GENDER BEHAVIOR TYPES, TEACHER-STUDENT INTERACTIONS, AND MATHEMATICS PERFORMANCE: AN EMPIRICAL ANALYSIS OF TEXAS HIGH SCHOOL STUDENTS

by

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Abstract

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ANALYSIS OF TEXAS HIGH SCHOOL STUDENTS

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The purpose of this study was to explore the gender behavior types for both female and male high school students. Using the gender behavior types as a lens, the study examined the existence of any differences in teacher-student interactions and mathematics performance by gender behavior type, and investigated factors that predict students' mathematics performance A survey was used to collect data concerning student self-concepts, student perceptions of teacher-student interactions, background characteristics, and course enrollment. The sample was drawn from high school students at a North Texas High School enrolled in Algebra 1, Geometry, and Algebra 2 during Spring 2015.

The researcher employed a conceptual framework of gender behavior types to classify high school students based on self-concept gender behaviors. This study used engagement theory to explore the interactions between the students and teachers, and the resulting effect on student achievement, measured through student reported mathematics performance. Teacher-student interactions were measured along the constructs of behavior management, language modeling, effective engagement, positive communication, and encouragement, using cumulative scores for each construct. Total scores of 50 or more were used to indicate students experiencing positive teacher student interactions, thus indicating desired levels of engagement. The results of this study suggest that there was a small influence of gender behavior types on teacher-student interactions. The main predictor of mathematics achievement was student perceptions of teacher-student interactions, through the constructs of language modeling and encouragement.

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CHAPTER ONE:

INTRODUCTION

Overview

Differences between the genders have been the topic of research over the last few decades (Elmore & Oyserman, 2012). Some researchers focus on character traits which exclusively define masculinity and femininity (Bem, 1977). Other researchers describe character traits along more of a gender continuum while still identifying the ends of the spectrum as being dichotomous (Slesaransky-Poe & García, 2009). An example of character traits along the gender continuum is the classification of leadership as a stereotypical male trait (Leszczynski & Strough, 2008). Individuals displaying strengths from the continuum opposite of their gender identity, that gender which they are born into (Zimmer–Gembeck, Geiger, & Crick, 2005), are considered expressing gender atypical behavior (Sax, 2005).

The study of the differences between genders has extended beyond character traits along the gender continuum. The effect of mathematics performance for students exhibiting gender typical behavior (Meijs, Cillessen, Scholte, Segers, & Spijkerman, 2010) has expanded the literature within gender studies, comparing the mathematics performance between female and male students (Kane & Mertz, 2012). Other research has investigated the processing and learning of mathematics for gender typical students (Geist & King, 2008), between members of the same gender (Jurik, Gröschner, & Seidel, 2013) and with teachers of both genders (Gunderson, Ramirez, Levine, & Beilock, 2012).

As teachers lead classrooms, they naturally depend on their own character traits to build relationships and to facilitate learning. The social hierarchy of a classroom exists with the teacher at the apex and a stratification of the students based on the relationships between the students, both academically and socially. The classroom environment has an impact on academic success as the girls in the classroom will naturally "seek to affiliate with the teacher" (Sax, 2005, p. 80), thus increasing their academic performance (Kiefer, Matthews, Montesino, Arango, & Preece, 2013), while the boys are not as concerned with academic performance (Sax, 2005) but will "attribute their math success to their talent" (Sáinz & Eccles, 2012, p. 495) rather than teacher intervention and instruction.

The differences between female and male high school students in the classroom can be espoused in many ways, from reading differences (Eliot, 2010), to mathematics performance (Geist & King, 2008), to social interaction paradigms (Faris & Felmlee, 2011). Gender biases in the mathematics classroom, unintentionally harbored by mathematics teachers (Petty, Harbaugh, & Wang, 2013), have led to a gender gap (Wells, Seifert, & Saunders, 2013). The gender bias, and the gender gap, has been well documented (Sadker & Sadker, 1994), and has been attributed to multiple sources, one of which is the disruptive behavior of male students, commanding the attention of the teacher and distracting her from others in the classroom (Frawly, 2005).

Gender typed behavior in the traditional classroom, behaving in a way that is or is not stereotypical of a gender, impacts socialization and includes the entire spectrum of behavior, gender typical behavior, gender neutral behavior, and gender atypical behavior (Gupta, Way, McGill, Hughes, Santos, Jia, Yoshikawa, Chen, & Deng, 2013). Stereotypical assumptions between female and male students extend beyond the social expectations and encroach upon academic expectations, such as the male students performing at a higher performance level than female students (Passolunghi, Ferreira, & Tomasetto, 2014).

Learning abilities of high school students differ among the genders as do the abilities contrast within the genders (Eliot, 2010; Riordan, 2002). The differences between high school students must be recognized and addressed with the use of appropriate teaching strategies (Francis & Skelton, 2005), while helping the student to find their own way of learning (Gurian, Stevens, Henley, & Trueman, 2011) thus lessening the inequalities between genders.

The struggle for gender equality in public education has been a driving force for change in the United States K-12 education system for many years, such as the *No Child Left Behind Act of 2001* (NCLB), backed by a bipartisan team of Kay Bailey Hutchinson and Hillary Rodham Clinton. One challenge facing the driving force for change is the avoidance of the “stereotypes and absolutes” (Chadwell, 2010, p. 20) of gender differences as not all girls exude the same social behavior, but exhibit a spectrum of social behaviors. One atypical social behavior exhibited by some girls, relational aggression, is a masculine trait, including the anti-social rule-breaking behavior illustrated by physical violence (Zimmer-Gembeck, Geiger, & Crick, 2005). Classroom management techniques used to combat atypical social behavior include, but are not limited to, rotating seating arrangements and having clear classroom organization (Page & Smith, 2012).

Statement of the Problem

The role of a high school mathematics teacher is to help the students not only learn the curriculum, but to teach the students of all behavior types how to transfer processes learned in mathematics into other disciplines. Student characteristics such as gender typical behavior types (Petty, Harbaugh, &Wang, 2013), have been studied within mathematics classrooms to determine the effect of the characteristics on learning. Other studies have focused on cognitive and motivational-affective student characteristics (Jurik, Groschner, Seidel, 2013), gender segregation within the classroom (Mehta and Strough, 2010), educational aspirations (Shapka, Domene, Keating, 2012), self-efficacy (Zimmerman and Kitsantas, 2005) and the gender achievement gap within mathematics classes (Sadker & Sadker, 1994). While female students have been shown to outperform male students in mathematics classes (Brophy, 2010), the number of female students who continue past the required courses into higher mathematics in high school and beyond is dramatically smaller than male students (Lane, Goh, & Driver-Lin, 2012). Although many studies have shown the impact of teacher-student relationships on student achievement (i.e., Newmann, 1991), a closer examination between the relationship between student perceptions of teacher-student interactions, and mathematics performance as seen through the lens of gender behavior types will add to the body of knowledge of teacher-student interactions and mathematics achievement.

Purpose of the Study

The purpose of this study was to explore the gender behavior types for both female and male high school students. Using the gender behavior types as a lens, the study examined the existence of any differences in teacher-student interactions and mathematics performance by gender behavior type, and investigated factors that predict students' mathematics performance. A quantitative research method was used to collect data from high school students in a coeducational public school in the State of Texas.

Research Questions

To carry out the purpose of this study, the guiding research questions were:

Research Question 1: What are the background characteristics of the high school students who participated in the study?

Research Question 2: To what extent are high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

Research Question 3: To what extent are high school students different in their mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

Research Question 4: What are the specific factors that predict high school students' mathematics performance?

Conceptual and Theoretical Frameworks

Literature based on previous research into gender behavior types (Kochel, Miller, Updegraff, Ladd, & Kochenderfer-Ladd, 2012) and engagement theory (Hoyt, 2010) provided a contextual background for the research study.

Gender Behavior Types

The environment of a high school can be described using the lens of gender behavior types. Self-perceived gender behavior types are described by social scientists as "feeling that one is a typical example of one's gender category" (Egan & Perry, 2001, p. 455) as compared to others in the same gender (Leaper, Farkas, & Brown, 2012). Thus, the complement of gender typical behavior, gender atypical behavior, is feeling one is not typical of one's gender category (Pedhazur & Tetenbaum, 1979). Neutral behavior is "gender duality" (Egan & Perry, 2001), possessing both typical and atypical behavior. Students experiencing gender rigidity, the belief that the genders are singularly associated with certain traits (Gunderson, Ramirez, Levine, & Beilock, 2012), is uncommon, as the partitioning of gender behavior has fuzzy boundaries with many variables and varying parameters (van Hop, 2007).

