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Mathematics Self-Efficacy and the Smarter Balanced Assessment: An Intersection of Race, Socioeconomic Status and Gender

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MATHEMATICS SELF-EFFICACY AND THE SMARTER BALANCED ASSESSMENT: AN INTERSECTION OF RACE, SOCIOECONOMIC STATUS AND GENDER

by

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Abstract

This quantitative study investigated the relationship between the mathematics self-efficacy of high school seniors and their 11th grade mathematics scores on the Smarter Balanced Assessment (SBAC). This study also examined the interactions of race, gender, and socioeconomic status with mathematics self-efficacy. This study employed survey research using the 8-item, self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ) created by Pintrich and McKeachie (1993), which was modified to measure mathematics self-efficacy. Seven hundred and fifteen high school seniors were invited to participate in the study and 233 responded, which constituted a response rate of 33 percent. A multiple regression model was used to analyze the relationship between students' scores on the mathematics SBAC and their mathematics self-efficacy. Results indicated that 1) There was a statistically significant relationship between high levels mathematics self-efficacy and high scores on the mathematics portion of the SBAC. Race also significantly contributed to the multiple regression model created by this study to predict a negative relationship between students of color and mathematics SBAC scores. 2) There was no difference between the mathematics self-efficacy of low-SES students of color and low-SES White students; between White males and males of color, or between White females and females of color. While mathematics self-efficacy showed little difference in students across gender, race, and socioeconomic status, students of color showed a negative relationship to their scores on the SBAC. There continues to be an achievement gap in mathematics regardless of the mathematics self-efficacy of students of color.

Key Words: Mathematics self-efficacy, self-efficacy theory, social cognitive theory

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Chapter 1: Introduction

After a six-year journey through college, my son defied the odds and was one of only a handful of African-American males to graduate with a bachelor's degree in mechanical engineering. Beaming with pride during his university's commencement, I sat and listened to the names of over a thousand graduating engineering students for the chance to cheer for my son. While watching each graduate walk, I began to take note of how few women walked across the stage compared to men, and how this gender disparity paled in comparison to the number of African-American or Hispanic graduates. This was not surprising to me, as I remembered my son coming home from high school lamenting that he was the only African-American in his Advancement Placement (AP) physics and calculus courses.

The long-standing under-representation of African-Americans and Hispanics in science, technology, engineering, and mathematics (STEM) has long been documented. In 2011, only 8% of STEM jobs in the United States were held by women who were also ethnic minorities (National Science Foundation, Division of Science Resources Statistics, 2012). As a country, the STEM workforce in United States is dominated by White and Asian males (National Science Foundation, Division of Science Resources Statistics, 2012) and advanced mathematics high school classrooms reflect a similar demographic (U.S. Department of Education Office for Civil Rights, 2014). Self-efficacy is positively related to academic achievement (Feldman & Kubota, 2015; Parker et al., 2014; Vogel & Human-Vogel, 2017) and academic achievement predicts college success (Noble & Sawyer, 2004). Course choice in college influences career paths after college which effects earning potential (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001). This presents formidable implications for the future employment of these students, as the United States Bureau of Labor and Statistics states that jobs in STEM fields are growing faster than in

any other sector in the United States (National Science Foundation, Division of Science Resources Statistics, 2012). Many of our nation's African-Americans and Hispanics will not be able to participate in the fastest growing career area. I could not shake these thoughts as I watched graduate after graduate crossing the stage.

While the causes of the achievement gaps between women and men, and minorities and white students in STEM are complex and still debated, researchers such as Steele & Aronson (1995) argue that stereotype threat might be one such contributor. Stereotype threat is defined as a "situational predicament in which individuals are at risk of confirming negative stereotypes about their group" (p. 797) which affects how one perceives his/her own ability to perform specific tasks. Inzlicht & Schmader (2011) add, "it is the resulting sense that one might be judged in terms of negative stereotypes about one's group instead of on personal merit" (pp. 5-6). Steele and Aaronson (1995) propose that pre-conceived ideas about gender roles and levels of intelligence based on race, unconscious bias, and stereotype threat continue to have a significant effect on the achievement of women and people of color, indicating that stereotype threat may be a significant contributor to achievement and opportunity gaps. In particular, mathematics presents its own profile stereotypes. These stereotypes can enhance existing labels within groups which are already at an academic disadvantage. Women and ethnic minorities fall into such groups. (Aronson, Good, & Harder, 2008; Cheryan, Master, & Meltzoff, 2015).

The importance of these findings is contrasted with research investigating the role of self-efficacy in relation to general academic success across all disciplinary areas. Bandura (1977) defined self-efficacy as "the conviction that one can successfully execute the behavior required to produce the outcomes" (p. 193). Self-efficacy has been researched for decades and is a positive predictor of academic success (Feldman & Kubota, 2015; Parker et al., 2014; Vogel &

Human-Vogel, 2017). Phan's (2012) research indicates that self-efficacy can even determine the levels of effort, perseverance, and resiliency one exhibits when faced with obstacles and adverse situations. Bandura (1977) found that there are several factors that contribute to the levels of one's self-efficacy, including performance accomplishments (opportunities for success), vicarious experience (examples of success), verbal persuasion, and emotional arousal (motivation). It is important to note that content or task-specific self-efficacy, rather than generalized self-concept, predicts success within that content or task (Feldman & Kubota, 2015; Parker et al., 2014; Vogel & Human-Vogel, 2017).

A student's perception of self-efficacy begins at an early age. Wigfield and Eccles (2002) found that by early elementary school, students have already developed perceptions about their academic abilities. In fact, Cvencek, Meltzoff, and Greenwald's (2011) study found that in as early as the second grade, girls had already determined that "math was for boys" (p. 766). While students' self-efficacy may be relatively strong in elementary school, students' beliefs about their academic ability tend to decline and adjust as they acquire experience and form more realistic self-evaluations (Freedman-Doan, Wigfield, Arbreton, & Harold, 2000; Jacobs, Lanza, Osgood, Eccles, & Wigfield, 2002). This study seeks to understand the relationships between students' mathematics self-efficacy beliefs and their mathematics ability, as a way of contributing additional insight into this complex topic.

Context of the Study

West School District (WSD) is located in a small suburb in a rural Oregon county. The population of approximately 10,000 students is predominately White and middle class. While the district maintains high rates of graduation, the achievement gap for students of color and those in poverty is still an area of concern (Oregon Department of Education, 2017). Standardized tests

are administered yearly to monitor progress in reading and mathematics, but there is currently no assessment data in the district to indicate students' levels of mathematics self-efficacy. The relationships between self-efficacy and mathematics achievement, race, SES, and gender have not yet been explored in WSD.

Statement of Purpose

At the school level, linking concepts such as mathematics self-efficacy to achievement results on statewide standardized tests like the Smarter Balanced Assessment (SBAC) offers the opportunity for districts to gather information about how they are serving students of color, females, and students in poverty in mathematics. Mathematics self-efficacy is an important indicator of whether women choose to go into STEM fields as well as predicting interest in participating in mathematics courses (Correll, 2001; Gainor & Lent, 1998). It is also a primary component in the determination of how long women persevere in STEM fields (Eccles, 1994; Lent, Brown, & Hackett, 1994).

The purpose of this study was to examine the levels of mathematics self-efficacy for 12th grade students in the WSD and correlate these results with their SBAC mathematics scores to discern a relationship between them. Twelfth grade students were chosen because of the time elapsed between the administration of the SBAC in eleventh grade for the same students. Students take the SBAC only once in high school, eleventh grade. Due to the fact that the results of the SBAC were not delivered to school districts until the late summer months, twelfth grade was selected for this study in order to have the most current data. Additionally, the researcher sought to understand the relationship between the dependent variable (mathematics self-efficacy) and three independent variables (race, gender and socioeconomic status).

The research is well-established that self-efficacy is a positive predictor of academic success (Bandura & Locke, 2003; Feldman & Kubota, 2015; Parker et al., 2014; Vogel & Human-Vogel, 2017), yet these relationships still benefited from exploration in local contexts. The results from this study provided information that gave the West School District a research-based perspective on how they are supporting their students in mathematics.

Research Questions

This study used the *self-efficacy for learning* subscale of the Motivated Strategies for Learning Questionnaire (MSLQ-SE) to measure the levels of mathematics self-efficacy of approximately 700 twelfth-grade students in Westside School District. The MSLQ-SE is an instrument developed by Pintrich, Smith, Garcia and McKeachie (1993) to measure the motivation and use of learning strategies of college students. It has had proven reliability with a range of ages of students including adolescents. Therefore, it was an appropriate tool to be used for 12th grade students (Jiang, Song, Lee, & Bong, 2014; Lodewyk & Sullivan, 2016; Schweinle & Mims, 2009).

The Smarter Balanced Assessment (SBAC) is a standardized assessment developed to measure the academic benchmark levels of students in grades 3, 4, 5, 8 and 11 in the areas of reading and mathematics. This assessment has been used to determine the achievement levels of schools and districts as a whole. Performance on the SBAC is used statewide to guide professional development and determine placement of students in advanced courses in middle and high school.

This study sought to correlate the results of the MSLQ-SE to the mathematics scores on the Smarter Balanced Assessment of the same population to understand the relationship between them. The MSLQ-SE results were used to examine how mathematics self-efficacy correlates

with a student's race, gender, and SES status. A clearer understanding of the correlations between mathematics self-efficacy, race, gender, and SES will offer further confirmation of the interrelatedness and/or the identification of these independent variables that seem most strongly connected to students' mathematics self-efficacy. Despite an extensive search of the extant literature, the researcher could not identify any studies comparing mathematics self-efficacy to achievement on the Smarter Balanced Assessment. This guided the development of the study and its research questions, which investigated the achievement gap in mathematics and the underrepresentation of women and people of color in STEM careers.

The research questions that informed this study were:

1. Is there a relationship between high mathematics self-efficacy, as measured by the MSLQ-SE, and high mathematics achievement, as measured by the Smarter Balanced Assessment?
2. Is there a difference between the mathematics self-efficacy of low socioeconomic students who identify as People of Color (African-American, Hispanic, or multi-racial) and low socioeconomic students who identify as White?
3. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic, or multi-racial) males and White males?
4. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic, or multi-racial) females and White females?

Hypotheses

Hypothesis 1. There will be a positive relationship between a student's mathematics self-efficacy on MSLQ-SE and their Smarter Balanced Assessment mathematics scores.

Hypothesis 2. There will be a negative difference between the mathematics self-efficacy of POC students who have low SES, and White students who have low SES.

Hypothesis 3. There will be a negative difference between the mathematics self-efficacy of male POC students, and White male students.

Hypothesis 4. There will be a negative difference between the mathematics self-efficacy of female POC students, and White female students.

Definitions of Key Terms

This section provides an overview of the key terms used throughout this study and their definitions:

Self-efficacy: A student's judgement of her capabilities to organize and execute courses of action required to attain designated types of performances (Bandura, 1986).

Socioeconomic status (SES): Socioeconomic status is the social standing or class of an individual or group. It is often measured as a combination of education, income (as generally determined by free and reduced-price lunch status), and occupation. (American Psychological Association, 2007)

Free and Reduced Priced Lunch Program (FRPL): The National School Lunch Program is a federally-assisted meal program that allows schools to provide the nutritionally balanced, free or reduced priced lunch (FRPL) to children each school day. (United States Department of Agriculture Food and Nutrition Service, 2017). There is an income cut-off to determine if a child qualifies for FRPL and families must apply each year. The number of students in a school or district that qualify for FRPL is used to classify schools as having high or low socioeconomic status (SES). Based on the SES of a school or district, the federal government allocates dollars to

provide academic support. In this study, the researcher will determine a student's SES based on whether or not they qualify for FRPL.

People of Color (POC): Although the term "people of color" generally refers to any person who is not White, this study will use this term to refer to persons identifying as Hispanic, African-American or multi-racial. The reason for this is that there are some groups of non-white races that are well-represented in STEM careers such as those of Southeast Asian descent (National Science Foundation, Division of Science Resources Statistics, 2017).

Smarter Balanced Assessment Consortium (SBAC): According to the Smarter Balanced Assessment Consortium (2018) website, it is a "public agency currently supported by its members . . . . [which has] created an online assessment system aligned to the Common Core State Standards (CCSS), as well as tools for educators to improve teaching and learning" (http://www.smarterbalanced.org/about/)

Significance

Self-efficacy has been well-researched (Bandura, 1977; Bandura 1989; Corcoran, 1991; Zimmerman, 2000;) and is a reliable predictor of academic achievement (Feldman & Kubota, 2015; Parker et al., 2014; Vogel & Human-Vogel, 2017) and it can shape a child's career choices (Bandura et al., 2001). This study explored the mathematics self-efficacy of students to learn whether self-efficacy has predictive power for a relatively new standardized assessment, the SBAC.

Limitations

The most significant limitation in this study was the low number of students of color in the overall population (roughly 20% Hispanic, African-American, and multi-racial combine). It was challenging to collect the number of surveys needed to accurately represent the independent

variable of race. In contrast, the data collected had the potential to provide unique insights into the mathematics self-efficacy levels of students who may otherwise not be reflected in large data sets due to low numbers.

Another possible limitation was that MSLQ-SE was originally created for college students (Garcia, McKeachie, Pintrich et al., 1993). The MSLQ-SE is detailed in chapter three. Several studies have modified the MSLQ-SE to adapt to younger students (Jiang et al., 2014; Lodewyk, & Sullivan, 2016; Schweinle & Mims, 2009; Vekiri, 2013; Wang, 2012) and indicated the modified tool produced reliable results.

This study used a modified version of the MSLQ-SE to ascertain mathematics self-efficacy. As with any survey, there was an assumption that participants would answer questions honestly, however the self-report nature of the survey presented the possibility of false information being reported.

Potential Contributions of the Study

This research has the potential to shed additional light on how mathematics self-efficacy is correlated to achievement scores on the SBAC for students in WSD. It also has the potential to expand the knowledge of how mathematics self-efficacy interacts with race, socioeconomic status, and gender. Results from this study raise questions for WSD as to how well they serve students in those populations.

