 39-48.

Klopfenstein, K. (2003b). The link between Advanced Placement experience and early college success. *American Secondary Education*, *34*(4), 27-39.

Klopfenstein, K. (2004). Advanced placement: Do minorities have equal opportunity? *Economics of Education Review, 23*(2), 115-131. Retrieved from http://dx.doi.org/10.1016/S0272-7757(03)00076-1

Klopfenstein, K., & Thomas, M. K. (2009). The link between Advanced Placement experience and early college success. *Southern Economic Journal, 75*(3), 873-891. Retrieved from http://www.jstor.org/stable/27751419

Kotok, S. (2017). Unfulfilled Potential: High-Achieving Minority Students and the High School Achievement Gap in Math. *The High School Journal*. 100. 183-202. 10.1353/hsj.2017.0007.

Ladson-Billings, G. (2006). From the achievement gap to the education debt: understanding achievement in U.S. schools. *Educational Researcher*, *35*(7), 3–12. https://doi.org/10.3102/0013189X035007003

Liu, W. C., Wang, J. C. K., & Ryan, R. M. (2016). Understanding Motivation in Education: Theoretical and Practical Considerations. In: W. B. Liu, J. C. K. Wang, & R. M. Ryan (Eds.) Building Autonomous Learners Perspectives from Research

and Practice using Self-Determination Theory. Retrieved 10 July, 2018 from https://link-springer-com.ezproxy.lib.swin.edu.au/book/

Laine, Erkka & Gegenfurtner, Andreas. (2013). Stability or change? effects of time lag and training length on achievement goal orientations and transfer of training. *International Journal of Educational Research*. 61. 71-79. 10.1016/j.ijer.2013.03.014.

Lee, J. (2012). College for all: Gaps between desirable and actual p-12 math achievement trajectories for college readiness. *Educational Researcher, 41*(2), 43-55.

Lim, J. H. (2008b). The road not taken: two African-American girls' experiences with school mathematics, *Race Ethnicity and Education, 11*:3, 303-317, DOI: 10.1080/13613320802291181

Leonard, J. & Martin, D. B. (2013). *The brilliance of Black children in mathematics: Beyond the numbers and toward new discourse*. Information Age Publishing, Inc. USA.

Martin, D. B. (2006). Mathematics learning and participation as racialized forms of experience: African American parents speak on the struggle for mathematics literacy. *Mathematical Thinking and Learning*, *8,* 197-229. 10.1207/s15327833mtl0803_2.

Martin, D. B. (2012). Learning mathematics while Black. *Educational Foundations*, *26*(1), 47-66.

McAuley, E., Duncan, T., & Tammen, V. V. (1989). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting: A confirmatory factor analysis. *Research Quarterly for Exercise and Sport*, *60*, 48-58.

McBride Davis, C. A., Slate, J. R., Moore, G. W., & Barnes, W. (2015). Advanced placement exams, incentive programs, and cost effectiveness: A lack of equity and excellence for Black students in Texas, New York, and Florida. *Journal of Negro Education, 84*(2), 139-153. doi:10.7709/jnegroeducation.84.2.0139

McFarland, J., Hussar, B., Wang, X., Zhang, J., Wang, K., Rathbun, A., Bullock Mann, F. (2018). *Condition of Education 2018*. Retrieved from https://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2018144

McNeal, R. B., Jr. (1999). Parental Involvement as Social Capital: Differential Effectiveness on Science Achievement, Truancy, and Dropping Out*. *Social Forces, 78*(1), 117-144. doi:10.1093/sf/78.1.117

Meece, J., Blumenfeld, P., & Hoyle, R. (1998). Students' goal orientation and cognitive engagement in classroom activities. *Journal of Educational Psychology, 80*, 514-523.

Minor, E. C. (2016). Racial differences in mathematics test scores for advanced mathematics students. *High School Journal, 99*(3), 193-210. Retrieved from http://ezproxy.gsu.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=eric&AN=EJ1104153&site=ehost-live&scope=site http://dx.doi.org/10.1353/hsj.2016.0006

Minor, E. C., Desimone, L. M., Phillips, K. J. R., & Spencer, K. (2015). A new look at the opportunity-to-learn gap across race and income. *American Journal of Education, 121*(2), 241-269.