Social behavior is reflective of gender typicality as members of the social hierarchy interact with each other and exhibit "traits typical of their sex" (Egan & Perry, 2001, p. 459). The exhibition of typical and atypical traits in a classroom allows residents of the environment to explore all aspects of the behavior spectrum freely, establishing a sense of compatibility with one's gender category (Yu & Xie, 2010, p. 111). Through the explorations of gender typical behavior and gender atypical behavior, a hierarchy amongst the participants will organically develop.

Previous research has investigated the relationship between academics and multiple aspects of social development and social goals of adolescents. Meijs et al. (2010) conducted research between adolescent relationships and academic skills. One of the goals of their study was to examine the effect of academic performance on social relationships, including popularity. They did not find any conclusive effect on the relationships by academic performance with the exception of differences between schools with low emphasis on academics as compared to schools with a high emphasis on academics.

Engagement Theory

Engagement theory is concerned with the integration of thought and action through a continuum of stages (Hoyt, 2010). As applied to education, student engagement can be defined as "psychological investment in and effort directed toward learning, understanding, or mastering" (Newmann, 1991, p. 59) the learning targets developed through the related curricular standards (Konrad, Keesey, Ressa, Alexeff, Chan, & Peters, 2014). Through the interaction with and support of the teacher, all students have the chance to achieve significant mathematics performance (Ahmed, Minnaert, van der Wef, & Kuyper, 2010).

This current study used engagement theory to explore the interactions between the students and teachers, and the resulting effect on student achievement, measured through student reported mathematics performance. Teacher-student interactions were measured along the constructs of behavior management, language modeling, effective engagement, positive communication, and encouragement, using cumulative scores for each construct. Total scores of 50 or more were used to indicate students experiencing positive teacher student interactions, thus indicating desired levels of engagement.

Methodology

This study was a quantitative study which focused on high school students at a traditional, coeducational public school in North Texas. The study began with an examination of student self-concepts on gender behaviors, categorizing students based on cumulative scores from the Student Survey, adapted from existing survey instruments. This study also investigated whether there were any differences between students' perceptions of teacher-student interactions. Additionally, this study measured high school students' mathematics performance and the predictive abilities of background characteristics, gender behavior types, and student perceptions of teacher-student interactions on mathematics performance.

The questionnaire was a compilation of selected questions from the *Revised Competitiveness Index* survey (Harris & Houston, 2010), the *Bem Sex Role Inventory* (Bem, 1977) and the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* (Bill and Melinda Gates Foundation, 2012). The questions chosen from the established survey instruments cover the areas of interest determined by the literature review, gender behavior types, and student perceptions of teacher-student interaction. The gender behavior types questions measured student self-concepts of social interaction (Sidanius & Pratto, 1999), leadership (Landau & Weissler, 1991), competition (Gupta, Poulsen, & Villeval, 2013), and gender specific traits (Bem, 1977). Each of the self-concept questions were further analyzed using two of the five personality traits, Extraversion and Agreeableness, as described in the Five-Factor Model (Antonioni, 1998). The student perceptions of teacher-student interaction questions were characterized into the categories of behavior management (Mullola, Ravaja, Lipsanen, Alatupa, Hintsanen, Jokela, & Keltikangas-Järvinen, 2012), encouragement (Malecki & Demaray, 2003), effective engagement (Cooper, 2012), language modeling (Weiss, 2001), and positive communication (Pianta, Hamre, & Allen, 2012). Student demographics and student reported averages were on the bottom of the questionnaire.

The data from the questionnaire was analyzed using a cumulative score for each of the participants for eighteen of the first twenty questions. Two questions were removed from the analysis. By focusing on the cumulative questionnaire score, individual questions were not the sole determination of classifying high school students into gender behavior types. Data from the student perceptions of teaching (questions 21 through 33) provided insight into classroom activities from the perspective of the student.

Each of the research questions was analyzed using appropriate analysis techniques. Background characteristics were analyzed with descriptive statistics to describe the characteristics of the student participants, including gender, race/ethnicity, and age. The analysis of the teacher-student interactions began with a computation of the reliability of the data using Cronbach's Alpha followed by a one-way ANOVA test to investigate differences between the three gender groups (i.e., gender typical, neutral, and atypical) per gender regarding their perceptions of teacher-student interactions. Descriptive statistics were used to describe the mathematics performance per gender behavior type (i.e., gender typical, neutral, and atypical) per gender. A one-way ANOVA was used to determine a difference in mathematics performance by gender behavior types per gender. A step-wise multiple regression analysis was conducted to investigate which variables were significant predictors of students' mathematics performance.

Significance of the Study

The current study made additional contributions to the research on gender behaviors and mathematics performance. As such, this study will add to the literature on gender behavior types, student perceptions of teacher-student interactions, and mathematics performances. The results of this study will help to further the theory on gender-related behavior .

Past research examining the effect of gender on academic performance has produced results indicating the dominance of males over females in respect to cognitive and motivational attitudes (Jurik, Gröschner, & Seidel, 2013). This study takes typically male traits, such as leadership and self-efficacy (Zimmerman & Kitsantas, 2005), and investigates the expression of these traits among girls. Additionally, this study takes typically female traits, such as shyness and being soft spoken (Leszczynski & Strough, 2008) and investigates the expression of these traits among boys. The analysis of the self-concepts will help to advance the knowledge of understanding how students express these atypical behaviors through interactions with the teacher and the effect on mathematics performance.

A greater understanding of how gender atypical behavior effects both teacher-student interactions, as well as mathematics performance, will help to advance classroom practice. Research has shown that the ways in which boys and girls learn and process mathematics differs (Geist & King, 2008) even though there is not a significant difference between attitudes towards mathematics between boys and girls (Brown & Ronau, 2012). This study will help to expand the knowledge concerning the learning and processing of mathematics in the Algebra 1, Geometry, and Algebra 2, helping to identify strengths and weaknesses in the learning process through the classroom interactions. Since student engagement in classroom discussions is important to student learning, further research should carefully take student characteristics into account (Jurik, Gröschner, & Seidel, 2013).

Definition of Key Terms

The following terms are used throughout the study. Other terms may be used locally in a section and thus will be defined in place.

Gender typical behavior is behavior which demonstrates the tendency for girls to be more interested in verbal activities, such as reading, while boys are more interested in physical activities, such as taking risks (Sax, 2005). Aggression in girls is an example of *gender atypical behavior* (Kochel et al., 2012). *Gender neutral behavior* is defined therefore as the exhibition of both atypical and typical behavior. The typical and atypical social behavior of the students were identified through the Student Survey in Appendix A.

Teacher-student interactions are all interactions between the teacher and the student. These include written interactions, such as in communications and written assignments, verbal interactions, and supervisory interactions as associated with managing a classroom, student achievement, and instructional strategies (Pianta, Hamre, & Allen, 2012). Teacher-student interactions include the categories of behavior management (Moore Partin, Robertson, Maggin, Oliver, & Wehby, 2010), language modeling (Alderman, 2008), effective engagement (Newmann, 1991), positive communication (Dinkmeyer & Dreikurs, 1963), and encouragement (Li, 2011).

For this study, *academic performance* is referring to a course grade of a specific high school mathematics course from the academic year 2014-2015 (Boutakidis, Rodríguez, Miller, & Barnett, 2014). Students reported semester grades as part of the questionnaire.

Chapter Summary

The first chapter of this dissertation gave an introduction to the research study. The beginning overview discussed preliminary information on gender traits and differences and how they affect students. The statement of the problem followed the overview with a brief discussion of mathematics performance and student perceptions of teacher-student interactions. The purpose of this research study then discussed the investigation of the student self-concepts on gender behaviors, mathematics performance, and student perceptions of teacher-student interactions through the four research questions. The next section of this chapter gave an overview of the conceptual and theoretical framework (gender behavior types and engagement theory, respectively) before moving on to a discussion of the methodology and the significance of the study. Finally, the chapter ended with the definition of terms where common terms used throughout the paper were given to aid in the understanding of this paper.

The remainder of this dissertation provides a review of literature related to the topic in chapter two followed by a discussion of the methodology of the study and collection of data as seen through the related literature in chapter three. The fourth chapter discusses the details of the study and how the data was analyzed. The final, fifth, chapter discusses the meaning of the data along with recommendations for further research.