Summary

The results of this study have the potential to contribute to the conversation about mathematics self-efficacy and its potential effects on students' performance on the SBAC. In addition, this study examines how the race, gender, and SES of a student related to their scores on the Smarter Balanced Assessment. Understanding more about students' mathematics self-

efficacy may help shape future research around mathematics programs and preparation for summative assessments. Although there has been established research around self-efficacy, more can be explored on mathematics self-efficacy and its role in student success in high school mathematics. Furthermore, there is room for researchers to begin the conversation around how mathematics self-efficacy correlates to the Smarter Balanced Assessment.

Chapter 2: Literature Review

Albert Bandura, the pioneer of self-efficacy research, identified the power of one's perceived ability on a desired outcome (Bandura, 1994). Since self-efficacy is not stagnant and can change depending environmental factors such as stereotype threat, opportunity for mastery experiences, and role models, an abundance of research has been done to add to the discussion of how self-efficacy interacts with those factors (Bandura, Barbaranelli, Caprara, & Pastorelli, 2001; Good, Rattan, & Dweck, 2012; Schwinle & Mimms, 2009). Frequent opportunities for mastery are the most influential factor that affect a student's self-efficacy. Depending on one's gender, opportunities for mastery experiences in school may differ. For reasons such as stereotype threat or personal experiences with mathematics, teachers or parents may have lower expectations for the students who do not fit the stereotype, which in turn can negatively influence self-efficacy levels (Herbert & Stipek, 2005; Meece, Parsons, Kaczala, Goff, & Futterman, 1982).

This literature review begins with an overview of self-efficacy originating from the research of Albert Bandura. This review briefly discusses the literature on students' self-efficacy regarding mathematics and its link to students' career paths in science, technology, engineering, and mathematics, as well as its interactions with gender, race, poverty, and academic achievement. The research discussed in this chapter supports the idea that early mathematics experiences for girls affect self-efficacy, leading to course choices in high school and college which affects future career choice and career opportunities.

Several major areas of the literature deserve consideration in a discussion of self-efficacy pertaining to these topics, including Expectancy-Value Theory as conceptualized by Wigfield & Eccles (2000), considerations of motivation for African American students (Graham, 1994),

foundational theories of self-efficacy (Bandura, 1977), self-efficacy and K-12 education (Pajares, 1996), measuring self-efficacy (Pintrich et al., 1993), and stereotype threat theory (Johns, Inzlicht, & Schmader, 2008).

Albert Bandura's Self-Efficacy Theory

Bandura (1977) found that an individual's self-efficacy significantly affects how he or she copes with any situation. He differentiated outcome expectancy from efficacy expectation. Outcome expectancy refers to an individual's knowledge and belief in a particular course of action in order to achieve a particular outcome. Efficacy expectation encompasses the confidence or doubt about one's ability to perform (Bandura, 1977). Bandura's work suggests that individuals who consistently encounter unconquerable situations will eventually abandon or avoid them. One's beliefs about one's own efficacy are influenced and developed by four main factors: mastery, vicarious experiences, social persuasion, and emotional state.

Factors Influencing Self-Efficacy

The first influencing factor is *mastery*. This factor is the most effective way to build self-efficacy (Bandura, 1994; Britner & Pajares, 2006), due to the fact that people use their interpretations of past performance to form their beliefs about future success (Bandura, 1994; Kiran & Sungur, 2012). For example, if students experience success at a task, they will reference that success when deciding whether or not to attempt future tasks. These tasks must be appropriately challenging and not too easy so that they do not expect that all tasks will produce immediate results and then become discouraged by failure (Bandura, 1994). If students experience failure at a particular task, their self-efficacy is undermined and expected to diminish, especially if they fail before they succeed or if their self-efficacy is not well-established prior to the failure (Bandura, 1994; Kiran & Sungur, 2012).

The second way of creating and strengthening self-efficacy is through the *vicarious experiences* provided by social models (Bandura, 1994). When a student observes others who they feel are similar to them trying hard and not giving up, it raises that student's belief that he, too, is capable of mastering that activity. The same is true for the student who observes failure. Watching others fail lowers self-efficacy and can lessen the effort of the observer (Bandura, 1994). Bandura emphasizes the positive correlation between the assumed similarity or differences and the levels of influence of the successes and failures of the observed.

Social persuasion is the third influence over one's self-efficacy. This is the ability of one's peers or environment to verbally or socially influence one's beliefs in their capabilities to succeed (Bandura, 1994). Not only are people who are verbally and socially persuaded that they are capable of mastery able to expend greater effort, and try harder, but they are able to do so for longer than if they possessed low levels of self-efficacy (Bandura, 1994). Cheema and Skultety (2016) confirmed this in their study that found students' levels of self-efficacy can be influenced by the traits of the majority. For example, if a student with low self-efficacy participates in a class with a majority of highly-confident students, that student will display higher levels of self-efficacy (Cheema & Skultety, 2016).

One's *emotional state or mood* is the fourth and final factor influencing levels of self-efficacy. When determining their capabilities, students will take their emotional state into account. In general, positive moods enhance self-efficacy and negative moods diminish it. For example, if a student is under high stress, he may be less likely believe that he is capable of being successful at that task depending on how he interprets that stress. Reducing negative reactions to stress and changing how one interprets one's physical state shapes self-efficacy (Bandura, 1994). Bandura (1994) states that people who possess a high sense of self-efficacy

tend to use intense emotions as an energizer to boost performance rather than as a debilitating factor inhibiting success.

Psychological Manifestations of Self-Efficacy

Bandura (1994) identified four major psychological processes through which self-efficacy manifests in human functioning. Self-efficacy affects how one thinks (cognitive processes), how motivated one is (motivational processes), how equipped one is to manage and control stress and anxiety (affective processes) and the choices one makes in his or her life (selection processes) (Bandura, 1994).

Motivational processes. Bandura's research is foundational to other studies that examine self-efficacy. Wigfield and Eccles (2002) researched the Expectancy-Value Theory which was first studied by Atkinson (1964). This theory states that the amount of effort one expends on a task or goal is dependent on the value that individual places on it (Wigfield & Eccles, 2000). This research is important in self-efficacy conversations because one's values and expectations for outcomes on a task can be shaped by past successes or failures with that task (Bandura, 1994) therefore affecting one's level of self-efficacy. Once students believe that they are less competent, they lower the value they place on that task (Jacobs, Lanza, Osgood, Eccles & Wigfield, 2002).

In one qualitative study on social cognitive career theory (Lent et al., 1994) and Bandura's (1986) social cognitive theory, researchers interviewed 31 women who began careers as engineers to determine what factors caused women to persist in those careers (Buse, Bilimoria, & Perelli, 2013). Of the 31 women, 21 had been in the field for an average of 21 years and ten had left their engineering career. High levels of self-efficacy were the differentiating factor for perseverance and persistence between the two groups as measured by interviews with

the women. The interview transcripts were put through a software program to code the data and to identify themes and key words around self-efficacy. The women who stayed in their career were motivated by challenge and described themselves as engineers (Buse et al., 2013). Self-efficacy plays a major role in how motivated one is to accomplish personal goals, how long one perseveres in order to achieve those goals and how one responds to failure in the process (Bandura, 1994). As evidenced in the Buse et al. (2013) study, the women demonstrated high self-efficacious beliefs which confirmed Bandura's (1994) results in one working harder and longer through a challenge even in situations where she experiences failure (Bandura, 1994).

Cognitive processes. Through cognitive processes, self-efficacy can manifest itself in personal goal-setting and the ways one may anticipate or visualize his or her future success or failure (Bandura, 1994). Those with high levels of self-efficacy will set high goals, see themselves accomplishing those goals, and stick to them (Bandura, 1994). Bandura (1994) found that those who set challenging goals and use "good analytic thinking" see the result in positive performance outcomes.

Dweck (1999) conceptualized and expanded on the idea of cognitive processing reflecting self-efficacy by asserting that one's intelligence is not fixed and that it can continue to grow and develop depending on his/her mindset. Dweck (1999) found that when one possesses a growth mindset, one will view intelligence as something that can change and increase capacity over time. People with a growth mindset are more likely to take on challenging tasks, and view failure as an event from which they can learn.

Affective processes. Self-efficacy can manifest through affective processes or one's belief in his ability to cope in stressful situations (Bandura, 1994). The level at which one believes he has the ability to cope in stressful situations determines his level of anxiety, as well

as his choice to engage in that situation (Bandura, 1994). When one thinks that he cannot handle stress, he will envision the worst possible outcome which can cause anxiety (Bandura, 1994).

Selection processes. Finally, self-efficacy manifests itself through the influencing of one's choices. These choices involve the type of activity, the level of challenge the activity presents, and in which surroundings one chooses to participate or reside (Bandura, 1994). One's life is determined by whether or not he chooses to challenge himself or remain in environments in which he is more able to cope (Bandura, 1994).

Generalized Self-Efficacy and Domain Specific Self-Efficacy

Generalized self-efficacy is the confidence that one has in his or her overall ability to perform global or generalized tasks (Pajares, 1996). This confidence measure may not accurately reflect one's confidence in his or her ability to perform a specific task. Bandura (1997) advised researchers to be specific with self-efficacy measurements and ensure that the assessments correspond with the task or the domain being measured. He wrote that "efficacy beliefs should be measured in terms of particularized judgments of capability that may vary across realms of activity, under different levels of task demands within a given activity domain, and under different situational circumstances" (p. 42).

When generalized self-efficacy is measured, its accuracy is weakened, as judgements of self-efficacy depend on the considerations of a specific task or domain (Pajares, 1996). Domain specific self-efficacy is a more accurate predictor of performance than is generalized self-efficacy (Bandura, 1997; Feldman & Kubota, 2015). Pajares (1996) notes that mismeasurement of self-efficacy is where researchers can run into problems.

The mathematics domain itself presents cultural stereotypes that can serve as gatekeepers to not only who can be mathematicians, but also how one behaves in order to be a mathematician

(Good, Rattan, & Dweck, 2012; Cheryan, Master, & Meltzoff, 2015). This highlights the need for discussions around mathematics self-efficacy for girls, children in poverty, and children of color, while exposing additional layers for consideration. The literature is shallow in this area and reports are inconclusive on how race, gender, and poverty contribute to mathematics self-efficacy.

Stereotype Threat

One example of an affective process that can create anxiety or stress is stereotype threat. Johns et al. (2008) examined stereotype threat, the sense that one might be judged in terms of negative stereotypes about his or her group instead of on personal merit, and its effect on stigmatized groups of and their performance. They gathered data across four different samples (the first three samples were made up of Caucasian females and the fourth sample was made up of a combination of Latino females and males compared to Caucasian females) and found that emotional regulation, or how capable one is of controlling his emotional response, is essential to how he responds to stereotype threat (Johns et al., 2008).

Logel, Iserman, Davies, Quinn, and Spencer (2009) use the term *thought suppression* to describe one's response to stereotype threat. Thought suppression as it relates to stereotype threat is defined as "the effort required to avoid thinking about a negative stereotype…[and] uses up mental resources needed to perform well in the stereotyped domain" (p. 299). In their study of women's mathematics performance, Logel et al. (2009) found that thought suppression predicted women's underperformance on mathematics tests compared to men. They described a "double consciousness" by which the participants in the study needed to navigate how to respond to stereotype threat and thus performed worse on the tests.

The awareness of a positive or negative expectation or belief about a certain group can influence the performance of a person in that group (Johns et al., 2008; O'Brien & Crandall, 2003; Stangor, Carr, & Kiang, 1998). The member of that group can feel a sense of pressure to confirm or disprove that stereotype which can affect their performance on a specific task (Logel, et al., 2009). The women in the Logel et al. (2009) study were able to activate their thoughts of negative gender stereotypes around mathematics, then suppress those thoughts while performing a mathematics task. Research suggests that this emotional suppression created anxiety, which affected intellectual performance (Johns et al., 2008; Logel et al., 2009). The act of thought suppression of negative stereotypes increases the cognitive load and uses up the amount of cognitive energy needed for successful performance on intellectual tasks such as mathematics (Logel et al., 2009).

Johns et al. (2008) suggested that members affected by stereotype threat may not be able to regulate their emotions under pressure, which may affect their academic performance. Schweinle and Mimms (2009) examined mathematics self-efficacy and its relationship to classroom racial environment from the perspectives of stereotype threat. Schweinle and Mimms (2009) surveyed 243 fifth-grade students and found that the self-efficacy of the African-American students in predominantly White classes were not significantly different than that of their African-American peers in predominantly African-American classes. Schweinle and Mimms (2009) give several explanations for this finding. First, they noted the impact of ethnic group identity and the tendency for people to separate themselves into culturally and demographically similar clusters. Group identity creates a sense of belonging which is positively correlated to feelings of self-esteem, sense of mastery and optimism. Schweinle and Mimms

(2009) named studies that supported ethnic identity as a way that students compensated for feelings of discrimination at school.

Mathematics Self-Efficacy

In mathematics, high school students are constantly asked to take intellectual risks. These risks may include enrollment in advanced placement courses or attempting mathematical tasks that the student perceives as difficult. Those who possess a fixed mindset and/or low levels of self-efficacy are less likely to accept mathematical challenges (Andersen & Cross, 2014). As a result, students are less likely to choose to take higher-level courses in mathematics (Larson et al., 2015) or may graduate from high school underprepared to compete for higher-wage jobs (Kamas & Preston, 2012).

Self-efficacy is a positive predictor of student academic performance (Bandura, 1977; Lent et al., 2016; Shultz, 2005). Higher levels of self-efficacy are needed in order to increase a person's desire to take on challenging tasks. Students who exhibit higher levels of self-efficacy show higher academic success in school (Lent et al., 2016; Kamas & Preston, 2012). Some studies show that as students progress through grades kindergarten through twelve, beliefs in their abilities can diminish, especially for girls with regards to their mathematics skill (Freedman-Doan, Wigfield, Arbreton, & Harold, 2000; Jacobs et al., 2002; Wigfield & Eccles, 2000).

Domain-specific rather than generalized self-efficacy is a more accurate predictor of student achievement in that domain (Bandura, 1977). For example, while a student's general self-efficacy levels can be high, his mathematics self-efficacy may be low and therefore lead him to avoid challenging math courses (Andersen & Cross, 2014). High personal academic self-efficacy not only influences academic performance which influences college success, but also

course enrollment choices and occupational aspirations (Eccles & Wigfield, 2002; Feldman & Kubota, 2015; Neihaus, Rudasill, & Adelson, 2011).