Moore, G. W., Combs, J. P., & Slate, J. R. (2012). Advanced Placement Exams participation and performance: A national study of gender differences. *İleri*

Yerleştirme Sınavlarına Katılım ve Performans: Ulusal bir Cinsiyet Farklılıkları Çalışması., 3(3), 18-32.

Murrell, P. (1994). In search of responsive teaching for African American males: An investigation of students' experiences of middle school mathematics curriculum. *The Journal of Negro Education, 63*(4), 556-569. doi:10.2307/2967295

Nasir, N. (2002). Identity, goals, and learning: mathematics in cultural practice. *Mathematical Thinking and Learning, 4*:2-3, 213-247, DOI: 10.1207/S15327833MTL04023_6

Nasir, N., & de Royston, M. M. (2013). Power, Identity, and Mathematical Practices Outside and Inside School. *Journal for Research in Mathematics Education*, *44*, 264-287. 10.5951/jresematheduc.44.1.0264.

National Council of Teachers of Mathematics Commission on Standards for School Mathematics. (1989). Curriculum and evaluation standards for school mathematics. Reston VA: The Council. http://www.standards.nctm.org/index.htm

Niemiec, C. P., & Ryan, R. M. (2009). Autonomy, competence, and relatedness in the classroom: Applying self-determination theory to educational practice. Theory and Research in Education, 7(2), 133–144. https://doi.org/10.1177/1477878509104318

Norman, Geoffrey. (2010). Likert scales, levels of measurement and the “laws” of statistics. *Advances in health sciences education: theory and practice*. 15. 625-32. 10.1007/s10459-010-9222-y.

Oakes, J. (1986a). Keeping track: How schools structure inequality. New Haven, CT: Yale University Press.

Oakes, J. (1986b). Keeping track, part 2: Curriculum inequality and school reform. *The Phi Delta Kappa*, 68(2), 148-154. Retrieved March 20, 2020, from www.jstor.org/stable/20403289

Oakes, J. (1990). Opportunities, achievement, and choice: women and minority students in science and mathematics. *Review of Research in Education*, 16, 153-222. Retrieved March 20, 2020, from www.jstor.org/stable/1167352

Oakes, J., Muir, K., & Joseph, R. (2000). Coursetaking & Achievement in Mathematics and Science: Inequalities that Endure and Change. National Institute of Science Education.

Oakes, J. (2005). Keeping track: How schools structure inequality (2nd ed.). New Haven, Conn.; London: Yale University Press.

Oakes, J. (2008). Keeping track: Structuring equality and inequality in an era of accountability. *Teachers College Record*, 110, 700–712.

Ortiz, N., Capraro, M., & Capraro, R. (2018). Does it really matter? Exploring cultural relevance within a majority white classroom. *The Journal of Negro Education, 87*(4), 404-419. Retrieved April 1, 2020, from www.jstor.org/stable/10.7709/jnegroeducation.87.4.0404

Phillips, J. S., & Lord, R. G. (1980). Determinants of intrinsic motivation: Locus of control and competence information as components of deci's cognitive evaluation theory. *Journal of Applied Psychology, 65*(2), 211-218. doi:10.1037/0021-9010.65.2.211

Phinney, Jean. (1990). Ethnic Identity in Adolescents and Adults: Review of Research. *Psychological bulletin*. 108. 499-514. 10.1037/0033-2909.108.3.499.

Plant, R. W., & Ryan, R. M. (1985). Intrinsic motivation and the effects of self-consciousness, self-awareness, and ego-involvement: An investigation of internally controlling styles. Journal of Personality, 53(3), 435-449. doi:10.1111/j.1467-6494.1985.tb00375.