CHAPTER TWO:

REVIEW OF LITERATURE

Overview

In this review of the literature, I situated the study within the tapestry of gender behavior types, teacher-student interactions and mathematics performance. I evaluated and drew connections between research relating personality types drawn from the five-factor model of personality types (Mayes, 2005) to self-concepts and gender behavior types (Jurik, Gröschner, & Seidel, 2013). I considered how self-conceived gender behavior types informed the teacher-student interactions in the classroom, and impacts mathematics performance (Newmann, 1991). I presented a discussion of the orienting conceptual framework, the lens of gender behavior types, followed by a presentation of the theoretical framework of engagement theory and how it has been used in previous studies to understand student academic performance in general and high school student mathematics performance in particular.

The Development of a Self-Concept Model

This study focused on gender behavior types correlated with attributes of personality traditionally aligned with masculine or feminine stereotypes (Arnott, 2008). Gender behavior types do not exist in a vacuum, and thus the behaviors are expressed in various degrees through the five personality types of neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness, depending on the situation (Mayes, 2005). Self-concept, an "individual's personal perception of life and self" (Dinkmeyer & Dreikurs, 1963, p. 75), was measured in this study by two of the five factors of the five-factor model of personality, *extraversion* and *agreeableness*.

Five-Factor Model of Personality

Personality factors, called the five-factor model of personality (Costa & McCrae, 1985), have been accepted by behavioral psychologists as a way to describe the various patterns of behavior and to predict an individual's predisposition to respond in situations (Barakat & Othman, 2015). The factors of the five-factor model of personality are not unique parts of a person's identity, but manifested in combinations and varying degrees, with different factors dominating in different situations (Mayes, 2005) and are consistently present and stable. These stable personality tendencies are relatable to specific abilities and behaviors (Jensen, 2015). Aspects of personality have been associated with learning and intelligence, linking dimensions of personality to success in both employment satisfaction and academic performance (Day & Silverman, 1989).

The five dichotomous dimensions of personality represent both positive and negative traits, *neuroticism*, *extraversion*, *openness to experience*, *agreeableness*, and *conscientiousness*. All five dimensions of personality have been linked to academic performance. *Neuroticism* focuses on the emotional aspects of personality; by extension, therefore, *neuroticism* focuses on the emotions associated with academic performance (Seevers, Johnson, & Darnold, 2015). *Openness to experience* is the dimension of personality that embraces creativity and originality. *Conscientiousness* is the factor in the five-factor model which identifies with precision, scrupulousness, and accuracy (Troncone, Drammis, & Labella, 2014). Since conscientious persons accept responsibility, are strong-willed, are task focused, and are achievement oriented (Barrick & Mount, 1991), people who have conscientiousness as a dominant trait will at times be aggressive if the situation requires an aggressive stance to achieve accuracy (Zhang, 2006). Students who are dominantly conscientiousness have the tendency to excel academically, due to a high level of intrinsic motivation to perform well (Jensen, 2015).

Two of the dichotomous dimensions of personality used in this research study to classify study participants within gender typed behavior are *extraversion and agreeableness* (Chowdhury, 2006). Research has shown that both extraversion and agreeableness can be used as predictors of scholastic achievement (Troncone, Drammis, & Labella, 2014). These dimensions of personality can be described based on components, or facets (Jensen, 2015).

The personality trait, *extraversion*, is described as a trait expressed by people who are self-reliant, confident, and assertive (Antonioni, 1998; Ross, Rausch, & Canada, 2003; Zhang, 2006). People who lean towards extraverted personality traits have a tendency to enjoy competition (Ross, Rausch, & Canada, 2003) and are ambitious (Antonioni, 1998). Academically, extraverts have a tendency to be analytical (Komarraju, Karau, Schmeck, & Avdic, 2011) and tend to use paradigms, models, theories, and systems to understand situations (Mayes, 2005).

Agreeableness is associated with people who are kind, unselfish, and fair (Goldberg, 1992). The person with agreeableness as the dominant personality trait focuses on the social aspect of interactions (Chowdhury, 2006) and have a tendency to be soft spoken, remain quiet, and follow the group rather than lead (Antonioni, 1998). Academically, students who demonstrate agreeableness and low levels of aggression have a tendency to be the students who are "trying hard and succeeding academically" (Harachi, Fleming, White, Ensminger, Abbott, Catalano, & Haggerty, 2006, p. 286) among both female and male students.

Self-Concepts and Academic Performance

In conjunction with the classification of the two factors of the five-factor personality model, extraversion and agreeableness, the facets of these traits can be redefined as self-concept beliefs as they fall into behavior categories. The belief in one's ability to excel has a major influence on academic achievement (Pintrich & Blumenfeld, 1985), and thus the student's self-concept can have an influence on academic achievement. Self-concept of mathematics abilities and performance, and academic performance in general, has a tendency to decline over time as children of both genders age into adolescence (Sáinz & Eccles, 2012). Academic self-efficacy, an individual's belief to succeed in academics, is built on abilities, attitudes, and experiences (Mercer, Nellis, Martínez, & Kirk, 2011), all of which are influenced by personality types and can be described by gender behaviors types.

Gender Behavior Types

Characteristics between same gender students differ along a continuum as do the differences between genders (Eliot, 2010), ranging from gender typical female behavior such as expressing "emotional literacy" (Sax, 2005, p. 30) to gender-typical male behavior such as aggression (Kochel, Miller, Updegraff, Ladd, & Kochenderfer-Ladd, 2012). Gender stereotyping, such as the affiliation between sports and masculinity (Steinfeldt & Steinfeldt, 2010), can guide the understanding and application of personality traits to partition students into gender behavior types, typical masculine (atypical feminine), neutral behavior types, and atypical masculine (typical feminine). As children transition into adolescence, they begin to internalize gender stereotyping (Arnott, 2008), and expect certain behaviors depending on experiences in their own lives (Weiss, 2001). Competition and dominance (i.e., leadership in a group) are two stereotypical masculine traits while cooperation through attitudes and actions are stereotypical feminine traits (Leszczynski & Strough, 2008).

Gender female behavior type expressed in social situations, whether small or large groups, is that of a nurturer (Mehta & Strough, 2010). Females have tendencies to make group oriented decisions in social situations insomuch that everyone benefits from the outcome whereas males are more inwardly focused on personal goals (Kiefer, Matthews, Montesino, Arango, & Preece, 2013). In contrast to males, while engaging in active listening, females are more skilled at listening and responding (Mehta & Strough, 2010), thus nurturing the relationships already formed.

Linearly, as females are more apt to work towards a common goal, the nature of individual competition tends to make women “shy away from competition” (Gupta, Poulsen, & Villeval, 2013, p. 817). One possible reason for the opposition to competition has been linked to suppression of empathy, a female-typical behavior, which is required to promote competition (Hibbard & Buhrmester, 2010). Thus, the qualities associated with competition, aggression, toughness, apathy, are associated with “traditional understandings of masculinity” (Steinfeldt & Steinfeldt, 2010). Academic competition, students competing against each other to earn the highest grade on an assignment, in a classroom, or in larger populations, for example class rank, has been seen to improve student performance (Czaja & Cummings, 2009), without regard to gender (Ozturk & Debelak, 2008).

Another gender typical male behavior associated with competition is leadership. The stereotype of a leader includes one who must conform to the stereotypes of being task oriented and master of the environment (Chin, 2011), concepts which are in opposition to the nurturing attitudes of social interactions and female behavior. As students mature into adolescence, socialization and hierarchical relationships among children of the same gender help students to accept and self-promote for leadership positions (Gurian, Stevens, Henley, & Trueman, 2011). However, even though individual groups may develop leaders as necessary, the “social construction of leadership” (Chin, 2011) follows stereotypical behavior types.

Aggression is another male-dominated behavior type. Aggression, outside of competitive situations, is a behavior which challenges the stereotypical expectations of feminine behavior (Arnott, 2008). Female aggression and competition are acceptable female within sports and other male dominated arenas even though they are atypical female behaviors (Hibbard & Buhrmester, 2010).

Within an academic setting, the gender behavior types of both female and male students influence student performance, through the way the students interact (Pianta & Stuhlmna, 2004), and learn (Weiss, 2001). As part of the teacher appraisal system for teachers in the 2014-2015school year, the state of Texas presented to teachers and administrators criteria in the *Professional Development and Appraisal System for Texas Teachers* (Texas Education Agency, 2009) concerning expectations for student achievement and instructional strategies based on "learning styles, handicapping conditions, *gender expectations*, cultural background, potential for at-risk indicators, and age appropriateness" (p. 133) [emphasis added]. While the teacher appraisal system publication does not specify what gender expectations teachers should consider when planning lessons, "student characteristics" (p.72) is one of the alignments required for instructional strategies.