Mathematics Self-Efficacy, Race, and Achievement

The research findings on self-efficacy and race and the ways they interact with academic achievement are mixed and inconclusive. With various layers that contribute to one's self-efficacy, researchers have been unable to agree as to whether or not there is a clear relationship between race/ethnicity and self-efficacy. The studies discussed in this section are examples of ways that researchers have tried to make sense of the ambiguity that surrounds this issue. Social constructs such as stereotype threat, socioeconomic status, and school environment all play a role in how students of color view their ability in mathematics. Overall, there are two things on which research is in general agreement with regard to self-efficacy as it relates to race: 1) self-efficacy is not an inherent trait based on one's race or ethnicity and 2) self-efficacy is an important predictor of student achievement regardless of race (Graham, 1994; Kitsantas, Cheema & Ware, 2011; Stevens, Olivarez, Lans, & Tallent-Runnels, 2004; Wigfield & Eccles, 2000).

A historical background on how research has conceptualized race in relation to self-efficacy and academic performance in necessary before moving into current discussions around this topic. Genetics were considered as an explanation for an intelligence gap between African-Americans and Whites in 1969 (Jensen, 1969). This is critical to keep in mind when analyzing literature involving race, as it frames the context from which the researchers are basing their perceptions. In addition, the overlap of race with poverty can be difficult to tease out. Lee's (2002) research points to SES, sociocultural factors, and school resources as factors that may speak to the achievement gap between students of color and White students in mathematics. While the present study will not only consider African-Americans, history provides a lens to

extend the conversation around race and the effects society has on the self-efficacy and academic achievement of students of color.

This section of the literature review discusses the inconsistencies in the findings on how race, particularly for students of color, can influence self-efficacy, along with the ways self-efficacy may not always mirror achievement in mathematics. In addition, self-confidence which is often measured using tools to determine self-efficacy (i.e., "How confident are you that you can complete this problem?") in students of color can be disconnected from their own mathematics performance.

Graham (1994) did a comparative analysis of 140 studies of literature on African-American students. Graham reviewed empirical literature prior to 1990 narrowing her search to include only studies with the key word or ideas of achievement motivation, locus of control, and need for achievement. Only journal articles and empirical investigations from monographic books were considered. This study was conducted in order to test the beliefs that African-Americans: 1) held negative self-views about their competence, 2) lacked the necessary personality traits to be motivated to achieve, and 3) were less likely to believe in their own personal control of outcomes (Graham, 1994). Graham found that contrary to existing beliefs, African-American subjects reported high optimism and self-regard even when experiencing failure in achievement. Graham (1994) made a case for further exploration and highlighted her concerns surrounding the focus on race comparatives in previous research. Seventy-seven percent of the studies reviewed by Graham were race comparative studies between Whites and African-Americans.

Graham cautioned future researchers of the dangers of race comparative studies in that it may reinforce assumptions that the behavior and performance of African-Americans was

deviant. Graham encouraged future researchers to examine within-group variations to attain a better understanding of how people of different races compare among their peers in regard to motivation. In Graham's discussion of the analysis, she suggests six principles of motivational psychology for African-Americans to stimulate thinking about future research in the area of race and motivation. A motivational psychology for African Americans must 1) explicitly be concerned with the self, 2) incorporate a range of cognitive and affective determinants of behavior, 3) be particularly sensitive to the dynamics of failure, 4) acknowledge the complex relations between race and social class in this society, 5) address the socialization (child rearing) antecedents of achievement striving, and 6) contribute to the understanding of general principles of human behavior (Graham, 1994).

Considering the findings of Graham's (1994) analysis, specifically the importance of the role self-efficacy plays in motivation, Pajares and Kranzler (1995) sought to measure the predictive and mediational role of self-efficacy in relation to mathematical problem solving in African-American and White students. This was a replication study of Pajares and Miller (1995) that differed in that general mental ability was measured rather than using standardized tests such as the SAT to measure academic achievement. Three hundred twenty-nine White and African-American high school students in grade nine through twelve were given a non-verbal reasoning test to measure intelligence. Mathematics level was measured by the highest-level mathematics course that students had completed by the time of the study. The Mathematics Confidence Scale was used to measure mathematics self-efficacy. Based on the ratings from Mathematics Confidence Scale or level of self-efficacy, over and under confidence was determined. If a student rated themselves as a 4, 5, or 6, they were considered over-confident. A path analysis was used to determine direct and indirect effects of the variables. Results indicated that more

than self-concept or students' mathematics levels, mathematics self-efficacy was a strong predictor of mathematics performance (Pajares and Kranzler, 1995). An interesting finding in this study revealed that African-American students were less accurate in predicting their ability on mathematics ability. They reported higher levels of self-efficacy than Whites but low levels of mathematics achievement. This aligns with Graham's study analysis reporting that African-Americans in the literature maintained "undaunted optimism and positive self-regard even in the face of achievement failure" (p. 103).

In an analysis of the Program for International School Assessment (PISA), researchers found that African-American students reported higher levels of self-confidence, as measured by their ratings of confidence on a mathematics self-efficacy scale, in contrast to their lower achievement scores on PISA (Cheema & Skultety, 2016). Cheema and Skultety (2016) also used the same self-efficacy measurement tool to define how often students under/overestimated their ability in mathematics and found that African-American and Hispanic students consistently overestimate their abilities in science and mathematics (Cheema & Skultety, 2016). Regardless of gender, African-American and Hispanic students' mathematics self-efficacy scores were higher than their mathematics achievement scores as opposed to White and Asian students whose mathematics self-efficacy and performance were more closely aligned (Cheema & Skultety, 2016). In contrast, Eaton and Dembo (1997) observed slightly different results with Asian students, who demonstrated high mathematics achievement but reported lower academic self-efficacy and greater fear of failure (Eaton & Dembo, 1997).

Kitsantas et al. (2010) analyzed the results of PISA exams to determine the role self-efficacy plays in student achievement in mathematics. Using three approaches to analyzing nested data, researchers compared three analytical approaches to determine the most effective.

The findings revealed that in addition to self-efficacy, both race and SES were important predictors in math achievement (Kitsantas et al., 2010)

There are many factors to consider when analyzing how race interacts with self-efficacy and mathematics achievement. Whether it be cultural history, stereotype threat, or motivation, it is important to keep in mind the layers of complexity that affect self-efficacy when race is a factor for consideration.

Mathematics Self-Efficacy, Socioeconomic Status, and Achievement

Of the limited research on how SES and self-efficacy interact, studies discussed in this section address the significance of mathematics and race on self-efficacy, which are of interest to the present study. This section discusses the effects of SES on student achievement and what research says about the connection between the two. It examines the results of American and international studies and how they have attempted to make sense of the relationship between self-efficacy and a student's family and/or school income status. The international studies provide notable results that come from Australia and Nicaragua.

Mueller and Parcel (1981) define SES as a person's relative position in a hierarchy based on his or her access to wealth, power, and/or social status. There are three main indicators that are commonly used to determine SES in children and adolescent populations and those are parental income, parental education, and parental occupation (Conger & Donnellan, 2007; Hauser, 1994; Mueller & Parcel, 1981).

Research is inconsistent with respect to which one or combination of the three is used across studies. For example, Wiederkehr, Darnon, Chazal, Guimond, and Martinot (2015) asked 8th and 9th grade students to report their parents' occupation to determine their level of SES while Jurecska et al. (2012) used school records (free or reduced priced lunch status) to

determine SES. Parents voluntarily complete forms to identify income levels base on the number of family members and household income (Jurecska et al., 2012). The national free or reduced priced lunch program (FRPL) is a federal program to supplement student meals whose family income falls within or below the national poverty level. The variation in how researchers have measured SES has created some ambiguity in how findings around SES are interpreted. Mueller and Parcel (1981), cautioned that researchers run the risk of misinterpreting data when labeling SES as a homogeneous group and limiting student groups to one or two characteristics to determine SES.

The SES of individual students can be an important factor in predicting student achievement in mathematics (McConney & Perry, 2010) and a strong correlate of overall academic performance (Lent et al., 2016; Schulz, 2005; Sirin, 2005). Sirin (2005) conducted a meta-analysis of 74 independent studies from journal articles on SES and academic achievement published between 1990 and 2000. Over one hundred thousand students across 128 school districts were analyzed. The findings revealed that SES at the student level is one of the strongest correlates to academic achievement (Sirin, 2005).

McConney and Perry (2010) noted in their study of more than 12,000 Australian fifteen-year-old students who participated in the PISA exam that, specifically in mathematics achievement, there were substantial increases in achievement when students attended high SES schools (McConney & Perry, 2010). This is important to note because the present study holds demographics of a majority white, affluent population.

Wiederkehr et al. (2015) examined 148 students from two different schools to determine if students internalize SES in the form of high or low school self-efficacy. This French study found that students of low SES exhibited not only low performance in mathematics achievement,

but also lower self-efficacy than their high SES peers (Wiederkehr et al., 2015). In contrast to this study, Jurescka et al. (2012) had surprising results in their small study comparing Spanish-speaking students in the United States to students in Nicaragua. This study consisted of 63 participants from Central America and 27 from the United States, and explored the relationship between intellectual ability, SES, academic achievement, and self-efficacy. Jurescka et al. (2012) found that even while demonstrating strong academic performance, the self-efficacy of students with high SES was consistently lower than those who came from poverty. This was particularly surprising because the students with high SES also recorded higher grade point averages than their low-SES peers. Jurescka et al. (2012) offered several possible explanations for this including that personal experiences that influence self-efficacy (mastery, vicarious experiences, for example), were not accounted for in this study. They also pointed to parenting styles such as family rules, parental involvement, and household responsibilities as potential factors affecting these students' self-efficacy. While there were limitations to this study (population size and imbalance of Nicaraguan students versus American students), it is worth noting that this study would support the findings from Schwienle and Mimms (2009) and Cheema and Skultety (2016) that while African-American students report higher self-efficacy and confidence, they can perform lower on academic achievement.

Mathematics Self-Efficacy, Gender, and Achievement

Although achievement data has historically shown that male students outperform female students in the area of mathematics, there is no definitive research to support that males are inherently mathematically superior to females (Meece, Parsons, Kaczala, Goff, & Futterman, 1982). The stereotype that males are better-suited for mathematics unfortunately still exists. Fennema and Sherman (1978) found in their study of over 1,200 high school students in

Wisconsin that boys viewed math as a male domain, reported higher confidence, and viewed mathematics as more useful subject than did girls. Decades later, studies report that as early as age six, children have already identified with the stereotype that mathematics is for boys (Cvencek, Meltzoff & Greenwald, 2011).

Else-Quest, Mineo, and Higgins (2013) are believed to be the first group of researchers to examine adolescents' math and science attitudes (self-concept, task value and expectations for success) and achievement (grades in math and science) at the intersection of gender and ethnicity. Findings showed that regardless of race (African-American, White, Asian, Latino/a), male adolescents reported more positive attitudes toward mathematics than did their female peers (Else-Quest et al., 2013). While mathematics self-efficacy was not specifically measured in this study, self-concept, task value and expectations for success are all outcomes determined by levels of one's self-efficacy (Bandura, 1977).

The gender gap in mathematics self-efficacy tends to grow as student move from kindergarten through 12th grade (American Association of University Women, 1991; Jacobs et al., 2002). Herbert & Stipek (2005) found that by third grade, regardless of high achievement, girls rated their competence in mathematics lower than did boys. Wigfield and Eccles (2002) point to the middle school years as a time when students are particularly sensitive to their social rank and are more aware of their abilities in comparison to their peers and therefore narrow the gap between their perceived ability and their performance.

While the mathematics achievement gap has narrowed between males and females, there is still a notable underrepresentation of women in science, technology, engineering and mathematics (STEM) careers. The National Science Foundation Division of Science Resources and Statistics (2015) reported that in the United States, women only held 24 percent of the jobs

in STEM fields. Even though women and men were represented evenly in undergraduate degrees, about 30 percent of all STEM degrees are obtained by women. Moreover, in 2012, the same foundation reported that only eight percent of STEM jobs in the United States were held by women who were also ethnic minorities.

Underrepresentation of women in mathematics. There is an underrepresentation of women in mathematics careers and mathematics-related degrees (National Science Foundation, Division of Science Resources and Statistics, 2015). Some researchers reference self-efficacy indicators as explanations for the gender gap in STEM career paths (Buse, Bilimoria, & Perelli 2013; Isaac, Kaatz, Lee, & Carnes, 2012; Kamas & Preston, 2012; Zeldin, Britner, & Pajares, 2008). Other literature attributes the gap to social barriers such as gender stereotypes as well as stereotypes about mathematics careers (Cheyran, Master, & Meltzoff, 2015). Buse et al. (2013) identified high levels of self-efficacy as one of several key reasons for women engineers' persistence in the field. Similarly, researchers such as Isaac et al. (2012) propose an increase of women's leadership self-efficacy, or how women perceive their own ability in leadership, in order to combat the stereotype threat that comes with pursuing STEM careers.

In childhood and adolescence, literature identifies several factors as possible influences on girls' choices to move away from careers in STEM. Gender appears to impact children's thinking about their future career options. Dasgupta and Stout (2014) wrote an article describing the STEM career path of females from childhood to adolescents to adulthood. They identified and synthesized research to support that parent and peer influences during childhood and adolescence, along with personal motivation and values, are important factors in predicting women's STEM career choices (Dasgupta & Stout, 2014). Shapiro et al. (2015) support the peer group influence in their research of students in grades six through eight. Results indicated that

when girls are a part of an organized peer group such as the Girl Scouts, they showed higher levels of overall self-confidence but still identified female-dominated careers as preferable to careers in mathematics (Shapiro et al., 2015).

Mathematics Self-Efficacy, Student Achievement and the SBAC

The Smarter Balanced Assessment (SBAC) was developed by a group of educators at every academic level across 30 states, with the goal of creating a comprehensive assessment that would help to assess students' preparedness against the Common Core State Standards (CCSS) upon graduation from high school (Smarter Balanced Assessment Consortium [SBAC], 2018). The SBAC and the Partnership for Assessment of Readiness for College and Career (PARCC) assessments came about in response to the No Child Left Behind Act of 2002, with 30 states coming together to apply for a federal grant to support the creation of a comprehensive common assessment (SBAC, 2018).