Powell, Douglas & Son, Seung-Hee & File, Nancy & Froiland, John. (2012). changes in parent involvement across the transition from public school prekindergarten to first grade and children's academic outcomes author(s). *The Elementary School Journal*. 113. 276-300. 10.1086/667726.

Ramsay-Jordan, N. N. (2017). Examining the Integration and Use of Culturally Responsive Mathematics Pedagogy in Preservice Teachers Reflections and Practice: Implications for Black Children. Dissertation, Georgia State University, https://scholarworks.gsu.edu/mse_diss/45.

Reeve, Johnmarshall. (2016). Autonomy-Supportive Teaching: What It Is, How to Do It. 10.1007/978-981-287-630-0_7.

Rice, F. P., & Dolgin, K. G. (2008). *The adolescent: development, relationships, and culture*. 12th ed. Boston: Allyn and Bacon.

Rice, J., Lash, A., Huang, M., Tran, L., Peterson, M., Regional Educational Laboratory, (2015). *Advanced Course Completion in Magnet and Comprehensive High Schools: A Study in Nevada's Clark County School District. What's Happening. REL 2016-099*. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=eric&AN=ED561144&site=ehost-live&scope=site&custid=gsu1

Riegle-Crumb, C., Moore, C., & Ramos-Wada, A. (2011). Who wants to have a career in science or math? Exploring adolescents' future aspirations by gender and race/ethnicity. *Science Education, 95*(3), 485-476.

Riley, G. (2016). The role of self-determination theory and cognitive evaluation theory in home education. *Cogent Education, 3*(1).

Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, 43, 450-461. Retrieved from https://selfdeterminationtheory.org/intrinsic-motivation-inventory/

Ryan, R. M., Connell, J. P., & Plant, R. W. (1990). Emotions in nondirected text learning. *Learning and Individual Differences*, *2*(1), 1-17. doi:10.1016/1041-6080(90)90014-8

Ryan, R., & Deci, E. L. (2000). Self determination theory and the facilitation of intrinsic motivation, social development, and well being. *American Psychologist*, 55, 68-78. doi:10.1037//0003-066X.55.1.68

Ryan, R., & Deci, E. L. (2006). Self-regulation and the problem of human autonomy: does psychology need choice, self-determination, and will?. *Journal of Personality*, 74: 1557-1586. doi:10.1111/j.1467-6494.2006.00420.x

Ryan, R., & Deci, E. (2017). Self-determination theory: basic psychological needs in motivation, development, and wellness. New York, New York: Guilford Publications.

Ryan, R. M., Mims, V., & Koestner, R. (1983). Relation of reward contingency and interpersonal context to intrinsic motivation: A review and test using cognitive

evaluation theory. *Journal of Personality and Social Psychology*, 45(4), 736-750. doi:10.1037/0022-3514.45.4.736

Sadler, P. M., Sonnert, G., Tai, R., & Klopfenstein, K. (2016). AP: A critical examination of the advanced placement program. *NCSSS Journal, 21*(1), 26-27.

Sansone, C. & Harackiewicz, J. (2000). Intrinsic and extrinsic motivation: The search for optimal motivation and performance, *Academic Press*, San Diego.

Sacerdote, B. (2011). Peer effects in education: How might they work, how big are they and how much do we know thus far?. *Handbook of the Economics of Education*, 1(3).

Schmidt, W., & McKnight, C. (2015). Inequality for All: The Challenge of Unequal Opportunity in American Schools: Teachers College Press.

Shah, N. (2017). Race, ideology, and academic ability: A relational analysis of racial narratives in mathematics. *Teachers College Record. 119*. 1-42.

Sneyers, E., Vanhoof, J., & Mahieu, P. (2019) The Impact of Primary School Teachers' Expectations of Pupils, Parents and Teachers on Teacher Track Recommendations, *Educational Studies*, 55:3, 327-345, DOI: 10.1080/00131946.2018.1562925

Snipes, V. (1997). Examination of the mathematical education of African Americans in North Carolina and Louisiana utilizing critical race theory of education: Four case studies. (Doctoral dissertation. The Florida State University, 1997). Dissertation Abstracts International, 58 (07A), 2577.