Student learning processes exhibit differences between students, some by brain chemistry (Weiss, 2001), some by gender behavior types such as the lack of taking risks in the classroom (Olafsdottir, 1996). However, although the diversity students may have in the classroom, learning disparities or gender type behavior differences, the student's engagement in the classroom can be positively or negatively impacted by the relationship between the teacher and the student (Pianta & Stuhlman, 2004). Just as positive interactions can positively influence student performance, negative interactions can negatively influence student performance

(Weinstein & McKown, 1998).

Teacher-Student Interactions

The relationship between a teacher and a student has been shown to be a prime factor in the success of a student in the classroom (Beutel, 2010). Strong relationships between teachers and students help to increase academic achievement and are crucial to the social and emotional development of the adolescents as they cross over from childhood into adulthood (Capern & Hammond, 2014). The classroom teacher has a unique positional relationship with students as students spend a large part of their day with teachers, and other adult figures, with whom they typically possess no familial relationship (Oswald, Johnson, & Howard, 2003).

The perception of the relationship with a teacher, however, can be tainted by previous associations with other teachers (McPherson & Liang, 2007), impacting not only the interactions with the current teacher, but also the student perceived teacher support for academic success (Mercer, Nellis, Martínez, & Kirk, 2011). The established expectations can lead down many roads, from discipline issues (Madill, Gest, & Rodkin, 2014) to poor academic performance (Gunderson, Ramirez, Levine, & Beilock, 2012). Teachers have the opportunity to help students overcome many predisposed attitudes, behaviors and ethos through the classroom culture and expectations of behavior management, encouragement academically and socially, effective engagement with the curriculum, language modeling, and positive communication with the student on multiple levels.

The discussion of these concepts will be structured in relation to the defined expectations, applied to educators, and formalized in the state of Texas by the Texas Education Agency, through the *Professional Development and Appraisal System* (Texas Education Agency, 2009) manual, abbreviated as *PDAS*. The *PDAS* manual is divided into eight domains:

Domain I: Active, Successful Student Participation in the Learning Process

Domain II: Learner-Centered Instruction

Domain III: Evaluation and feedback on Student Progress

Domain IV: Management of Student Discipline, Instructional Strategies, Time, and Materials

Domain V: Professional Communication

Domain VI: Professional Development

Domain VII: Compliance with Policies, Operating Procedures and Requirements

Domain VIII: Improvement of All Students' Academic Performance

The expectations developed by the Texas Education Agency, though focusing on actions and activities of the teacher, were designed to aid students in reaching individual potentials by increasing academic engagement (Guardino & Fullerton, 2010)

Behavior Management

Behavior management is an important component of maintaining a safe and nurturing classroom environment. Behavior management has a focus on the prevention and redirection of undesirable behavior through clear expressly defined behavioral expectations (Hamre, Pianta, Downer, DeCoster, Mashburn, Jones, Brown, Cappella, Atkins, Rivers, Brackett, & Hamagami, 2013). The characteristics of behavioral expectations extend to both the teacher in the classroom (Guardino & Fullerton, 2010) and the students (Hirn & Scott, 2014). The domain from the *PDAS* manual (Texas Education Agency, 2009) aligned with expectations for behavior management was *Domain IV: Management of Student Discipline, Instructional Strategies, Time, and Materials*. This domain consisted of six sub-domains, five of which describe the desired results of behavior management, as denoted within this research study:

Domain IV: Management of Student Discipline, Instructional Strategies, Time, and Materials

Domain IV-1: The teacher effectively implements the discipline management procedures approved by the campus. (p. 85)

Domain IV-3: The teacher interacts with students in an equitable manner, including fair applications of rules. (p. 89)

Domain IV-4: The teacher specifies expectations for desired behavior. (p. 90)

Domain IV-5: The teacher intervenes and re-directs off-task, inappropriate, or disruptive behavior. (p. 91)

Domain IV-6: The teacher reinforces desired behavior when appropriate. (p. 93)

Maintaining control within a classroom is a teacher-directed endeavor, with equal parts of correcting student misbehavior (Moore Partin, Robertson, Maggin, Oliver, & Wehby, 2010), and controlling the environment through classroom modifications (Guardino & Fullerton, 2010). Techniques for achieving desired behavior include intervening and re-directing disruptive behavior. One method of maintaining control in a classroom is the use of verbal warnings and “controlling by eye contact” (Gulcan, 2010, p. 262).The personalities and nature of individual teachers vary, impacting the degree to which control is maintained in distinct classrooms (Hayes, Hindle, & Withington, 2007).

Controlling the environment of the classroom includes the emotional and social environment. The social and emotional environment includes the praise of students for exhibiting desirable behaviors as well as academic performance (Moore Partin, Robertson, Maggin, Oliver, & Wehby, 2010). When teachers fail to control the social environment of the classroom, they risk being perceived negatively and as anti-social by the students (McPherson & Liang, 2007).

Another consequence of a failure to maintain the social and emotional environment of the classroom is the potential of classroom disruptions. When disruptions are caused by a member of the classroom, such as not following rules and talking back to the teacher (Estell, Farmer, Pearl, Van Aker, & Rodkin, 2008) the result of the disruption includes other students losing focus and "leaving the instruction" (Hirn & Scott, 2014, p. 596).

Another aspect of the classroom environment is the physical environment. The physical environment of the classroom involves manipulation of the classroom furniture, such as seating arrangements, group space, and walkways. Organizational materials, such as shelving, posters, bags or boxes for supplies, can impact the classroom environment as well, as these materials add to the ambiance of the environment (Guardino & Fullerton, 2010).

Behavior management is not limited to the teacher's expectations for students, but includes the student reactions to those expectations and how they express respect towards the teacher and the educational environment. Disruptive and distracting students (McPherson & Liang, 2007) display overt disrespect towards the teacher. These students have a tendency to upset other students when joining a group for collaborative work (Estell, Farmer, Pearl, Van Aker, & Rodkin, 2008).

Language Modeling

Students experience the most frequent form of language modeling in a classroom through the viewing of a task or two-way verbal interaction, with either the teacher or another student (Alderman, 2008). The two-way interaction can be demonstrated by the teacher within the classroom at large (Weiss, 2001) or individually (Sax, 2005) through personal interaction with a student. Language modeling is included in the *PDAS* manual (Texas Education Agency, 2009) under two domains, each with one sub-domain relevant to this research study:

Domain III: Evaluation and Feedback on Student Progress

Domain III-3: Assessment strategies are appropriate to the varied characteristics of students. (p.81)

Domain V: Professional Communication

Domain V-6: The teacher's interactions are supportive, courteous, and respectful with students, parents, staff, community members, and other professionals. (p.102)

Evaluation and feedback take many forms as teachers use various forms of strategies, models, and open-ended questions to elicit thoughts and ideas from students and to make connections between new and previous knowledge (Pianta, Hamre, & Allen, 2012). Through the use of language models, teachers can strengthen the self-efficacy of students as the students participate in classroom discussions (Alderman, 2008).

Teachers take student personalities into consideration when eliciting answers within a class discussion. Students who are not comfortable sharing thoughts with others will participate in individual teacher-student interactions. Personal interactions allow teachers to informally assess student understanding (Luna & Revilla, 2013). Individual interactions allow teachers to fulfill the demands of the sub-domain as the teacher "models courtesy and respect through patience and active listening" (Texas Education Agency, 2009, p. 102).

Effective Engagement

A key element in academic success is the effective engagement of students with the curriculum for students at all levels (Alderman, 2008). Low engagement and lack of preparation for the lesson/course is indicative of problem classes (Chafouleas, Hagermoser Sanetti, Jaffery, & Fallon, 2012), thus active and high engagement is characteristic of successful classes.

Successful student engagement falls into three domains of the Texas Education Agency's *PDAS* manual (Texas Education Agency, 2009):

Domain I: Active, Successful Student Participation in the Learning Process

Domain II: Learner-Centered Instruction

Domain III: Evaluation and Feedback on Student Progress

These three domains take into consideration the quality and level of engagement, reinforcement of engagement, and alignment of feedback with learning objectives.

In Domain I from the *PDAS* manual, the sub-domain, I-1, focuses on the active engagement in the learning process, evaluating the activities in which the students are engaged and the alignment of the activities with the learning objective:

Domain I: Active, Successful Student Participation in the Learning Process

Domain I-1: Students are actively engaged in learning. (p. 63).

Student collaboration, as they work through activities aligned with learning objectives, helps students to establish connections between the objectives and their own experiences and knowledge (Dominguez, LópezLeiva, & Khisty, 2014).