The SBAC is aligned to measure the Common Core State Standards (CCSS) which are a group of academic standards that set the minimum learning expectations for students at each grade level for kindergarten through twelfth grade (SBAC, 2018). While standardized assessments are not new because state education standards and associated assessments have been around since the early 1990s, the SBAC and PARCC are relatively new; the first pilot test for SBAC was conducted in 2013. At the time of this writing in 2018, there are no studies that specifically link mathematics self-efficacy to mathematics achievement on the SBAC. However, there is research connecting self-efficacy to student achievement as measured by other standardized tests such as the Program for International School Assessment (PISA), as well as high school grade point averages (GPA).

One study that analyzed the results of more than 10,000 fifteen-year-old Australian students' 2003 PISA results, linked self-efficacy to achievement (Parker et al., 2014). Parker et al. (2014) tested the hypothesis that self-efficacy, as measured by an eight item self-efficacy scale from the PISA database, predicted performance on the Australian college entrance exam called Tertiary Entrance Exam (TER), now the Australian Tertiary Admission Rank (ATAR), a standardized test to determine a student's Tertiary Entrance Aggregate (TEA) (TISC, 2016). The results indicated that self-efficacy was a significant predictor of TER scores over and above prior achievement (Parker et al., 2014). Kitsantas et al. (2010) found similar results when they compared mathematics self-efficacy as measured by the 2003 PISA to the PISA mathematics assessment. The PISA measures mathematics self-efficacy by asking students to rate their levels of confidence in their ability to perform certain mathematical tasks. American students' mathematics self-efficacy was found to be an important predictor of mathematics achievement (Kitsantas et al., 2010).

Other studies point to self-efficacy as a mediating factor to student achievement. Feldman and Kubota (2015) researched 89 college freshmen students in Northern California, in an effort to compare generalized hope, domain-specific hope, generalized self-efficacy, and academic self-efficacy to explore possible paths to predict GPA. They found that generalized hope predicted academic self-efficacy which predicted GPA (Feldman & Kubota, 2015). While there were limitations due to sample size and results are not generalizable, this study does contribute a unique concept to the research around how self-efficacy may affect academic achievement through hope. Niehaus, Rudasill, and Adelson (2012) found that self-efficacy was a positive predictor of several outcomes for Latino students in an after-school program including school attendance, which contributes to mathematics achievement.

Measuring Self-Efficacy

Although measurement tools can vary, almost all researchers have used a Likert-type response scale on surveys to measure mathematics self-efficacy. These response scales ask students to identify the numbers indicating their levels of certainty that they can perform specific mathematical tasks. This section discusses the survey model of measurement and the background of the self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ-SE), as one tool for measuring self-efficacy.

Surveys are a common way to quantify self-efficacy. Toland & Usher (2016) conducted a study that used a survey analysis approach called the Rasch method. The Rasch method is a technique that is used to evaluate how middle school students use rating scales, address limitations of the rating scales, and the fit of the construct with the respondents in the study. In one sample of 1,110 sixth, seventh, and eighth grade students, Toland & Usher (2016) used a 6-point Likert scale model, a Mathematics Skills Self-Efficacy Scale, to measure self-efficacy. In a second sample of 803 sixth, seventh, and eighth grade students, they used a response scale that required students to rate their self-efficacy by choosing a number between 0 and 100. Students in both samples were asked to rate their confidence in various mathematics areas where the number 1 represented the anchor (not at all confident) and 6 (completely confident). Sample two used the 0 to 100 confidence scale anchors at 0 (not at all confident), 50 (somewhat confident), and 100 (completely confident).

The results from the Rasch model indicated that the differences between level 2 and level 3 and again on levels 4 and 5 on the first rating scale were interpreted as having the same meaning to the respondents. The survey was then modified/collapsed from a 6-point scale to a 4-point scale. Results from the study suggested that for young adolescents, the 4-point scale rather

than the 0 to 100-point response items was optimal for several reasons. Pre-adolescents are still developing their own judgements about their capabilities and may not be able to decipher between tens or hundreds of categories (Schneider, 2008). Differentiating between the many responses that are possible on a 0 to 100 scale may cognitively overwhelm young learners which could lead to the response categories not being utilized. Additionally, a 4-point scale increases the likelihood that adolescents will complete the survey (Toland & Usher, 2016).

Lastly, it has been argued that the working memory, especially in young learners, has difficulty holding more than several categories at a time (Cowan, Morey, Chen, Gilchrist, & Saults, 2008). Toland & Usher's (2016) research suggested that researchers find balance between offering too few categories resulting in a loss of reliability and offering too many categories that can result in measurement error. Toland & Usher (2016) also suggested labeling each response option to avoid the chance that students insert their own meaning into what is in between the anchor ends of *not at all confident* and *completely confident*.

Other instruments that have been used to measure self-efficacy include: The Sherer General Self-Efficacy Scale (GSES), a 17-item instrument that assesses generalized self-efficacy in adults, using a 5-point Likert scale (Peter, Cieza, & Geyh, 2014), and the Moorong Self-Efficacy Scale (MSES), which uses 16 items to measure adults' confidence in their ability to control their outcomes on a 7-point Likert scale (Middleton, Tran, Lo, & Craig, 2016).

Motivated Strategies for Learning Questionnaire. In 1986, the National Center for Research on Improving Teaching and Learning (NCRITL) funded Pintrich et al. (1993) to begin research on college student learning and teaching. The Motivated Strategies for Learning Questionnaire (MSLQ) was one result of their work. The full 81-item version underwent numerous revisions since its first iteration and was created to be used in different domains.

Pintrich et al. (1993) administered the first versions of the questionnaire to more than 1,700 college students between 1986 and 1988 then revised the items after each administration. Since then, the MSLQ has been replicated in hundreds of different domains, settings, and samples, and each scale is shown to be stable and specifically created to be domain independent (Pintrich et al., 1993).

The most recent version of the MSLQ dated 1991, is divided into two parts. Part one encompasses the six scales measuring motivation and part two includes nine scales measuring various learning strategies, for a total of 15 scales (Pintrich, Smith, Garcia, & McKeachie, 1991). Each of the 15 scales can be given in isolation. The six scales on the MSLQ that measure motivation include intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning and performance. Items are measured using a 7-point Likert scale ranging from 1 (not at all true of me) to 7 (very true of me). The mean of the scales is calculated to determine an overall score (Pintrich et al., 1991).

Pintrich, Smith, Garcia and McKeachie (1993) performed an analysis on the MSLQ to determine its internal consistency, reliability and predictive validity. They utilized previous data from 380 college students who completed the MSLQ in 1990. A volunteer sample of students across 14 different subject domains and five disciplines was used. A confirmatory factor analysis was performed. The predictive validity of the questionnaire was based on the correlations of the motivational scales to that of students' later academic performance (Pintrich et al., 1993). Students' scores on the motivational scales in this study were predictive of their academic achievement, as measured by their GPA. This study was careful to point out that student grades are not necessarily reliable measures of academic achievement.

When measuring self-efficacy, it is important that the tool address a participant's perceptions of his or her ability to solve specific problems and/ or a specific domain or content area rather than measuring an overall belief in his or her general abilities (Pajares & Miller, 1995). The MSLQ is adaptable and has been used and modified to address specific subjects (physical education, mathematics, and confidence in classwork, as examples) in several studies to measure academically-specific self-efficacy levels of middle and high school students (Jiang et al., 2014; Lodewyk & Sullivan, 2016; Schweinle & Mims, 2009).

While the GSES, MSES and the MSLQ offer various benefits in terms of validity and efficiency, the MSLQ offers the greatest potential for offering insight into adolescent self-efficacy. It has been used, modified, and translated for use with children, adolescents and adults with reliability (Jiang et al., 2014; Lodewyk & Sullivan, 2016; Schweinle & Mims, 2009; Erturan Ilker, Arslan, & Demirhanc, 2014; Ramírez-Dorantes, Canto y Rodríguez, Bueno-Álvarez, & Echazarreta-Moreno, 2013).

Summary

In education, self-efficacy can manifest through cognition, motivation, affection, and selection. Research offers several ways that self-efficacy in children and adolescents shapes achievement and informs future choices. Students are constantly asked to take academic risks or challenges in school. This researcher was unable to find studies that explore mathematics self-efficacy and its interactions with mathematics achievement (as measured the SBAC), race, gender, and poverty. As a result, there was room for further exploration into how mathematics self-efficacy interacts with these variables.

Chapter 3: Methodology

Design of the Study

This chapter describes the methods that were used in this research process, including the design, sampling plan, instrumentation, and analytics plan. The following questions guided this study's efforts to examine the relationship between mathematics self-efficacy, race, socioeconomic status (SES), gender, and mathematics achievement scores as measured by the Smarter Balanced Assessment.

Research Questions

1. Is there a relationship between high mathematics self-efficacy, as measured by the self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ-SE), and high mathematics achievement, as measured by the Smarter Balanced Assessment (SBAC)?
2. Is there a difference between the mathematics self-efficacy of low socioeconomic students who identify as People of Color (African-American, Hispanic, or multi-racial) and low socioeconomic students who identify as White?
3. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic, or multi-racial) males and White males?
4. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic, or multi-racial) females and White females?

Hypotheses

Hypothesis 1. There will be a positive relationship between a student's mathematics self-efficacy on MSLQ-SE and their Smarter Balanced Assessment mathematics scores.

Hypothesis 2. There will be a negative difference between the mathematics self-efficacy of POC students who have low SES, and White students who have low SES.

Hypothesis 3. There will be a negative difference between the mathematics self-efficacy of male POC students, and White male students.

Hypothesis 4. There will be a negative difference between the mathematics self-efficacy of female POC students, and White female students.

Table 1 describes the relationship between the independent variables, dependent variables, their measures, and the methods used to evaluate their interactions.

Research Methodology

A multi-method quantitative approach was necessary in that it allowed for the researcher to collect the required data from multiple quantitative methodological approaches. This multi-method quantitative study used secondary data from the mathematics SBAC scores, socioeconomic status, race, and gender as the response variables, and MSLQ-SE data for self-efficacy. A multiple regression model was used to examine the relationships between the independent variables of race, socioeconomic status, gender, and the dependent variable of mathematics self-efficacy.

Previous studies, while not showing a direct link between mathematics self-efficacy and SBAC scores, have examined relationships between mathematics self-efficacy and mathematics problem solving.

Sampling

The West School District (WSD) was a moderately-sized suburban school district of 15 schools and approximately 10,000 students in a rural county in Oregon. The district's student demographics were comprised of roughly 75% White, 10% Hispanic and 15% other races

Table 1

Relationships of Research Questions, Variables, Measures, and Analytics

RQ	Dependent Variable	Dependent Variable Measure	Independent Variable	Independent Variable Measure	Analysis
1	Mathematics Self-Efficacy	Motivated Strategies for Learning Questionnaire (self-efficacy for learning subscale)	Race	Asian-0 African American-1 Hispanic-2 Multi-Race-3 White-4	Multiple Regression
2	Mathematics Achievement	Smarter Balanced Assessment (mathematics portion)	Free/ Reduced Lunch	Yes – 0 No – 1	Multiple Regression
			Gender	Male-0 Female-1	Multiple Regression

as reported on the district school report card housed on the department of education website (Oregon Department of Education, 2017).

This single-staged sampling design used a convenience sample of 715 high school students in grade 12 during the 2017-2018 school year, who attended two high schools in WSD. Students in this convenience sample were offered the opportunity to participate voluntarily, based on their participation in the 11th grade SBAC test during the 2016-2017 academic year. Students who did not take the SBAC in 2016-2017, or who did not have a corresponding score according to their ID number, were not included in the study. Of this sample, 48.2% were female, 51.8% were male, 77% White, 9.2% Hispanic/Latino, 1.2% Black/African American, 8.4% multi-racial, 4% Asian, and 0.4% other races, and 15.2% were economically disadvantaged as reported by the qualification of the Free and Reduced-Price Lunch Program (Oregon Department of Education, 2017). The demographics of this sample were similar to that of the overall district demographics.

The SBAC was only administered in 11th grade in Oregon high schools, therefore, 12th graders were selected as participants for this study to get the most current academic results relative to the study results from the mathematics self-efficacy survey. This convenience sample was also selected because the age of the participants was close to the age to which the MSLQ-SE is intended to be administered.

Instrumentation Administration and Procedures

Survey research is a common way to gather information in order to generalize and make inferences about a population. This study used the self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ-SE) to gather data. The MSLQ-SE did not require researcher permission for use, as it is a commonly-utilized survey to measure self-efficacy.

Online surveys can provide a quick collection and response turnaround for data collection, increased anonymity, and the ability to ask sensitive questions (Sue & Ritter, 2012). This cross-sectional survey was completed by approximately 700 students in one 10-15-minute session during their required English course. Students took the survey on district-provided laptops.

The MSLQ is an 81-item self-report instrument that was initially designed to measure value, expectancy, and learning strategies in college students. The entire instrument is composed of five subscales: intrinsic goal orientation, extrinsic goal orientation, task value, control of learning beliefs, and self-efficacy for learning and performance (Pintrich et al., 1993). While the compilation of the subscales gives an overall assessment of a participant's value and expectancy, as well as the learning strategies s/he uses, each part can be given as an individual assessment (Pintrich et al., 1993). This study excerpted and modified the eight items within the s*elf-efficacy for learning and performance* subscale of the MSLQ to measure self-efficacy pertaining to mathematics (Appendix A). This subscale was chosen for several reasons. Narrowing the umbrella of motivation to highlight self-efficacy kept the focus of this study on content-specific (mathematics) self-efficacy rather than expanding into other components that make up the value and expectancy portion of the MSLQ. Additionally, the *self-efficacy for learning and performance* subscale of the MSLQ has been used and modified by other researchers to research academic self-efficacy in high school students (Vick & Packard, 2008), and it has been tested for validity and reliability with high school and college age students in the United States and Turkey (Erturan Ilker et al., 2014; Pintrich et al., 1993).