Solorzano, D., & Ornelas, A. (2004). A Critical Race Analysis of Latina/o and African American Advanced Placement Enrollment in Public High Schools. *The High*

School Journal, 87(3), 15-26. Retrieved April 30, 2020, from www.jstor.org/stable/40364293

Stanley, G. K., & Baines, L. (2002). Celebrating mediocrity? How schools shortchange gifted students. *The Journal of Culture and Education*, 153-163.

Stiff, L., & Harvey, W. (1988). On the Education of Black Children in Mathematics. Journal of Black Studies, 19(2), 190-203. Retrieved February 24, 2020, from www.jstor.org/stable/2784437

Sullivan, G. M., & Artino, A. R., Jr. (2013). Analyzing and interpreting data from likert-type scales. *Journal of graduate medical education, 5*(4), 541-542. doi:10.4300/JGME-5-4-18

Taliaferro, J., & DeCuir-Gunby, J. (2008). African American educators' perspectives on the advanced placement opportunity gap. *Urban Review, 40*(2), 164-185. doi:10.1007/s11256-007-0066-6

Trochim, W. (2000). *The Research Methods Knowledge Base,* (2nd ed.). Cincinnati, OH: Atomic Dog Publishing.

Urdan, T., & Schoenfelder, E. (2006). Classroom effects on student motivation: Goal structures, social relationships, and competence beliefs. *Journal of School Psychology, 44*(5), 331-349. doi:10.1016/j.jsp.2006.04.003

U.S. Bureau of Labor Statistics. (2020). *Employment in STEM Occupations*. U.S. Bureau of Labor Statistics. https://www.bls.gov/emp/tables/stem-employment.htm

Vallerand, R. J., & Reid, G. (1984). On the causal effects of perceived competence on intrinsic motivation: A Test of Cognitive Evaluation Theory. *Journal of Sport Psychology, 6*(1), 94-102.

Vaughn, M. (2018). Making sense of student agency in the early grades. *Phi Delta Kappan*, 99(7), 62–66. https://doi.org/10.1177/0031721718767864

Vygotsky, L.S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Warne, R. T., Larsen, R., Anderson, B., & Odasso, A. J. (2015). The impact of participation in the advanced placement program on students' college admissions test scores. *Journal of Educational Research, 108*(5), 400-416. doi:10.1080/00220671.2014.917253

Wilson, J. L., Slate, J. R., Moore, G. W., & Barnes, W. (2014). Advanced placement scores for black male students from Connecticut, Florida, Maryland, Massachetts, and Texas. *Education Research International*, 1-14. doi:10.1155/2014/659212

Appendix A

Research Questionnaire

Q 1. What grade are you in?

1) 11th
2) 12th

Q 2. What is your gender?

1) Male
2) Female
3) I wish not to disclose

Q 3. Which best describes your living situation?

1) Live with both parents
2) Live with one parent
3) Live with guardian
4) Live with grandparent

Q 4. Did anyone in your living situation attend college?

1) Yes
2) No

Q 5. Identify your race/ethnicity.

1) Other
2) Black or African Decent
3) Asian American
4) Latino American
5) White/Caucasian

Q 6. If you were to purchase lunch, please indicate the purchase price.

1) Full Price
2) Reduced Lunch Price
3) Free Lunch

Q 7. What was your grade in your previous math course?

1) A
2) B
3) C
4) D
5) F

Q 8. What was your grade on your Coordinate Algebra EOC?

1) Distinguished
2) Proficient
3) Developing
4) Beginning

Q 9. What was your grade on your Analytic Geometry EOC?

1) Distinguished
2) Proficient
3) Developing
4) Beginning

Q 10. Which AP math course(s) are you taking? (Select all that apply)

1) AP Calculus AB
2) AP Calculus BC
3) AP Statistics

Q 11. How would you describe your current grade in your AP math course(s)

1) A
2) B
3) C
4) D
5) F

Use the following scale to answer #12-22

For each of the following statements, please indicate how true it is for you, using the following scale:

1	2	3	4	5	6	7
not at all true			somewhat true			very true

Q 12. I enjoyed doing math very much

Q 13. I would describe math as very interesting

Q 14. While I was doing math, I was thinking about how much I enjoyed it.