Domain II: Learned-Centered instruction in the PDAS manual (Texas Education Agency, 2009) addresses approaches to successfully engage students in the learning process:

Domain II-4: Instructional strategies include motivational techniques to successfully and actively engage students in the learning process. (p. 63)

Actively engaging students in the learning process not only helps to motivate the students to internalize the curriculum, but to help the student to affirm their self-worth and to reflect on perception of self (Cooper, 2012). Students who identify their teacher as a supportive participant in the learning process have a tendency "to show adaptive motivational and affective patterns of behavior, which, in turn, are related to achievement" (Ahmed, Minnaert, Van der Wef, & Kuyper, 2010).

The third domain in which teachers are appraised for engagement is *Domain III: Evaluation and Feedback on Student Progress*. This domain focuses on the reinforcement of student engagement (p. 82) through constructive feedback (p. 83). Two sub-domains are relevant to this research study:

Domain III: Evaluation and Feedback on Student Progress

Domain III-4: Student learning is reinforced.

Domain III-5: Students receive specific, constructive feedback.

Teachers have the opportunity to reinforce learning through acknowledgment of abilities (Cooper, 2012) and use of repetition to create a safe environment (i.e., consistent beginning of class procedures) which reinforces learning (Sayeski & Brown, 2014). Specific, constructive feedback, presented in a private environment, can help students of all backgrounds to improve their academic performance, but has been shown to help certain populations to reach goals (Dominguez, LópezLeiva, & Khisty, 2014).

Positive Communication

Positive communication is included within *Domain V: Professional Communication* of the *Professional Development and Appraisal System* created by the Texas Education Agency.

Domain V: Professional Communication

Domain V-1: The teacher uses appropriate and accurate written, verbal and non-verbal modes of communication with students. (p. 97).

Positive communication, like the other aspects of teacher-student interactions, is not a solitary activity, but exists in tandem with other categories. Positive communication between teachers and students leads to higher achievement as students are encouraged to internalize and remember new information (McPherson & Liang, 2007). Encouragement, combined with positive non-verbal communication such as eye-contact, helps to reassure students that ideas are respected (Sax, 2005).

The five facets of teacher-student interactions, behavior management, encouragement, effective engagement, language modeling, and positive communication, all converge at one pinnacle: assist students to attain a high level of mathematics performance. Behavior management within the classroom provides an environment conducive to learning (Sayeski & Brown, 2014).

Encouragement

Encouragement reinforces the emotional and social environments of the classroom, placing not only value in the student, but supports the student's belief in self and recognizes accomplishments (Dinkmeyer & Dreikurs, 1963). Consistent encouragement, from peers (Kiefer, Matthews, Montesino, Arango, & Preece, 2013) and teachers (Carpenter, 1985), also build a person's self-esteem, increasing personal feelings of confidence and self-worth (Brophy, 2010). Through encouragement, teachers can help students change their self-concepts from a negative perspective, "I cannot do that," to a positive one, "I'm pretty good at that" (Dinkmeyer & Dreikurs, 1963).

The evaluation of teacher encouragement was defined by the Texas Education Agency in the *PDAS* (Texas Education Agency, 2009) manual in *Domain V: Professional Communication*:

Domain V: Professional Communication

Domain V-3: The teacher encourages and supports students who are reluctant and having difficulty. The teacher modifies and positively reinforces student-learning success. (p. 99)

The teacher encouragement to participate helps to “press [students] to persevere” (Bill and Melinda Gates Foundation, 2012, p. 2) even when the student is having difficulty in the course. Encouraging students to reach their potential, through verbal interactions and by writing and commenting on student work, helps to promote academic success (Capern & Hammond, 2014).

The student perception of support from teachers, via teacher encouragement, has implications not only for academic success in general (Kiefer, Matthews, Montesino, Arango, & Preece, 2013), but is a predictor of overall academic success in the final year of high school (Carpenter, 1985). Positive encouragement helps students to rise towards their full potential as active participants in the two-way transfer of information (Beutel, 2010). Negative encouragement, and indeed conflictual teacher-student relationships, can negatively affect a student’s ability to learn and reach academic success (Oren & Jones, 2009). In particular, a student’s mathematics attitude and success can change and evolve, or devolve, depending on encouragement not only from parents and peers, but from mathematics teachers, preventing from or promoting to academic success (Gunderson, Ramirez, Levine, & Beilock, 2012).

Mathematics Performance

A common assumption which many mathematics teachers have heard over the years is the belief that girls do not do well in mathematics (Kane & Mertz, 2012). Gender stereotypes concerning girls’ mathematical ability (Gunderson, Ramirez, Levine, & Beilock, 2012) permeate still, impacting the number of girls who enroll in advanced mathematics or science courses (Sax, 2005). The permeation of female inadequacy in mathematics is based more on girls’ lack of confidence in themselves to perform well in mathematics and not necessarily lack of ability (American Association of University Women Educational Foundation, 1992). Historically, male students have preferred mathematics classes while female students prefer language arts; however, female students generally outperform male students in the mathematics classroom (Brophy, 2010).

Regardless of ability or performance, students typically understand the importance of mathematics courses and understand the “utility of mathematics” (Brown & Ronau, 2012, p. 74) to open up the possibilities of future interdisciplinary courses. Understanding the importance of mathematics, however, does not necessarily indicate engagement or success in mathematics, or even enrollment in advanced mathematics courses (Fong, Jaquet, & Finkelstein, 2014). The key to opening the doors of advanced classes, for both genders, is the presentation of an engaging, challenging, and meaningful curriculum which grabs the students’ attention. Involvement in the learning process and the connection between the curriculum and the relevance of the everyday lives of the students (Martin, 2000) is a key component as well. These doors begin opening as students enter high school, and encounter the first truly abstract reasoning and symbolic course, Algebra 1 (Fong, Jaquet, & Finkelstein, 2014).

Typically, the first mathematics course taken in high school (grade 9) is Algebra 1, though some districts have tried to implement early algebra-for-all with limited success in middle school (Liang, Heckman, & Abedi, 2012). Algebra 1 has been labeled as the “gatekeeper” (Stinson, 2004, p. 9) course for more advanced courses in both mathematics and the sciences as algebra provides the basic reasoning skills students need to be successful (Fong, Jaquet, & Finkelstein, 2014). The argument behind offering the course as part of the high school curriculum is founded on the biological base associated with the development of the adolescent’s brain. Not until adolescence can a student conceptualize the abstract reasoning or formal logic necessary for mastery of algebra (Dashiff, 2000), but not even then can all students be successful in algebra without the necessary tools and encouragement from parents and teachers (You, 2010). Many students who take Algebra 1 as freshmen in high school are not successful, impacting enrollment and success in Geometry and Algebra 2. Those students who repeat Algebra 1 thus fall behind or eventually drop out of high school due to subsequent failures of the same course (Howard, Romero, Scott, & Saddler, 2015).

Conceptual and Theoretical Framework

This study employed one conceptual framework and one theoretical framework. The conceptual framework of gender behavior types, such as traditional feminine or masculine traits (Bem, 1981), was used to explore the students' gender behavior type through a self-concepts model. Engagement theory, the integration of thought and action (Hoyt, 2010), was used to explore the interactions between the students and teachers, and the resulting effect on student achievement, measured through student reported mathematics performance.

Lens of Gender Behavior Types

Gender is often thought of as a dichotomous construct into which people have been classified by birth (McCabe, 2014). Self-perceived gender behavior leads to self-inclusion in gender typicality, a person's view of self as being typical as compared to others in their gender category (Leaper, Farkas, & Brown, 2012). The development of a *gender identity*, the alignment of a person's conceptualization of gender with biological gender (Kahn & Gorski, 2016) is the logical extension of gender typicality.

Gender identity is typically rigid in young children, as they follow a strong adherence to the belief of stereotypical gender characteristics, called *gender rigidity* (Gunderson, Ramirez, Levine, & Beilock, 2012). Gender rigidity in pre-school children extends from classical clothing choices (i.e., girls wear dresses), to toys (boys like trucks), and even book/movie characters

(Halim, Ruble, Tamis-LeMonda, & Shrout, 2013). When young, children may express gender in a variety of ways, but as they age into pre-adolescence, they narrow down their behavior to show unity with some, but not all, gender behaviors (Halim, Ruble, Tamis-LeMonda, & Shrout, 2013).

The entry into adolescence, the years children spend in middle school, is a turning point for gender behavior adherence, which in fact leans more towards gender flexibility than gender rigidity. Once children are in high school, the gender flexibility decreases again until they reach adulthood. At that point, an adult has assumed their gender behavior identity. However, deviation from the gender stereotype can be still judged harshly (Lobel, Nov-Krispin, Schiller, Lobel, & Feldman, 2004). The transitional existence of a gender identity, through the various lenses of gender behaviors, is considered the gender continuum (McCabe, 2014).