Validity and Reliability of the MSLQ

The MSLQ has been shown to be reliable and to predict meaningful outcomes of the self-efficacy for learning and performance subscale (Pintrich et al., 1993). Pintrich et al. (1993)

sought to test the internal consistency, reliability and predictive validity of the MSLQ, which they developed. In 1990, they tested a sample population of 380 college students from 37 courses across 14 subjects. With the use of a Confirmatory Factor Analysis (CFA), the results were compared against students' final grades to measure construct validity. A Confirmatory Factor Analysis (CFA) is a tool used to measure construct validity and has four major purposes: "psychometric evaluation of measures; construct validation; testing method effects; and testing measurement invariance (e.g., across groups or populations)" (Harrington, 2008, p. 3). For the self-efficacy for learning portion of the MSLQ, the predictive validity was significant at .41 (for a sample size of 380, values of .13 and above were significant), meaning that there were significant correlations with the students' final grades.

Erturan Ilker et al. (2014) administered a Turkish version of the MSLQ to 1,600 fifteen-year-old students from three different high schools in Turkey to determine the validity of the instrument. Confirmatory Factor Analysis (CFA) and Cronbach's alpha techniques were used to analyze the data. Cronbach's alpha measures internal consistency, the relationship of items, and the overall reliability of a scale. Results of the Erturan Ilker, et al., study showed the MSLQ to be reliable and valid instrument for high school students. Reliability coefficients of 0.75 indicated a sufficient level of reliability. There were strong correlations between self-efficacy and intrinsic value ($r = 0.25$), self-efficacy and motivational beliefs ($r = 0.79$), and self-efficacy and test anxiety ($r = 0.25$), showing construct validity for the self-efficacy subscale of the MSLQ. Ramírez-Dorantes, Canto y Rodríguez, Bueno-Álvarez, & Echazarreta-Moreno (2013) tested a Spanish-translated version of the MSLQ for reliability and validity against the English version. Based on Cronbach's alpha, the findings were consistent with the English analysis (Pintrich et al., 1993) and showed strong internal reliability and validity.

Burlison, Murphy, & Dwyer (2009) examined the relationships between the MSLQ, course grades, and ACT scores to find out if any of the subscales provided incremental validity. Incremental validity is the degree to which a psychological measurement "add[s] to the prediction of a criterion above what can be predicted by other sources of data" (Hunsley & Meyer, 2003, p. 446). Each of 352 college undergraduates completed all 15 subscales of the MSLQ and their scores were compared to their course grades. Hunsley & Meyer (2003) broke down the student scores on their ACT into low, middle, and high and found that the self-efficacy scale was one of two subscales that provided strong incremental validity in predicting course grades. Additionally, the MSLQ, when used in conjunction with standardized tests such as the ACT (Naumann, Bandalos, & Gutkin, 2003) and the SAT (Sumerson & Farley, 2007), become significant predictors of GPA.

Administration of the MSLQ-SE

Participants took an eight-item, online survey using Survey Monkey, a secure internet survey service, to indicate their levels of mathematics self-efficacy on a 7-point Likert scale ranging from 1 (not at all true of me) to 7 (very true of me). The individual survey scores were summed and represented a range of 0-56 points. This range was based on an 8-question survey with the highest possible selection for each item being seven and the lowest being zero. A modification was made to the survey items to make them specific to mathematics (Appendix A). The modifications are denoted with brackets below. This modification did not alter the meaning or intent of the items as they still measured self-efficacy as the instrument intended.

Parents and students over 18 were provided the opportunity to opt-out of survey participation through email or paper copy (Appendix B). Parents and students could opt-out at any time during data collection through an email to district technology personnel or by indicating

the student ID number on the paper copy of the opt-out form. All students had an additional opportunity to decline participation on the day of administration. Once a student indicated consent on the survey, the survey proceeded with the questions.

Students were asked to provide their student identification numbers on the survey, which maintained students' confidentiality to the researcher, while allowing for SES, race, and gender data to be cross-referenced to the student ID number and connected to their survey results. The West School District's database information on SES, race, and gender was utilized by the district's technology personnel to ensure confidentiality. They disaggregated the data based on race, gender, and SES, removed student identification numbers, and replaced them with a random identification number. The data was provided to the researcher and methodologist for analysis. The results of the student self-efficacy survey were compared to the students' mathematics SBAC scores and analyzed for predictive tendencies using SPSS.

West School District's existing policy about the sharing of personally identifiable information (Appendix C) did not require written prior consent when the information is being delivered "to personnel within the district who have legitimate educational interests." Since researchers did not receive any personally identifiable information, prior consent was not required. Parents and students were offered an opt-out opportunity.

Since the participants entered student identification numbers on the survey and surveys went directly to the technology staff (district personnel), neither the researcher nor the methodologist had access to any personally identifiable information about participants. In addition, identification numbers were replaced with dummy numbers to protect anonymity. West School District has routinely offered parents the opportunity to not have student information be included or provided for research or marketing purposes. As a result, this study offered an

electronic and paper opt-out opportunity for parents and student participation. This opt-out opportunity was sent to parents/students two weeks before survey administration, with one follow-up reminder one week later.

Administration of the survey was done by students' course instructors during a required senior English class for participants. Administration information (Appendix D) was provided to survey administrators, including information on how to help students access the online survey, survey directions, and a description of the purpose of the study. Each student had a laptop provided by the school on which to take the survey.

Administration during participants' required senior English course was selected for several reasons. First, all participants take senior English each day which allowed administration to happen during the same window of time for all participants. Also, since the class is required, there was an increased opportunity for participation which may have increased the response rate. Since students are reporting about their confidence in mathematics, taking the survey in English class provides another level of security that their answers will have no negative academic consequences (i.e., students may feel less comfortable completing the survey if their math teacher was the test administrator). Finally, all students have access to a laptop during the senior English class which ensures equity in opportunity for participation.

Each value expectancy subscale of the MSLQ was represented by alternating questions throughout the section. The numbers assigned to the questions below were the actual numbers assigned on the MSLQ-SE and were adjusted on the survey of this study to number items 1 through 8. Only the items from the self-efficacy for learning subscale were selected. Other subscales were considered and rejected for this study. Since the present study sought to measure self-efficacy, this subscale yielded the results that most aligned with the research questions.

Specific instrument questions were modified to capture student responses specifically related to their math classes. Brackets denote the adjustments made to the survey responses for this study and were removed on the survey administered to students:

5. I believe I will receive an excellent grade in my [math] class.

6. I'm certain I can understand the most difficult material presented in the assignments for my [math] class.

12. I'm confident I can understand the basic concepts taught in my [math] class.

15. I'm confident I can understand the most complex material presented by the instructor in my [math] class.

20. I'm confident I can do an excellent job on the assignments and tests in my [math] class.

21. I expect to do well in my [math] class.

29. I'm certain I can master the skills being taught in my [math] class.

31. Considering the difficulty of my [math] course, the teacher, and my skills, I think I will do well in my [math] class.

Results from the MSLQ-SE were matched to participants' 11th grade SBAC mathematics test scores by district technology personnel. The researcher only used the results from participants who provided consent and had an 11th grade SBAC score. All others were removed from the data prior to analysis.

Implementation

Appropriate forms for the university's IRB were completed and presented to the George Fox University IRB for approval prior to implementation of the study. Appropriate district-level permissions (Appendix E) were obtained by the West School District. Additionally, information

about the study and paper/electronic opt-out forms (Appendix B) were sent home with all potential participants.

1. Offered opportunity for opt-out. A description of the study and its purpose were included on the opt-out form (Appendix B), which was distributed twice. First the opt-out form went out two weeks before survey administration via paper and electronic copy. A second electronic reminder took place seven days prior to survey administration. Anyone choosing to opt-out responded to the sender (which was technology personnel, not the researcher). As a confidentiality measure, all paper opt-out forms were collected by classroom teachers and sent directly to the technology personnel. All parents and students could opt-out at any time up until the ID numbers were removed from the survey responses by district level technology personnel.
2. The ID numbers for all participants who opted-out were matched against the ID numbers of those participants who took the survey. If there were students who took the survey who also submitted an opt-out form, their results were not included in the study results.
3. On the day of administration, all students who chose to participate had the opportunity to consent by reading the consent page on the first page of the survey (Appendix F) and providing their student ID number. The consent page asked participants to verify that no opt-out was submitted prior to moving on to the survey questions. Any participant who had previously opted-out or chose to opt-out on the day of administration did an alternate activity of the teacher's choice during the 5-10 minutes of the survey (i.e., read a book).

4. If a student chose to participate on the day of the survey administration AND the parent of that student had chosen to opt-out, the district technology staff matched the student ID to the IDs of the opt-out responses and that student's information was removed from the data set.
5. Test administration happened during first part of the participants' required senior English class.
6. The link address to the survey was visible for students to access. All participants had access to a laptop computer during the time of administration.
7. The survey administrator used the administration script (Appendix G) to remind students that the survey was optional and directed those who wished to participate to go to the link provided. The survey administrator reminded students that the 8-item survey will took approximately 5-10 minutes to complete, that it was voluntary, and that survey item responses would only be seen by the district technology personnel, the principal researcher, and methodologist. This meant there was no identifiable way for the researcher to trace their responses to their personal identification. The administrator then directed participants who chose not to participate to do an alternative, quiet activity such as read a book.
8. Each teacher who administered the survey received a Starbucks gift card of $5.00 in value provided by the researcher.
9. District technology personnel were sent student results for disaggregation.
10. Students' ID numbers were used by the district technology personnel to disaggregate by categories of race, socioeconomic status, and gender. The student-supplied ID numbers were used to add student demographics of race, gender, SES, and SBAC

math components to the self-efficacy data. Once joined, all unique student identifiers of any kind were removed and replaced with anonymous dummy codes. Data provided to the researcher held no personally identifiable information for students.

11. The district technology personnel deleted student ID numbers once the survey data was transferred to the researcher and methodologist once the study was completed.
12. Data was then uploaded into a statistical package (SPSS) for multiple regression analysis.

Analysis

The assumptions of a multiple regression analysis provide information on the accuracy of the predictions, test how well the regression model fits the data, determine the variation in the SBAC scores as explained by a student's race, gender and socioeconomic status, and test hypotheses on the regression equation (Laerd Statistics, 2015).

The multiple regression conducted in this study must meet eight assumptions:

Analytical Assumption #1. Mathematics self-efficacy score is the continuous dependent variable that will be measured at an interval level.

Analytical Assumption #2. There are four independent variables: 1) Race; 2) Socioeconomic Status (nominal: 2 categories of high and low); 3) gender (nominal: 2 categories of male and female) 4) SBAC mathematics scores (nominal)

Analytical Assumption #3. There will be an independence of residuals as measured by the Durbin-Watson statistic.

Analytical Assumption #4. There will be a linear relationship between the dependent variable and each independent variable, and the dependent variable and the independent

variables collectively. A scatterplot will be used to mark the regression standardized residual plotted against the regression standardized predicted value.

Analytical Assumption #5. There will be homoscedasticity, as assessed by visual inspection of a plot of standardized residuals as compared to unstandardized predicted values.

Analytical Assumption #6. The data will not show multicollinearity. SPSS statistics will be used to detect for multicollinearity through an inspection of correlation coefficients and Tolerance/VIF Values.

Analytical Assumption #7. There will be no significant outliers, high leverage points, or highly influential points, as assessed by Cook's distance as well as standardized residuals beyond +/-3.

Analytical Assumption #8. There will be a normal distribution of residuals as measured by The Regression Standardized Residual histogram which plots standardized residuals against standardized predictors.

Research Ethics

As this study surveyed twelfth-grade students enrolled in the 2017-2018 school year, ranging in age from 16-19 years, it required approval from the Human Subjects Research (IRB) Committee through George Fox University and the West School District. The researcher followed the procedures given by the institutional review board for approval. Written communication was required from the parent/guardian of each participant under the age of 18 to opt-out of participation prior to the administration of the survey. Required consent from each participant on the day of implementation was also secured. Students were informed of the voluntary nature of participation.

At the time of this study, the researcher was an employee in the WSD. Although the researcher was not directly connected to the high schools in WSD, she had professional relationships with the high school principals and district personnel allowing unique access to students and teachers within these schools.

Summary

Using the MSLQ-SE as the tool to measure the mathematics self-efficacy of high school seniors, this study aimed to explore its relationship to race, gender, SES and mathematics achievement. The process of implementation was clearly laid out in order to provide the highest protection of student anonymity, efficiency and communication for participants. The MSLQ-SE is a reliable and valid instrument that has been used repeatedly across domains and samples and will be the most effective tool to measure mathematics self-efficacy for the present study.

Chapter 4: Results

The purpose of this study was to explore the relationship between the independent variable of mathematics self-efficacy of high school seniors and their dependent scores on the mathematics portion of the Smarter Balanced Assessment (SBAC). Furthermore, this study considered the interaction of race, gender and socioeconomic status with mathematics self-efficacy as it impacted SBAC score.

The self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ-SE) was used to measure mathematics self-efficacy. The self-efficacy subscale of this well-utilized instrument was modified to reflect the domain of mathematics. Participants took the questionnaire through Survey Monkey. The data was compiled and the student ID numbers were then matched to their demographic data and mathematics SBAC scores. The ID numbers were removed and replaced with dummy numbers to protect the identity of the participants. The final data set was put through a standard multiple regression to determine relationships between the dependent and independent variables. This chapter includes the analysis of data collected from the questionnaire. In addition, it addresses the four research questions proposed for this study.

1. Is there a relationship between mathematics self-efficacy, as measured by the MSLQ-SE, and mathematics achievement, as measured by the Smarter Balanced Assessment?
2. Is there a difference between the mathematics self-efficacy of low socioeconomic students who identify as People of Color (African-American, Hispanic or multi-racial) and low socioeconomic students who identify as White?
3. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic or multi-racial) males and White males?

4. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic or multi-racial) females and White females?

Sample Demographics

This study examined a convenience sample of 2017-2018 senior students of West School District. Seven hundred, fifteen high school seniors were invited to participate in this study. A total of *n* = 233/715 students completed the modified, of the MSLQ-SE for this study, constituting a response rate of 33%. This is an acceptable survey response rate. Baruch & Holtom (2008) analyzed surveys from 1,607 studies and found the average level of response rate to be 52.7 percent with a standard deviation of 20.4. These studies were conducted between the 2000 and 2005. There are several studies that report little difference in outcomes whether response rates are low or high within the same population (Mealing, et al., 2010; Visser, Krosnick, Marquette, & Curtain, 1996). These studies also suggest there is not a direct correlation between response rate and validity. However, lower response rates raise the risk that the study will have low validity (Morton, Bandara, Robinson, & Atatoa Carr, 2012).