Q 15. I am satisfied with my performance in this class

Q 16. I think I am pretty good in this class compared to my peers

Q 17. I feel I am on the right track to pass the AP exam for this course as of today

Q 18. I felt that it was my choice to register for the AP exam

Q 19. I felt pressured to register for the AP exam because of the registration deadline

Q 20. The College Board late fee effected my decision to register for the AP exam

Q 21. The College Board registration deadline is too early to make a decision about registering for my AP exam

Q 22. The person teaching the course influenced whether I registered to take the math AP Exam

Appendix B

Georgia State University
Parental Informed Consent

Title: The Relationship Between the College Board AP Exam Registration Process and African American Students' Mathematics AP Exam Participation Rates
Principal Investigator: Dr. Pier Junor Clarke
Student Principal Investigator: Corey Williams

Introduction and Key Information

Your child is invited to take part in a research study. It is up to you to decide if you would like your child to be in the study. The purpose of this study is to assess the effects of College Board's new Advanced Placement (AP) registration process on African American students' motivation to register for mathematics AP exams. Your child's role in the study will last 15 minutes over one day. You child will be asked to complete a 22-question survey. Participating in this study will not expose your child to any more risks than he/she would experience in a typical day. This study is not designed to benefit your child. Overall, we hope to gain information about how to better advise students on the AP courses they should enroll in.

Purpose

The purpose of the study is to assess the effects of College Board's new Advanced Placement (AP) registration process on African American students' motivation to register for mathematics AP exams. Your child is invited to take part in this research study because he/she identifies as an African American student. Also, they must be enrolled in AP Calculus AB, AP Calculus BC, or AP Statistics. A total of 212 people will be invited to take part in this study.

Procedures

If your child decides to take part, he/she will take a 22-question paper survey. The survey will take 15 minutes over one day. These are the expectations and responsibilities of the participants

- Participants must be enrolled in AP Calculus AB, AP Calculus BC, or AP Statistics
- Participants must self-identify as being of African American descent
- Participants must have parental consent if they are under the age of 18
- Parental and student consent forms must be returned to the researcher by the designated time to participate in the study
- The study will take place at your child's school
- The study will take place after school hours
- Participants may choose to drop out of the study at any time without notice
- Participants will complete a 15-minute paper survey.

Future Research
Researchers will remove information that may identify your child and may use your child's data for future research. If we do this, we will not ask for any additional consent from you.

Risks
In this study, your child will not have any more risks than he/she would in a normal day of life. No injury is expected from this study, but if you believe your child has been harmed, contact the research team as soon as possible. Georgia State University and the research team have not set aside funds to compensate for any injury.

Benefits
This study is not designed to benefit your child personally. Overall, we hope to gain information about how to better advise students on the Advanced Placement courses they should enroll in.

Voluntary Participation and Withdrawal
Your child does not have to be in this study. If you decide to allow your child to be in the study and you change your mind, your child has the right to drop out at any time. Your child may skip questions or stop participating at any time. Your child may refuse to take part in the study or stop at any time. This will not affect your child's grade in any way.

Confidentiality
We will keep your child's records private to the extent allowed by law. The following people and entities will have access to the information you provide:

- Corey Williams and Dr. Pier Junor Clarke
- GSU Institutional Review Board
- Office for Human Research Protection (OHRP)

We will use participant numbers rather than your child's name on study records. The information your child provides will be stored on a password- and firewall-protected computers. Consent forms and data will be stored separately. When we present or publish the results of this study, we will not use your child's name or other information that may identify your child.