Despite the reality of a gender continuum, gender stereotyping still is the lens through which many people view others. The biological, unmalleable basis for the gender lines has begun to be blurred by the entry into society, and schools, of transgender persons (Cavanagh, 2016), but the stereotypical conceptualizations of gender are still generally prevalent (Spittle, Petering, Kremer, & Spittle, 2012). Stereotypes possess an element of truth, and extend expressed character traits, positive and negative, towards an ethnicity, culture, or gender, influencing expected behavior (Spears, Oakes, Ellemers, & Haslam, 1997).

Stereotypes for both genders present generalizations which can be used to describe a person, though the description is not always accurate, thus the negative connotation that is associated with stereotypes (Foote & Collins, 2011). A general feminine stereotype includes the cultivation and expression of delicate sensibilities and emotions, leading to the caricature of females to be snappy, sentimental, and emotional with mood swings (Mayes, 2005). Masculine stereotypes include being analytical, precise (Mehta & Strough, 2010), and exhibiting leadership traits (Landau & Weissler, 1991). A typical caricature draws males as opinionated, stubborn, and someone who is often caught in a “twisted web of logic” (Mayes, 2005, p. 68).

The acceptance and internalization of stereotypical gender behavior traits helps to blend the various personality types of feminine and masculine personages into a self-concept model. Gender behavior types (i.e., feminine/expressive traits or masculine/instrumental) are important facets of gender identity for adolescents (Mehta & Strough, 2010). The gender identity of high school students influences not only relationships with peers but also with teachers, affecting the engagement, interaction, and achievement of students (Jurik, Gröschner, & Seidel, 2013).

Engagement Theory

Engagement theory is concerned with the interaction between the student and the learning, internalizing, and mastering of the curriculum in a classroom (Newmann, 1991). Broadly defining engagement, Reichow et al. noted behaviors such as the purposeful manipulation of learning materials in an appropriate manner or attending to a teacher or peer who is speaking. Non-engagement was attending to something other than the required activity, being out of assigned seating, or inappropriate behaviors (Reichow, Barton, Sewell, Good, & Wolery, 2010). Engagement is a key component of student success in a mathematics classroom as without engagement students are no longer a participant in the learning environment, but just an observer. As Martin (2000) noted, "if curricula and pedagogy do not connect mathematics to the everyday lives of students in sufficiently meaningful ways, students may disengage from activities that they do not see as important or relevant" (Martin, 2000, p. 10).

Researchers also embrace engagement theory within the role of predictor of academic achievement (Skinner, Zimmer-Gembeck, & Connell, 1998). Engagement within a classroom displays various characteristics, as engagement is not only a physical activity but also an intellectual activity (Harcourt & Keen, 2012) with emotional consequences (Harris, 2010). Within a mathematics classroom, the engagement influences study strategies, learning outcomes, and student beliefs about ability (Beal, Adams, & Cohen, 2010).

The lens of gender behavior types was used to explore high school students' self-concepts model which pulled from two trait domains from the five-factor model of personality, agreeableness and extraversion (Mayes, 2005). The focus on these two domains helped to classify students according to three behavior types per gender (i.e., gender typical, neutral, and atypical) and then investigated the student perceptions of teacher-student interactions and mathematics performance by gender behavior type. Engagement theory, the integration of thought and action (Hoyt, 2010), was used to explore the interactions between the students and teachers, and the resulting effect on student achievement, measured through student reported mathematics performance.

Chapter Summary

This chapter presented a review of literature for gender behavior types, teacher-student interactions and mathematics performance. It then discussed two of the five aspects of the five-factor model of personality types (Mayes, 2005) to self-concepts and gender behavior types (Jurik, Gröschner, & Seidel, 2013). Following the discussion, I presented differences and similarities, based on stereotypical female and male characteristics. The section was concluded with a discussion of the constructs for teacher-student interactions and mathematics performance. I presented a discussion of the conceptual framework, the lens of gender behavior types, followed by a presentation of the theoretical framework of engagement theory.

The following chapter will present in detail the methodology of the research study, followed by a presentation of the results of the research study, concluding with a discussion in the final chapter of this document.

CHAPTER THREE:

METHODOLOGY

Overview

This study is a quantitative study that focused on high school students at a traditional, coeducational public school in North Texas. The study began with an examination of student self-concepts on gender behaviors, categorizing students based on cumulative scores from a Student Survey. This study investigated whether there were any differences in students' perceptions of teacher-student interactions by student gender behavior types. Additionally, this study measured high school students' mathematics performance and the predictive abilities of background characteristics, gender behavior types, and student perceptions of teacher-student interactions on mathematics performance.

The sample of this study was 473 high school students enrolled at the North Texas High School (a pseudonym, hereafter NTHS) Spring 2015. The sample was drawn from 986 students enrolled in Algebra 1, Geometry, and Algebra 2 during Spring 2015. Two weeks prior to the end of the semester, teachers sent home the *Informed Consent Document*, written as an *Opt-Out Form* (See Appendix B). The parents were asked to return the *Opt-Out Form* only if their students would not participate in the study. The students who received parental approval responded to a student survey questionnaire. Finally, 473 students participated in the study and completed the survey questionnaire.

The student survey was created through a compilation of questions drawn from the 1) *Revised Competitiveness Index* survey (Harris & Houston, 2010), the 2) *Bem Sex Role Inventory* (Bem, 1977), and 3) the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* (Bill and Melinda Gates Foundation, 2012). Teachers were given the option to send the questionnaires home over a weekend, to be returned on Monday, or to conduct the survey in class. The teacher choice for questionnaire distribution allowed the teachers to decide the best method of survey completion in conjunction with the minimization of classroom interruptions.

The data from the questionnaire was analyzed using a cumulative score for each of the participants for eighteen of the first twenty questions. Two questions were removed from the analysis. By focusing on the cumulative questionnaire score, individual questions were not the sole determination of calculating gender behavior types. Data from the student perceptions of teaching (questions 21 through 30) provide insight into classroom activities from the perspective of the student.

Analyses techniques appropriate for each area of interest were used to investigate the research questions. Background characteristics were analyzed with descriptive statistics to describe the characteristics of the student participants, including gender, race/ethnicity, and age. The analysis of the teacher-student interactions began with a computation of the reliability of the data using Cronbach's Alpha followed by a one-way ANOVA test to investigate differences between the three gender groups (i.e., gender typical, neutral, and atypical) per gender regarding their perceptions of teacher-student interactions. Descriptive statistics were used to describe the mathematics performance per gender behavior type (i.e., gender typical, neutral, and atypical) per gender. A one-way ANOVA was used to determine a difference in mathematics performance by gender behavior types per gender. A step-wise multiple regression analysis was conducted to investigate which variables were significant predictors of students' mathematics performance.

Research Questions

The guiding research questions were:

Research Question 1: What are the background characteristics of the high school students who participated in the study?

Research Question 2: To what extent are high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

Research Question 3: To what extent are high school students different in their mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

Research Question 4: What are the specific factors that predict high school students' mathematics performance?

Understanding the four questions above is important in advancing classroom practice and mathematics performance. The analysis of the self-concepts will help to advance the knowledge of understanding of how students express gender type behaviors through interactions with the teacher and the effect on mathematics performance. This study will help to expand the knowledge concerning the learning and processing of mathematics in the three high school mathematics classes, helping to identify strengths and weaknesses in the learning process through the classroom interactions.

Hypotheses

Null and alternative hypotheses are not provided for Research Question 1 because it is a descriptive research question. Null and alternative hypotheses are provided for the rest of the research questions because they are inferential research questions.

Research Question 2: To what extent are high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

For female students:

H_{O1}: There is no difference in the student perceptions of teacher-student interactions among female high school students in three gender behavior (i.e., gender typical, neutral, and atypical).

H_{A1}: Among female high school students, at least one of the gender behavior types (i.e., gender typical, neutral, and atypical) has a different mean of perceptions of teacher-student interactions.

For male students:

H_{O2}: There is no difference in the student perceptions of teacher-student interactions among male high school students in three gender behavior (i.e., gender typical, neutral, and atypical).

H_{A2}: Among male high school students, at least one of the gender behavior types (i.e., gender typical, neutral, and atypical) has a different mean of perceptions of teacher-student interactions.

Research Question 3: To what extent are high school students different in their mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

For female students:

H_{O1}: There is no difference in female high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

H_{A1}: There is a difference in female high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

For male students:

H_{O2}: There is no difference in male high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

H_{A2}: There is a difference in male high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

Research Question 4: What are the specific factors that predict high school students' mathematics performance?

H_{O1}: There are no specific factors that predict high school students' mathematics performance.