Of the 233 students, *n* = 109 (47%) were male; *n*=124 (53%) were female; *n* = 26 (11%) identified as low SES according to their free and reduced lunch (FRL) status. The racial/ethnic composition of the sample included *n* = 186 (80%) White; *n* = 40 (17%) African-American, Hispanic, or Multi-Race and *n* = 7 (3%) Asian. Due to the low response rate of any single race, the researcher and methodologist combine students of color (other than Asian) to report results for all research questions. It was necessary to tease out Asian students as to not skew the data in this study. Students identifying as Asian were not included in the *students of color* category because Asian students in the United States typically show higher test scores in mathematics,

often outperforming their White peers (U.S. Department of Education Office for Civil Rights, 2014).

Descriptive Statistics

Table 2 indicates the means of the two assessment tools used in this study, the SBAC and the MSLQ-SE. The average math SBAC score for all 233 participants was 2676.73. The range for possible outcomes on the SBAC is 2000-3000. An eleventh-grade student must receive a score of 2583 or above to be considered in the proficient or advanced levels of performance. The MSLQ-SE was modified to reflect the domain of mathematics self-efficacy. The MSLQ-SE consisted of 8 items with 7 permissible answers on a Likert scale; thus, the range ran from 0-56. The MSLQ-SE had an extremely high level of internal consistency, as determined by a Cronbach's alpha of 0.823.

Missing Data

The initial raw data included 248 responses. The researcher removed participants who did not have an SBAC math score, or who did not answer any of the questions on the MSLQ-SE. Blank questionnaires were considered "opt-out." Given how the statistical package optimizes the calculation of models, using pairwise and listwise deletion, 8 participants' data were removed from the final regression analysis. Following the standard multiple regression, 225 participants' scores were calculated.

Table 2

Descriptive Statistics

	M	SD	N
High-SBAC-Math	2676.73	110.09	225
Additive SE Scale	39.38	10.86	225

Assumptions

Eight assumptions were tested in order to help validate interpretations of the data analyses. All assumptions were met.

Assumption #1. There was one dependent variable: the mathematics Smarter Balanced Assessment score.

Assumption #2. There were at least two independent variables: mathematics self-efficacy (original ordinal measures with an approximate-interval scale), gender (nominal), race (nominal), and socioeconomic status (nominal).

Assumption #3. There was independence of residuals, as assessed by a Durbin-Watson statistic of 1.930.

Assumption #4. There was a linear relationship between SBAC mathematics test scores and mathematics self-efficacy. The P-P Plot (Partial Regressions Plot) can be found in Appendix H, Figure 1 and shows the points along the diagonal were situated close to the line.

Assumption #5. There was homoscedasticity, as assessed by visual inspection of a plot of standardizes residuals versus unstandardized predicted values (Appendix H, Figure 2). The spread of the residuals does not increase or decrease across the predicted values. The points have no pattern and are consistently spread across all possible range of values.

Assumption #6. The data showed no multicollinearity. Collinearity was examined through correlation coefficients and Tolerance/VIF values, as well as the correlation matrix values for the independent variables with the dependent variables. The correlations coefficients table showed VIF statistics < 10 and tolerance measures were > 0.1 (Appendix H, Table 14) meaning that there were no two independent variables that were highly correlated with each other.

Assumption #7. There were two, non-significant outliers. One SBAC score was higher than expected and one lower than expected (see Table 3). This number of outliers was expected under assumptions of the normal distribution.

Assumption #8. Residuals were plotted on a histogram (Appendix H, Figure 3) to verify approximate normal distribution. The histogram showed that the residuals were approximately normally distributed. Approximate normality could be assumed.

Research Question #1

Is there a relationship between high mathematics self-efficacy as measured by the self-efficacy subscale of the Motivated Strategies for Learning Questionnaire and race, gender, and SES with high mathematics achievement as measured by the Smarter Balanced Assessment?

There was a statistically significant, positive relationship between mathematics SE with SBAC scores, $p<.001$. The descriptive outcomes for relevant quantitative variables can be found in Table 4 for "Descriptive Statistics." All correlations and respective significance values can be found in Appendix H, Table 15.

Table 3

Casewise Diagnostics

Case Number	Std. Residual	High SBAC Math	Pred. Value	Res.
193	3.54	2860	2595.69	264.32
198	-3.19	2420	2658.15	-238.15

The results of a multiple regression are presented in Table 5, which was run to predict the interaction of mathematics SE with gender, race, GPA and SES. The multiple regression model predicted mathematics SBAC scores with statistical significance, $F(7, 217= 38.377$, $p < .001$, adj. $R^2 = .539$). Math SE, $p = .00$ and Race (AA, H, MR) $p = .01$ also contributed statistical

significance to the model, $p < .05$. Gender, $p = .07$ but SES, $p = .79$ did not contribute to the significance of the model. Regression coefficients and standard errors can be found in Table 6 and Table 7. These results indicate that mathematics SE predicted the mathematics SBAC scores of students in this sample.

Table 4

Descriptive Statistics

	M	SD	N
High-SBAC-Math	2676.73	110.09	225
Additive SE Scale	39.38	10.86	225

Table 5

Model Summary

							Change Statistics	
R	R Square	Adjusted R Square	Std Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
.74	.55	.54	74.77	0.55	38.38	7	217	0.00

Table 6

ANOVA Results

Model	Sum of Squares	df	M Sq.	F	Sig.
Regression	1501861.88	7	214551.70	38.38	.00
Residual	1213162.59	217	5590.61		
Total	2715024.46	224			

Research Question #2

Is there a difference between the mathematics self-efficacy of low socioeconomic (SES) students who identify as People of Color (African-American, Hispanic or multi-racial) and low socioeconomic students who identify as White?

There were 173 White participants and 25 participants who identified as a person of color (POC) (Black, Hispanic, multi-racial). An independent-samples t-test was run to determine if there were differences in the mathematics self-efficacy of low SES (POC) participants and that of White low SES students. The results indicated that the mathematics self-efficacy of low-SES, White students was higher (39.83 ± 10.98) than that of low-SES participants who identified as a POC (36.76 ± 9.17) (Table 8). However, table 9 provides the values indicating that this difference was not statistically significant, t(196) = 1.33, p = .18 (95% CI = -1.47 to 7.62). Levene's test for equality of Variances test to ensure that the groups that are being compared have equal variances. Table 9 shows that equal variance can be assumed p >.05.

Table 7

Coefficients

	B	Std. Error	Beta	T	Sig.	Tolerance	VIF
(Constant)	2232.08	32.88		67.90	0.00		
Additive_SE_Scale	1.62	0.51	0.16	3.17	0.00	0.81	1.23
SES	-5.20	16.96	-0.02	-0.31	0.76	0.88	1.14
Gender	-19.76	10.92	-0.09	-1.81	0.07	0.84	1.20
Unwtd-GPA	121.26	9.86	0.66	12.30	0.00	0.71	1.41
Race = AA, H, MR	-101.40	40.22	-0.12	-2.52	0.01	0.88	1.14
Race = Asian	56.13	32.57	0.09	1.72	0.09	0.78	1.29
Race = White	8.46	15.54	0.03	0.54	0.59	0.65	1.53

Table 8

Additive Self-Efficacy Scale (Group Statistics)

	N	M	SD	Std. Error M

White	173	39.83	10.98	0.84
POC	25	36.76	9.17	1.83

Table 9

Independent Samples Test (Group Statistics)

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% CI of the difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error of Difference	Lower	Upper
Equal Variance Assumed	1.19	0.28	1.33	196	0.18	3.07	2.31	-1.47	7.62
Equal Variance Not Assumed			1.53	34.77	0.14	3.07	2.01	1.02	7.16

Research Question #3

Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic, and multi-racial) males and White males?

There were 82 White male and 24 POC male participants. An independent-samples t-test was run to determine if there were differences in the mathematics self-efficacy of White male participants and that of POC male participants. The mathematics self-efficacy of White male students was slightly higher (41.11 ± 10.73) than that of POC male participants (41.00 ± 9.18), which is presented in Table 10. There was not a statistically significant difference between the two groups, $t(104) = .05$, $p = 0.96$ (95% CI = -4.68 to 4.90, $p = .17$) (Table 11).

Table 10

Additive SE Scale Group Statistics (White/Male vs POC/Male)

	N	M	SD	Std. Error M
White/Male	82	41.11	10.73	1.19
POC/Male	24	41.00	9.18	1.88

Table 11

Independent Samples Test (White/Male vs POC/Male)

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% CI of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error of Difference	Lower	Upper
Equal Variance Assumed	1.96	0.17	0.05	104	0.96	0.11	2.42	-4.68	4.90
Equal Variance Not Assumed			0.05	43.09	0.96	0.11	2.22	-4.36	4.58

Research Question #4

Is there a relationship between the mathematics self-efficacy of POC (African-American, Hispanic, and multi-racial) females and White females?

There were 103 White female participants and 15 POC female participants. An independent-samples t-test was run to determine if there were differences in the mathematics self-efficacy of White female participants and that of POC female participants. The mathematics self-efficacy of White female students was higher (38.66 ± 11.28) than that of POC female

participants (34.20 ± 8.06), which is described in Table 12. However, there was no statistically significant difference between the groups, t(116) = 1.48, p = .14 (95% CI = -1.49 to 10.41) (Table 13). There were no outliers in the data.

Table 12

Additive SE Scale Group Statistics (White/Female vs POC/Female)

	N	M	SD	Std. Error M
White/Female	108	38.66	11.21	1.10
POC/Female	15	34.20	8.06	2.08

Table 13

Independent Samples Test (White/Female vs POC/Female)

	Levene's Test for Equality of Variances		t-test for Equality of Means					95% CI of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error of Difference	Lower	Upper
Equal Variance Assumed	1.76	0.19	1.48	116	0.14	4.46	3.01	-1.49	10.41
Equal Variance Not Assumed			1.89	22.76	0.07	4.46	2.36	-0.41	9.33

Summary

This study indicated there was a statistically significant relationship between the interaction of mathematics self-efficacy and race with SBAC scores p < .001. Whites with low

SES reported higher levels of mathematics self-efficacy than their low-SES peers of color, however the difference was not statistically significant. Furthermore, there was not a statistically significant difference in mathematics self-efficacy between White males and males of color. Nor was there a statistically significant difference in mathematics self-efficacy (MSE) between White females and females of color even though White females reported higher MSE levels. Thus, given that students of color showed statistically lower SBAC scores than other groups, and MSE was statistically related to SBAC scores, no similar relationships were found for the other predictors of SES and Gender.

Chapter 5: Discussion

The purpose of this study was to examine the levels of mathematics self-efficacy for 12th grade students in the West School District and correlate these results with their 2016-2017 SBAC mathematics scores to discern a relationship between them. This chapter offers a discussion of the findings of the study and includes implications of these findings, limitations of the study, and recommendations for further research and practice.

This study identified four research questions:

1. Is there a relationship between high mathematics self-efficacy, as measured by the self-efficacy subscale of the Motivated Strategies for Learning Questionnaire (MSLQ-SE), and high mathematics achievement, as measured by the Smarter Balanced Assessment?

There was a statistically significant relationship between high levels of mathematics self-efficacy and high scores on the mathematics portion of the SBAC. There was also a negative relationship between students of color and mathematics SBAC scores, meaning that students of color were more likely to have a lower score on the mathematics SBAC than White students.

2. Is there a difference between the mathematics self-efficacy of low socioeconomic students who identify as People of Color (African-American, Hispanic or multi-racial) and low socioeconomic students who identify as White?

There was no difference between the mathematics self-efficacy of low-SES students of color and low-SES White students.

3. Is there a difference between the mathematics self-efficacy of POC (African American, Hispanic or multi-racial) males and White males?

There was no difference between the mathematics self-efficacy of White males and males of color.

4. Is there a difference between the mathematics self-efficacy of POC (African-American, Hispanic or multi-racial) females and White females?

There was no difference between the mathematics self-efficacy of White females and females of color.

Interpretation of Findings

The results of this study indicate that there was a statistically significant relationship between high math SE and high SBAC scores for students in this study ($p < .001$). Students who were identified as low SES showed no difference in mathematics self-efficacy than those who were not identified in this way. Furthermore, gender was not shown to be a factor affecting mathematics self-efficacy for females. White female students reported similar levels of mathematics self-efficacy as did their non-White or Asian female peers. Similarly, White males and males of color showed no statistically significant difference in their mathematics self-efficacy levels. These results are consistent with Schwienle and Mimms's (2009) findings in that African-American students' mathematics self-efficacy was not affected by the racial make-up of their environment. This was consistent whether or not their classes were predominately African-American or predominately White. Conversely, Else-Quest, Mineo, and Higgins (2013) found that regardless of race, males reported more positive attitudes toward mathematics than their female peers.

Although West School District (WSD) is mostly made up of a predominately White student population, students of color, no matter gender nor SES, reported similar levels of mathematics self-efficacy. This study's results are not in line with other research in the field

indicating that students in poverty typically report lower mathematics self-efficacy than their high SES peers (Wiederkehr et al., 2015). One reason that might explain this discrepancy is that in recent years, WSD has had a district-wide focus on self-efficacy and its importance to the success of students and teachers. The results in this study suggest that perhaps the intentionality of this work has had an effect on the mathematics self-efficacy of students of color and students in poverty in WSD.

Additional Findings

The following are notable findings that were not addressed through the four research questions, but offer compelling information for future researchers. This study did not specifically seek to address the academic achievement gap between students of color and their White peers, but in light of the level of consistent mathematics self-efficacy across race, gender and SES in this study, this issue offers potential for deeper discussion.

While there was no statistically significant differences in the mathematics self-efficacy of students across gender, race, and SES, this study indicates that students of color continue to perform lower than their White peers on the mathematics portion of the SBAC. This raises questions as to what additional factors may influence the mathematics SBAC performance of students of color.

Implications

While this study was small and focused on a single district, it offers direction for future researchers to expand upon these results.

Research is consistent that self-efficacy is an important component in academic success, but the findings in this study raise questions as to why students of color tend to be the exception. Are there enough opportunities at WSD for students of color to engage in learning at high levels?

Are the ample STEM resources in this school district made equally available to all students? While self-efficacy levels are similar, do teachers of mathematics have the same high expectations for all students? Is the SBAC an assessment that is ethical and free of racial bias?