Contact Information
Contact Pier Junor Clarke at pjunor@gsu.edu or Corey Williams at cwilliams77@student.gsu.edu

- If you have questions about the study or your part in it
- If you have questions, concerns, or complaints about the study

The IRB at Georgia State University reviews all research that involves human participants. You can contact the IRB if you would like to speak to someone who is not involved directly with the study. You can contact the IRB for questions, concerns,

problems, information, input, or questions about your rights as a research participant. Contact the IRB at 404-413-3500 or irb@gsu.edu

Consent

The researcher will give you a copy of this consent form to keep. If you are willing to volunteer your child for this research, please sign below.

_____
Printed Name of Parent or Guardian

_____ _____
Signature of Parent or Guardian Date

_____
Print Child's Name

_____ _____
Principal Investigator or Researcher Obtaining Consent Date

Appendix C

Georgia State University
Student Informed Consent

Title: The Relationship Between the College Board AP Exam Registration Process and African American Students' Mathematics AP Exam Participation Rates
Principal Investigator: Dr. Pier Junor Clarke
Student Principal Investigator: Corey Williams

Introduction and Key Information

You are invited to take part in a research study. It is up to you to decide if you would like to take part in the study. The purpose of this study is to assess the effects of College Board's new Advanced Placement (AP) registration process on African American students' motivation to register for mathematics AP exams. Your role in the study will last 15 minutes over one day. You will be asked to complete a 22- question survey. Participating in this study will not expose you to any more risks than you would experience in a typical day. This study is not designed to benefit you. Overall, we hope to gain information about how to better advise students on the AP courses they should enroll in.

Purpose

The purpose of the study is to assess the effects of College Board's new Advanced Placement (AP) registration process on African American students' motivation to register for mathematics AP exams. You are invited to take part in this research study because you identify as an African American student. Also, you are enrolled in AP Calculus AB, AP Calculus BC, or AP Statistics. A total of 212 people will be invited to take part in this study.

Procedures

If you decide to take part, you will take a 22-question paper survey. The survey will take 15 minutes over one day. These are the expectations and responsibilities

- You must be enrolled in AP Calculus AB, AP Calculus BC, or AP Statistics
- You must self-identify as being African American
- You must have parental consent if they are under the age of 18
- Parental and student consent forms must be returned to the researcher by the designated time to participate in the study
- The study will take place at your school
- The study will take place after school hours
- You may choose to drop out of the study at any time without notice
- You will complete a 15-minute paper survey.

Future Research

Researchers will remove information that may identify you and may use your data for future research. If we do this, we will not ask for any additional consent from you.

Risks
In this study, you will not have any more risks than you would in a normal day of life. No injury is expected from this study, but if you believe you have been harmed, contact the research team as soon as possible. Georgia State University and the research team have not set aside funds to compensate for any injury.

Benefits
This study is not designed to benefit you personally. Overall, we hope to gain information about how to better advise students on the AP courses they should enroll in.

Voluntary Participation and Withdrawal
You do not have to be in this study. If you decide to be in the study and change your mind, you have the right to drop out at any time. You may skip questions or stop participating at any time. You may refuse to take part in the study or stop at any time. This will not affect your grade in any way.

Confidentiality
We will keep your records private to the extent allowed by law. The following people and entities will have access to the information you provide:

- Corey Williams and Dr. Pier Junor Clarke
- GSU Institutional Review Board
- Office for Human Research Protection (OHRP)

We will use participant numbers rather than your name on study records. The information you provide will be stored on a password- and firewall-protected computers. Consent forms and study data will be stored separately. When we present or publish the results of this study, we will not use your name or other information that may identify you.

Contact Information
Contact Pier Junor Clarke at pjunor@gsu.edu or Corey Williams at cwilliams77@student.gsu.edu

- If you have questions about the study or your part in it
- If you have questions, concerns, or complaints about the study

The IRB at Georgia State University reviews all research that involves human participants. You can contact the IRB if you would like to speak to someone who is not involved directly with the study. You can contact the IRB for questions, concerns, problems, information, input, or questions about your rights as a research participant. Contact the IRB at 404-413-3500 or irb@gsu.edu.

_____ _____

Print Name Date

_____

Signature

_____ _____

Principal Investigator or Researcher Obtaining Consent Date