$\beta_1 = \beta_2 = \ldots = \beta_k = 0$

H_{A1}: At least one factor can predict high school students' mathematics performance.

At least one β is not zero.

Research Design

Study Site

This study was conducted at a traditional, coeducational high school in North Texas (NTHS), with 1,656 students and 96 teachers in the Spring 2015 semester. NTHS is an urban school outside of a major metropolitan area in north Texas. NTHS had a diverse student population, with 85% defined as ethnic minorities. More specifically, 46.5% of the student population was identified as African American/Black and 25.2% as Hispanic/Latino. Within the student population, 45.1% were classified as economically disadvantaged, and 4.3% of the students were classified as English language learners.

The mathematics courses offered at NTHS were the traditional courses, Algebra 1, Geometry, Algebra 2, Mathematical Models, Pre-calculus, and Calculus. Nine mathematics teachers taught 36 sections of Algebra 1, Geometry, and Algebra 2, the three courses focused on during this study (Texas Education Agency, 2015).

Sample and Recruitment Procedures

The sample of this study was high school students from a traditional, coeducational high school, enrolled in Algebra 1, Geometry, and Algebra 2. These students were chosen because they were at a crucial point in their lives, entering the passage into adolescence, which begins around the age of 13 and ending at adulthood (Abend, 2009). The transition from childhood to adolescence is wrought with many changes, one of which is the compelling feeling of compliance to behave according to gender stereotypes ((Lobel, Nov-Krispin, Schiller, Lobel, & Feldman, 2004; Leszczynski & Strough, 2008). The exploration of the students' beliefs on gender stereotypes was an underlying current of the study questionnaire.

The recruitment of participants was dependent on a collusion of factors. I invited 986 high school students enrolled in Algebra 1, Geometry, and Algebra 2 at NTHS Spring 2015 from 36 mathematics sections, taught by nine mathematics teachers, to participate in my study. These high school mathematics courses were chosen because these courses still serve as "gatekeeper" courses (Stinson, 2004, p. 9) to the upper-level mathematics and science courses, as more advanced courses in these subjects require the fundamental ideas learned. Two weeks prior to the end of the Spring 2015 semester, teachers sent home the *Informed Consent Docume*nt, written as an *Opt-Out Form*. The *Informed Consent Document* was changed from the traditional parental approval form of the Institutional Review Board to an *Opt-Out Form* (see Appendix B) as the participating school district did not historically require parental approval for student surveys. The parents were asked to return the *Opt-Out Form* only if their student would not participate in the study.

Students completed surveys or *Opt-Out Forms* within a time frame of one week to their mathematics teachers. Eight parents returned the *Informed Consent Document*, presented to the parents as an *Opt-Out Form*, as required by the district, with a signature, indicating that they did not wish for their student to participate in the study.

Finally, of the 986 students invited to participate, 473 high school students (47.94%) agreed to participate in the study and completed the survey. The greatest percent of course participation came from the Algebra 1 classes with 380 students enrolled and 191 returned surveys (p=50.3%). Geometry classes had a lower return rate than Algebra 1 (p=45.6%), with 161 surveys returned out of 353 surveys administered. Algebra 2 classes had 253 students enrolled. Of this number, 121 students (p=47.8%) completed the surveys. The remaining 505 surveys were not returned (see Table 1).

Table 1

Class Enrollment and Participation

Variable	Total Enrolled	Total Participants	Percent of Participation	Male		Female	
				n	%	*n*	%
Algebra 1	380	191	50.3	92	48.2	99	51.8
Geometry	353	161	45.6	91	56.5	70	43.5
Algebra 2	253	121	47.8	61	50.4	60	49.6
Total	986	473	48.0	244	51.6	229	48.4

The gender distribution of the study participants varied across the courses with a total participation of 244 male students (p=51.6%) and 229 female students (p=48.4%). More female students (p=51.8%) returned completed surveys than male students (p=48.2%) in Algebra 1. Geometry students had reversed survey participation, with more of the surveys returned by female students (*p*=43.5%) than male students (*p*=56.5%). The return rates from students enrolled in Algebra 2 were closest between the genders, as female students (*p*= 49.6%) returned slightly few surveys than male students (*p*= 50.4%). Overall, more males student returned surveys (*p*=51.6%) than female students (*p*=48.4%).

Survey Instrumentation

To collect data on self-concepts, gender behaviors, teacher-student interactions, and mathematics performance, a high school student survey was created. This Student Survey questionnaire mainly measured high school students' self-concepts regarding gender behaviors and the students' level of interactions with mathematics teachers and their mathematics performance. The survey also included background information.

The Student Survey consisted of statements from the *Revised Competitiveness Index* survey (Harris & Houston, 2010), the *Bem Sex Role Inventory* (Bem, 1977) and the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* (Bill and Melinda Gates Foundation, 2012) because of the established reliabilities of the surveys as well as the content of the questions in relation to this research study. The *Revised Competitiveness Index* survey (Harris & Houston, 2010) focuses on participants self-reports of competitiveness, and demonstrates a high test-retest reliability (fourteen questions, α=.87) and a high inter-question reliability (α=.90). The *Revised Competitive Index* was used to assess competitiveness as a stable personality trait (Harris & Houston, 2010).The *Bem Sex-Role Inventory*, originally released in 1977, has been studied many times over the years. The original design of the inventory was to conduct empirical research on psychological androgyny and to determine how characteristics such as competitiveness and compassion related to masculine and feminine typical behavior (Choi & Jenkins, 2000). In a revalidation study (Hoffman & Borders, 2001), correlations for masculine and feminine traits were found to be .92 and .89 respectively.

The final survey from which questions were gleaned was the *Asking Students about Teaching: Student Perception Surveys and Their Implementation*, conducted by the Bill and Melinda Gates Foundation (2012). A review of scholarly literature conducted by Hanover Research (2013) analyzed the reliability of the Gates Foundation survey and found correlations between student achievement and the student survey of teacher perceptions: .67 for mathematics and .75 for reading. Calculating correlations between student achievement and student perceptions of teachers can be used to "provide accurate measures of teacher effectiveness" (Hanover Research, 2013, p. 7).

The self-concepts included social interactions, competition, leadership, and gender specific traits. The teacher-student interactions measured student perceptions of behavior management, effective engagement, encouragement, language modeling, and positive communication.

Two statements were excluded from the analysis. Statement number 10 was classified in the gender specific traits category, *10. I love to spend time with children*, and statement number 13 was classified in the social interaction category, *13. I am a cheerful person.* Spending time with children was classified on the *Bem Sex Role Inventory* (Bem, 1977) as a gender specific (feminine) question. However, in the current study, the majority of the respondents (71.1%) answered with *4* or more, indicating that, regardless of gender, they did enjoy spending time with children. Similarly, statement number thirteen was classified as a feminine trait on the *Bem Sex Role Inventory* (Bem, 1977). In the current study, 90.0% of the respondents answered with a self-report of *4* or more, indicating that the majority of the respondents believed they were cheerful. A Cronbach alpha of .470 with an inter-item correlation of .370, validated the decision to exclude the two statements from the overall analysis of data as an alpha less than .5 is considered unacceptable (George & Mallery, 2003).

Scoring

The final analysis of the Student Survey consisted of 28 items concerned with behavioral statements, student perceptions of teaching statements, five demographic questions, and two questions concerning course enrollment and semester averages. The first 28 statements on the Student Survey were scored on a 7-point Likert scale: *1=strongly disagree, 2=moderately disagree, 3=slightly disagree, 4=neither disagree nor agree, 5=slightly agree, 6=moderately agree, 7=strongly agree.* Eight of the statements, statements 3, 4, 5, 6, 7, 15, 17, 20, were reversed scored (1=7, 2=6, 3=5, 4=4, 5=3, 6=2, 7=1) to reflect alignment with the statements as seen on the *Revised Competitiveness Index* Survey (Harris & Houston, 2010) and the *Bem Sex Role Inventory* (Bem, 1977).

Self-Concepts of Gender Behavior

The questions chosen for the self-concept analysis explore the behavioral areas of interest determined by the literature review, social interaction (Sidanius & Pratto, 1999), leadership (Landau & Weissler, 1991), competition (Gupta, Poulsen, & Villeval, 2013), and gender specific traits (Bem, 1977). These traits can all be grouped together under *Extroversion* and *Agreeableness*, as described in the big five factor personalities, commonly called the *Five-Factor Model* (Antonioni, 1998).