Researchers Graham (1994) and Cheema & Skultety (2016) reported that the African-American students in their studies reported higher levels of self-confidence on a mathematics self-efficacy scale, in contrast to their lower achievement scores on the PISA. Consistent with students in the present study, it appears that mathematics self-efficacy does not always mediate achievement in mathematics. A better indicator of mathematics achievement would include race as an independent variable. Future studies may expand further to look specifically at students of color from a single race (i.e., African-American or Hispanic) rather than a combination of races. This would give insight into how one race's (i.e., African American, Hispanic, etc.) mathematics self-efficacy relates to mathematics SBAC scores.

Lee's (2002) research points to SES, sociocultural factors, and school resources as factors that may speak to the achievement gap between students of color and White students in mathematics. In WSD there is a high SES population and ample resources available to schools. This leaves sociocultural factors, or a set of beliefs, customs, practices and behavior that exists within a population, as an avenue for further exploration in educational contexts like WSD. Johns et al. (2008) offers stereotype threat as a possible barrier to academic achievement for students of color. Stereotype threat is the sense that one might be judged in terms of negative stereotypes about his or her group instead of on personal merit; this can affect performance on tests. A look into how mathematics stereotypes as well as who has historically been accepted and labeled as mathematicians may give insight into how students of color internalize this perception. A future study with a contrast to the population in this study would provide a perspective that

may add to this idea of stereotype threat as a sociocultural barrier. For example, if there was a study performed in a high-SES school where the population were majority students of color, might the results be similar?

It is also notable that just because the average SBAC score for the WSD population was unusually high compared to the state average, students of color scoring lower on the SBAC does not necessarily mean that they performed below the passing levels.

Limitations

During the research process, there were several limitations that are worth noting. The researcher had to determine how to categorize race and ethnicity due to the fact that there were a limited number of students of color in the sample. In this population of students, there were only 39 participants out of 233, or 17% who identified as a race or ethnicity other than White or Asian. Thus, this study combined several races and ethnicities in order to provide reportable data. This limited the type of reporting that could be done about one specific race. For example, it was not possible to report that African American students perform lower than White students on the mathematics SBAC because there were not enough African American students included in the sample. The literature in this study referenced African American and Hispanic students and their confidence levels (Graham, 1994) specifically, rather than a cluster of non-White races together. This should be considered when comparing this study to the literature in Chapter 2.

This study used the 8-item, *self-efficacy for learning* subscale of the MSLQ. This scale is one of two scales under an umbrella used to measure and give a more complete picture of one's self-efficacy beliefs. The second scale under the self-efficacy umbrella is the *control of learning beliefs* scale which refers to students' beliefs that their own efforts to learn will result in positive outcomes. The *self-efficacy for learning* scale only measures expectancy for success and self-

efficacy and solely focuses on expectations related specifically to task performance. Using both scales in this study would have provided an additional layer to better analyze and possibly tease out students' beliefs about the effects of their own efforts versus external factors (Pintrich, Smith, Garcia, & McKeachie, 1993).

Lessons Learned

Through the process of conducting this study, I have learned several lessons. Before going through this process, I would have never considered myself as a researcher. In a way, conducting a study about self-efficacy caused me to reflect on my own self-efficacy, specifically as it pertained to my self-efficacy in academic writing. I found myself employing Bandura's (1994) strategies in order to raise my own levels of self-efficacy for writing a dissertation. This meant I acknowledged when I mastered small writing tasks, sought out friends or colleagues who had completed their research to hear their vicarious experiences, checked my emotional state before writing to ensure that my mood was positive, and increased my social persuasion by joining a social media group that featured African-Americans pursuing their doctorate degrees. As difficult as this research process has been, there have been unexpected and life-changing lessons that I appreciate.

If this study were to be replicated, I believe a mixed methods approach would be beneficial. Conducting interviews with students or their math teachers to understand more about their students' and teachers' mathematics self-efficacy could give further insight into the results of this study. Adding a qualitative piece would bring a deeper level of understanding about how teachers view different types of student's abilities and how that might relate to students' overall mathematics self-efficacy.

Furthermore, observational data could be powerful and informative when examining teacher beliefs about students. For example, watching and documenting the interactions between teachers and students during mathematics lessons could give insight into how often positive messages are given to students of color versus White students. It could also be used to assess the amount of challenge opportunities that are offered to students of color versus White students.

Lessons about the writing process were also important and might serve future researchers who wish to build on this study. First, I learned it is important to formulate the research questions of a study in such a manner that it does not limit the discussion of the results. In retrospect, the questions in this study may have been too narrow. For example, in the research question #1, it was not possible to know the difference in the mathematic scores on the SBAC between White students and students of color, only that students of color are more likely to perform lower than White students.

While the total time to administer and participate in the survey took about 5-10 minutes, the actual average time that it took to take the survey was 2-3 minutes. This was shorter than the stated average time of 5-10. It may have helped incentivize students to take the survey if they knew that the active time was less than 3 minutes.

Conclusion

This study examined four research questions around mathematics self-efficacy and its relationship to the Smarter Balanced Assessment (SBAC). These questions also considered how race, gender and socioeconomic status (SES) might interact with mathematics self-efficacy. Students in poverty reported similar levels of mathematics self-efficacy as their high SES peers. Gender did not play a role in differentiating mathematics self-efficacy levels for females nor males. Additional findings showed that students of color, while reporting similar levels of

mathematics self-efficacy, were likely to perform lower on the mathematics SBAC then their White peers.

There are several considerations for future researchers. These considerations include ensuring that research questions leave room for deeper exploration, using a mixed methods approach to give further information about the mathematics self-efficacy of mathematics teachers and students, going deeper into the potential of racial bias of the SBAC, and conducting a similar study with a contrasting population.

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Appendix A

Survey Questions

Think about your current math course. If you are not taking math, imagine that you will be taking a math course in the near future.

Read each statement below about MATH. Select a number 1-7 to show how true each statement is for you. 1= (not true of me) to 7=(very true of me).

1. **I believe I will receive an excellent grade in my math class.**

1 2 3 4 5 6 7

not true very true

2. **I'm certain I can understand the most difficult material presented in the assignments for my math class.**

1 2 3 4 5 6 7

not true very true

3. **I'm confident I can understand the basic concepts taught in my math class.**

1 2 3 4 5 6 7

not true very true

4. **I'm confident I can understand the most complex material presented by the instructor in my math class.**

1 2 3 4 5 6 7

not true very true

5. **I'm confident I can do an excellent job on the assignments and tests in my math class.**

1 2 3 4 5 6 7

not true very true

6. **I expect to do well in my math class.**

1 2 3 4 5 6 7

not true very true

7. **I'm certain I can master the skills being taught in my math class.**

1 2 3 4 5 6 7

not true very true

8. **Considering the difficulty of my math course, the teacher, and my skills, I think I will do well in my math class.**

1	2	3	4	5	6	7
not true						very true

Appendix B

Opt-out Form

Dear Parent/Guardians of Seniors and Senior Students,

My name is Angela Freeman and I am a student in the Doctor of Education Program at George Fox University in Newberg, Oregon. I am also the principal at Molly Park Primary School in Small Town, Oregon. As a requirement of my doctoral program, I will be conducting research and have chosen to examine mathematics self-efficacy (which is a person's confidence in his or her ability to be successful in mathematics) and its relationship to the Smarter Balanced Assessment scores on the mathematics portion of the test. I will also be looking at how the interaction of race, gender, and socioeconomic status play a role in a student's mathematics self-efficacy.

Details of the Study

High school seniors will be invited to complete a short 8-question survey during their senior English class, which should only take 5-10 minutes.

Benefits

The findings of this study will give our district more insight into how mathematics self-efficacy interacts with our state assessment results. The results from this study can help inform decisions about how our district can better support students in mathematics.

Compensation

Students will not receive any compensation (pay) for their participation in this study.

Confidentiality

Students' identity will be protected in several ways. Survey participation is strictly voluntary and all responses are confidential. The survey will be administered through a secure site called Survey Monkey. Students will use their student ID to ensure that their responses can later be connected with their SBAC scores and demographic information. Only district-level technology personnel will have access to student identification numbers. Student ID numbers will be removed and replaced with dummy codes once SBAC scores and student demographics are matched. The anonymous information will then be transferred to myself and a methodologist for data analysis. There will be no personally identifiable information linked to the participants in any way.

Risks

The risks associated with this research are minimal as the survey questions are not personal in nature. The questions are general and related only to mathematics self-efficacy. Since the survey will be given during the senior English class, students will spend approximately 5-10 minutes of instruction time taking the survey. Students who do not take the survey will do an alternate academic activity within the same classroom at the time of the survey.

Location

Students will take the survey in their senior English class with their peers at their current high school.

Use of Study

The results of this study will be used for dissertation and research purposes. You can request a link to the final results of the study by sending an email to John Doe at Doej@abcd.k12.xx.us after September 15, 2018.

Other Information

Questions relating to this study can be directed to Angela Freeman at angelareafreeman@gmail.com or the faculty advisor Susanna Thornhill at sthornhill@georgefox.edu

<u>If you would like to opt-out,</u> or if you are the parent of a student under the age of 18 and would like to opt your child out of participation for this study, please email the student's name and ID number to the Technology Director, John Doe

***To opt-out by paper copy, please enter the student ID number below and return this form to the student's senior English teacher.**

I would prefer that my child's confidential responses NOT be used in this study.

Student ID#_____

Appendix C

Policy on Personally Identifiable Information

Code: **JOB**
Adopted: 3/07/16

Personally Identifiable Information**

Personally identifiable information includes, but is not limited to:

1. Student's name, if excluded from directory information, as requested by the student/parent in writing;
2. Name of the student's parent(s) or other family member;
3. Address of the student or student's family, if excluded from directory information, as requested by the student/parent in writing;
4. Personal identifier such as the student's social security number or student ID number or biometric record;
5. A list of personal characteristics that would make the student's identity easily traceable such as student's date of birth, place of birth and mother's maiden name;
6. Other information alone or in combination that would make the student's identity easily traceable;
7. Other information requested by a person who the district reasonably believes knows the identity of the student to whom the educational record relates.

Notice of and/or request for release of personally identifiable information shall specify the records to be disclosed, the purpose of disclosure and the identification of person(s) to whom the disclosure is to be made. Upon request of the parent or eligible student, the district will provide a copy of the disclosed record.

Exceptions to Prior Consent

The district may disclose personally identifiable information without prior consent under the following conditions:

1. To personnel within the district who have legitimate educational interests;

2. To personnel of an education service district or state regional program where the student is enrolled or is receiving services;
3. To personnel of another school, another district, state regional program or institution of postsecondary education where the student seeks or intends to enroll;
4. To authorized representatives of the U.S. Comptroller General, U.S. Attorney General, U.S. Secretary of Education or state and local education authorities or the Oregon Secretary of State Audits Division in connection with an audit or evaluation of federal or state-supported education programs or the enforcement of, or compliance with federal or state supported education programs or the enforcement of or compliance with federal or state regulations;
5. To personnel determining a financial aid request for the student;

6. To personnel conducting studies for or on behalf of the district;

7. To personnel in accrediting organizations fulfilling accrediting functions;

8. To comply with a judicial order or lawfully issued subpoena;

9. For health or safety emergency;

10. By request of a parent of a student who is not 18 years of age;

11. By request of a student who is 18 years of age or older or emancipated;

12. Because information has been identified as "directory information;"

13. To the courts when legal action is initiated;

14. To a court and state and local juvenile justice agencies;

15. A judicial order or lawfully issued subpoena when the parent is a party to a court proceeding involving child abuse and neglect or dependency matters;

16. To a caseworker or other representative of a state or local child welfare agency or tribal organization that are legally responsible for the care and protection of the student including educational stability of children in foster care.

END OF POLICY

Appendix D

Administration Information

Dear Teacher,

My name is Angela Freeman and I am the principal at Molly Park Primary School in Small Town, Oregon. I am a student in the Doctor of Education Program at George Fox University in Newberg, Oregon. As a requirement of my program, I will be conducting research and have chosen to examine mathematics self-efficacy (which is a person's confidence in his or her ability to be successful in mathematics) and its relationship to the Smarter Balanced Assessment scores on the mathematics portion of the test. I will also be looking at how the interaction of race, gender and socioeconomic status play a role in a student's mathematics self-efficacy.

This survey is comprised of 8 Likert-scale questions and will take students approximately 5-10 minutes to complete. It is very short and straightforward. The questions are all based on students' opinion and they should not need your support for answers.

Students will need their laptop or an electronic device to complete the survey. I will provide you with an administration script to read aloud to student prior to survey administration. Please use the Teacher Script provided to direct you in how to administer the survey.

This research will require your assistance in several ways:

- **Two weeks before test administration** please hand out opt-out forms to all senior students in your senior English class.
- All senior students and parents of students under 18 will also be sent an electronic copy of the opt-out form as well as a reminder 7 days before survey administration. If a student brings a paper opt-out form to you with their student ID written on the bottom, please place it in the envelope provided addressed to the Technology Director, Curtis Nelson and drop it into the inter-district mail in your main office.
- Plan to devote 10 minutes of your class time to administer this short survey at the beginning of your senior English class (on date to be determined upon approval).
- Please use the teacher script to administer the survey and ensure that all students have access to their laptops or electronic device.

A copy of the opt-out form is provided below. This also explains the details of my study. If you would like to know more about this research or the results, please email me at angelareafreeman@gmail.com

You will receive a $5 Starbucks Gift Card for your help with administrating the survey.

Thank you so much,

Angela Freeman

Appendix E

District IRB Approval

[redacted]

Dear George Fox Doctoral IRB,

I am writing to authorize approval from the V[redacted] for Angela Freeman's doctoral research proposal, "Mathematics Self-Efficacy and the Smarter Balanced Assessment: An intersection of race, socioeconomic status and gender. We understand this research will include subjects from our high school student population. We believe the outcome of this research will contribute to our leadership efforts of closing opportunity gaps and achieving equitable outcomes for all students. We have carefully reviewed Ms. Freeman's IRB proposal and have determined it provides appropriate safeguards for protecting the health, welfare and privacy of students.

Sincerely,

[redacted]

[redacted]

Appendix F

Cover Page/Consent to Participate

Dear Student,

My name is Angela Freeman and I am the principal at Molly Park Primary School. I am also a doctoral student at George Fox University. As part of my dissertation, I am exploring how senior students in our district perceive their own mathematics self-efficacy and how this is related to your 11th grade SBAC math scores, along with other demographic information.

I would like to ask for your participation in this research, by filling out this 5-10-minute survey. It will ask you about your confidence in your abilities in math.

Your responses will be anonymous. All of your responses will be strictly confidential and not even I will have access to your individual responses. This is because someone from the district technology staff will anonymize your responses before sending me your answers.

YOUR PARTICIPATION IS VOLUNTARY AND IS NOT RELATED IN ANY WAY TO YOUR GRADE IN YOUR MATH CLASS.

You may decide to participate now but you can change your mind at any time with no penalty.

The results of this study will be used for dissertation and research purposes. You can request a link to the final results of the study by sending an email to John Doe at unknown@west.wa.us after September 15, 2018.

THERE ARE NO RIGHT OR WRONG ANSWERS TO THIS QUESTIONNAIRE. THIS IS NOT A TEST.

Benefits

The findings of this study will give our district more insight into how mathematics self-efficacy interacts with our state assessment. The results from this study can help inform decisions about how our district can better support students in mathematics.

Risks

The risks associated with this research are minimal as the survey questions are not personal in nature. The questions are general and related only to mathematics self-efficacy. Since the survey will be given during your senior English class, you will lose approximately 5-10 minutes of instruction time. Students who do not take the survey will do an alternate academic activity within the same classroom at the time of the survey activity.

I appreciate you responding to this survey as accurately as possible, reflecting your own attitudes about mathematics.

By entering your STUDENT ID number below, you are agreeing the terms above and acknowledge that you have not been opted-out by a parent or guardian.

Appendix G

Teacher Script

Directions for teachers:
Please read the following to your class before administering the survey.

"Today you have the opportunity to participate in a research study being conducted by Angela Freeman, a student at George Fox University. She is also a principal at Molly Park Primary school. This research is being conducted as a part of her doctoral program.

If you choose to participate today, you will be asked to go to this website (point to the posted website), and read the first page that tells you about the study. If you agree to complete the survey you will enter your student ID number and proceed with the survey. If after you read the first page, you decide that you do not want to participate, you do not need to do anything else. You may log out and read quietly.

The survey has 8 questions that ask for a numerical rating and should only take 5-10 minutes to complete. You can decide to stop at any time and end the survey. All of your responses are confidential and will only be seen by district technology personnel who will delete your student ID numbers once they are matched with your demographics and your SBAC scores. There will be no way for the researcher or any teachers to trace your responses to your ID.

Now, if you choose to participate, please open your laptops, go to the designated link and begin the survey. If you choose not to participate, please quietly read a book.

When you are finished with the survey, please read quietly while the rest of the participants finish.

Appendix H

Figure 1

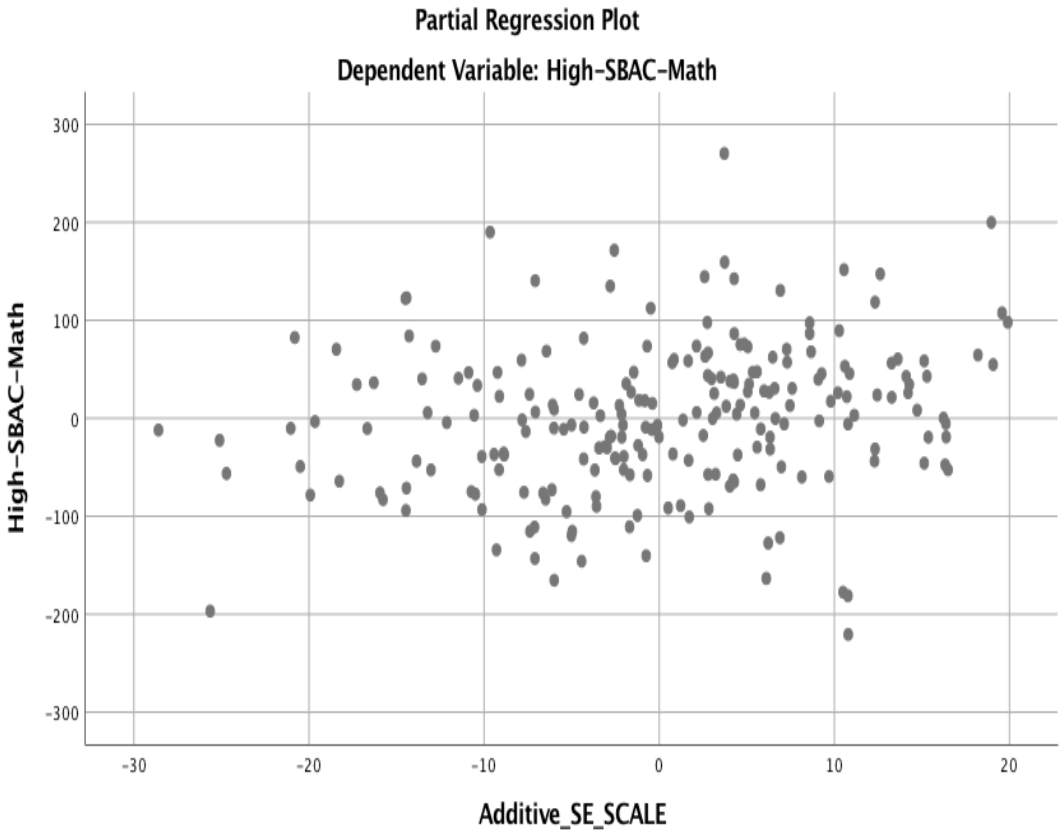

Figure 1: Partial Regression Plot of High SBAC mathematics scores vs Mathematics Self-efficacy scale. This figure was examined to determine if a linear relationship exists between the dependent variable (High SBAC mathematics scores) and this particular independent variable (Mathematics Self-efficacy).

Figure 2

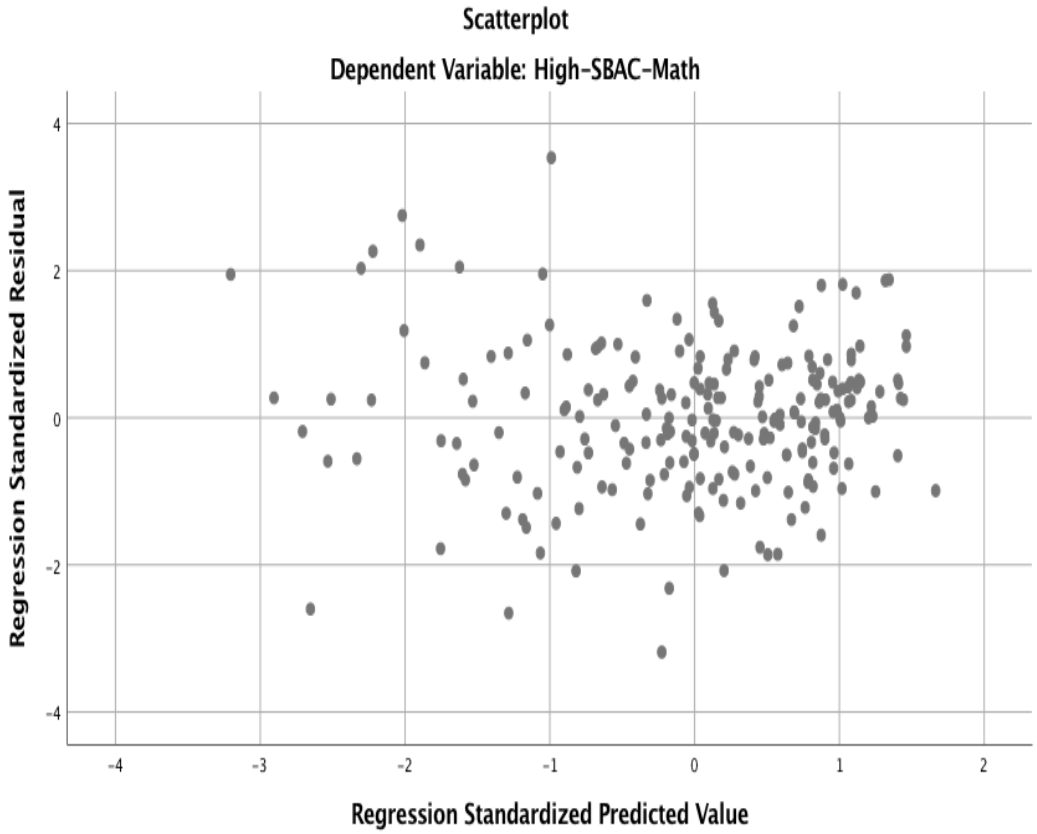

Figure 2: The Plot of Regression Standardized Residuals. The spread of the residuals does not increase or decrease across the predicted values. The points have no pattern and are approximately constantly spread across all possible range of values.

Table 14

Multicollinearity Values

	Standardized					Col. Stats
Model	β	t	Sig.	Partial	Tolerance	VIF
Additive SE Scale	0.16	3.17	0.00	0.21	0.81	1.23
SES Proxy	-0.02	-0.31	0.76	-0.02	0.88	1.14
Gender	-0.09	-1.81	0.07	-0.12	0.84	1.20
Unwtd-GPA	0.66	12.30	0.00	0.64	0.71	1.41
Race=AA, H, MR	-0.12	-2.52	0.01	-0.17	0.88	1.14
Race=Asian	0.09	1.72	0.09	0.12	0.78	1.29
Race=White	0.03	0.54	0.59	0.04	0.65	1.53

Table 14: Correlations Coefficients Table. Collinearity was examined through correlation coefficients and Tolerance/VIF values, as well as the correlation matrix values for the independent variables with the dependent variables. The correlations coefficients table showed VIF statistics < 10 and tolerance measures were > 0.1, meaning that there were no two independent variables that were highly correlated with each other.

Figure 3

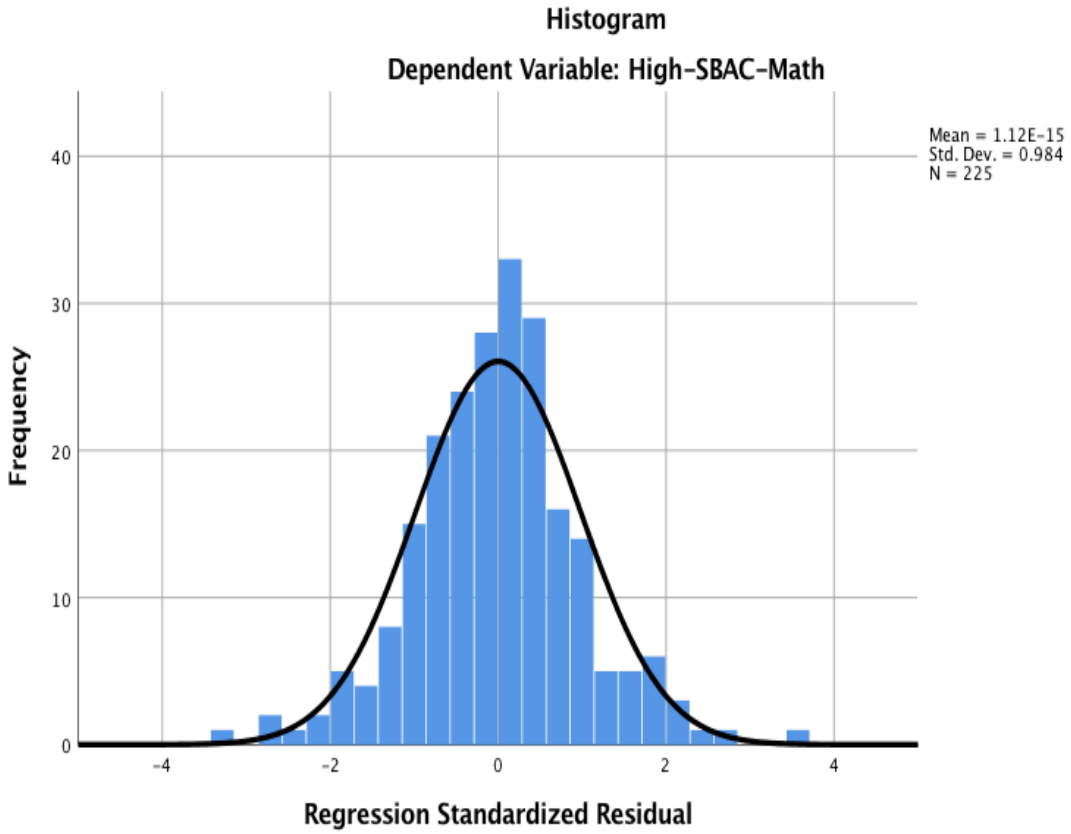

Figure 3: Histogram of the Regression Standardized Residual for High SBAC math scores. This chart was examined in order to test for normal distribution of residuals.

Table 15

Correlations

	High-SBAC-Math	Additive_SE_SCALE	SES Proxy	Gender	Unwtd-GPA	Race=B, H, I, PI	Race=Asian	Race=Multiracial	Race=White
High-SBAC-Math		0.384**	-0.132*	0.094	0.707**	-0.103	0.136*	-0.225**	0.175*
Additive_SCALE	0.384**		0.014	-0.157*	0.333**	0.045	-0.068	-0.056	0.065
SES Proxy	-0.132*	0.014		-0.091**	-0.159**	0.059	-0.063	0.333**	-0.289**
Gender	0.094	-0.157*	-0.091**		0.273**	-0.143*	0.067	-0.112*	0.118*
Unwtd-GPA	0.707**	0.333**	-0.159**	0.273**		0.016	0.108	-0.296**	0.211*
Race=B, H, I, PI	-0.103	0.045	0.059	-0.143*	0.016		-0.024	-0.056	-0.273**
Race=Asian	0.136*	-0.068	-0.063	0.067	0.108	-0.024		-0.074	-0.363**
Race=Multiracial	-0.225**	-0.056	0.333**	-0.112*	-0.296**	-0.056	-0.074		-0.841**
Race=White	0.175**	0.065	-0.289**	0.118*	0.211**	-0.273**	-0.363**	-0.841**	

Note: * indicates a p-value of < .05 and ** a p-value of < .001