Two dimensions which help describe personality types, extracted from Antonioni's (1998) five factor model of personality types are extraversion and agreeableness. Extraversion is a dimension of personalities which focus on sensation, intuition, and how a subject (person) thinks, feels, and relates to an object or situation (Mayes, 2005). Agreeableness is a dimension of personalities which focus on trust, acceptance, and tolerance towards others (Zhang, 2006). While each of the dimensions describes separate personality types, as with many things which relate to people, the dimensions are not separate but intertwined with other dimensions in the Five-Factor Model (Karwowski, Lebuda, Wisniewska, Gralewski, 2013). Thus, the behavioral areas of social interaction, leadership, competition, and gender specific traits are all present in both the dimensions of extraversion and agreeableness. The statements were randomly assigned an order on the questionnaire.

Social Interaction. The interaction between teachers and students, and between students themselves, helps to create the classroom environment. A positive correlation exists between social behavior and learning needs (Totan, Özyeşíl, Deniz, & Kiyar, 2014), thus linking the social interaction aspect of students' behavior with their mathematics performance. The social behaviors which impact mathematics performance include aggression, shyness, argumentation, and self-reliance.

Aggressive behavior (Estell, Farmer, Pearl, Van Acker, & Rodkin, 2008) and argumentation (Antonioni, 1998) are described as masculine behaviors. Males are typically more aggressive than females with a "much higher proportion of girls displaying little or no aggressive behavior" (Harachi, Fleming, White, Ensminger, Abbott, Catalano, & Haggerty, 2006, p. 284). Akin to non-aggressive behavior, shyness is a trait that is gender connected to females as shyness "violates male gender stereotypes" (Kingsbury, Coplan, & Rose-Krasnor, 2013, p. 141). Farrimond (2012) has described self-reliance as a masculine trait, thus a high self-rating in self-reliance indicates exhibition of a masculine trait.

Four survey items measured social interactions, taken from both the *Revised Competitiveness Index* survey and the *Bem Sex Role Inventory*.

4. I try to avoid arguments. (*Revised Competitiveness Index*, statement number 10) This statement was reverse coded.

8. I am self-reliant. (*Bem Sex Role Inventory*, statement number 31)

11. I am aggressive if needed. (*Bem Sex Role Inventory,* statement number 28)

20. I am shy. (*Bem Sex Role Inventory,* statement number 38) This statement was reverse coded.

Leadership. The qualities of a leader have long been studied, and many styles of leadership have been identified (Northouse, 2013). Historically, a good leader has been one which has been described as masculine (Yarrish, Zula, & Davis, 2010) and many qualities of a leader have been used to describe masculine tendencies, such as ambition and decision making (Chin, 2011). Harris and Houston (2010) identified the analytical characteristic as one which described masculine behavior. Strong personalities have been described as personalities with attributes which are "hard, clear, active, strict, and robust" (Makarova & Herzog, 2015, p. 113).

Student leadership is important to a student's growth, and thus to the school culture (Harachi, Fleming, White, Ensminger, Abbott, Catalano, & Hine, 2014). Within a classroom, opportunities for leadership arise regularly. Mixed gender groups in classrooms give students the opportunities to demonstrate leadership skills, though male students generally determine a hierarchy when given a group task (Davies, 2011).

Five statements on the questionnaire measured leadership qualities, all taken from the *Bem Sex Role Inventory* (Bem, 1977).

9. In general, I am analytical. (*Bem Sex Role Inventory*, statement number 37)

12. I will take any opportunity to act as a leader. (*Bem Sex Role Inventory*, statement number 58)

16. I have a strong personality. (*Bem Sex Role Inventory*, statement number 10)

18. I am ambitious. (*Bem Sex Role Inventory*, statement number 55)

19. I make decisions easily. (*Bem Sex Role Inventory*, statement number 40)

Competition. Within a classroom, competition is a key element in educational motivation (Van Nuland, Roach, Wilson, & Belliveau, 2015), though research has shown, even in an educational environment, male students are more competitive and aggressive than female students (Houston, Harris, Moore, Brummett, & Kametani, 2005). Consequently, a competitive orientation is diametrically opposed to stereotypical female traits (Hibbard & Buhrmester, 2010) which can impact a female student's academic performance.

The impact of self-identification of a competitive nature can have a situational, "relational, and contextual" effect based on gender (Faris & Felmlee, 2011, p. 49). The self-identification can influence the satisfaction of personal achievement through competition (Bicknell, 2008). Non-competitive persons, those who favor cooperation over competition (Geist & King, 2008), do not enjoy challenging others (Goodwin, 2011), or dread competing with others (Harris and Houston, 2010), exhibit distinctly different dynamic groups as compared with those of competitive individuals (Sax, 2005) within a classroom environment.

Five statements on the questionnaire measured competitiveness, all taken from the *Revised Competitiveness Index* (Harris & Houston, 2010).

1. I get satisfaction from competing with others. (*Revised Competitiveness Index*, statement number 3)

2. I am a competitive individual. (*Revised Competitiveness Index*, statement number 2)

5. In general, I will go along with the group rather than create conflict. (*Revised Competitiveness Index*, statement number 14) This statement was reverse coded.

6. I dread competing against other people. (*Revised Competitiveness Index,* statement number 7) This statement was reverse coded.

7. I don't really enjoy challenging others even when I think they are wrong. (*Revised Competitiveness Index,* statement number 13) This statement was reverse coded.

Gender Specific Traits. The binary concept of gender (Cavanaugh, 2016) has evolved into a gender continuum which allows for divergence outside of gender norms (Doan, 2010). Despite this evolution, however, certain aspects of behavior are still linked to a specific gender, with very few behaviors shared between the two genders. These gender behavior assignments have been found to be "universal or near-universal (and are) ….found across cultures" (Houston, Harris, Moore, Brummett, & Kametani, 2005, p. 207).

Group dynamics often encourage students to espouse traits which are stereotypical single gender traits. One stereotypical feminine trait of those within a group is the emphasis on similarities and relegation of differences (Davies, 2011). Thus the empathetic student will remain quiet and soft spoken when confronting others within and without their respective social groups rather than use harsh language (Makarova & Herzog, 2015) and seek out risks/conflicts (Sax, 2005).

Four statements on the questionnaire measured gender traits, originally asked in both the *Revised Competitiveness Index* (Harris & Houston, 2010) and the *Bem Sex Role Inventory* (Bem, 1977).

3. I often remain quiet rather than risk hurting another person. (*Revised Competitiveness Index,* statement number 12) This statement was reverse coded.

14. I am willing to take risks. (*Bem Sex Role Inventory,* statement number 19)

15. I do not use harsh language. (*Bem Sex Role Inventory,* statement number 56) This statement was reverse coded.

17. I am soft spoken. (*Bem Sex Role Inventory*, statement number 47) This statement was reverse coded.

Teacher-Student Interactions

The teacher-student interaction statements on the Student Survey included previously measured metrics from the *Measures of Effective Teaching (MET) Project*, conducted by the Bill and Melinda Gates Foundation (2012). The *MET Project* student survey focused on student perceptions of teacher effectiveness and determined that student perceptions of teacher-student interactions were predictive of student achievement across the curriculum. The results of the *MET Project* showed decisions based in student survey results have the potential to improve student achievement. The *MET Project* student survey, *Asking Students about Teaching: Student Perception Surveys and Their Implementation* (Bill and Melinda Gates Foundation, 2012), asked students 35 questions about teaching within seven categories. The categories were Care, Control, Clarify, Challenge, Captivate, Confer, and Consolidate. Students were asked to score statements on a scale of *1 (strongly agree), 2 (agree), 3 (Disagree),* to *4 (strongly disagree)*.

The statements pulled from the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey (Bill and Melinda Gates Foundation, 2012) were reclassified into the five teacher-student interaction categories in this study. The five teacher-student interaction categories were behavior management, effective engagement, encouragement, language modeling, and positive communication, to reflect the domains within the *Professional Development and Appraisal System Scoring Criteria Guide* (Texas Education Agency, 2009), the official State of Texas instrument for appraising teachers for the 2014-2015 school year.

Behavior Management. Behavior management is intrinsically linked to not only teacher control in the classroom (Mullola, Ravaja, Lipsanen, Alatupa, Hintsanen, Jokela, & Keltikangas-Järvinen, 2012), but also student engagement (Harris, 2008). As described in the *Professional Development and Appraisal System Scoring Criteria Guide* (Texas Education Agency, 2009), the tool by which administrators evaluate Texas teachers, teachers are expected to not only specify expectations for behavior, but also intervene and redirect undesirable student behavior in the classroom (Texas Education Agency, 2009). The monitoring and redirection of student behavior, in addition to maintaining the class control (Mullola, Ravaja, Lipsanen, Alatupa, Hintsanen, Jokela, & Keltikangas-Järvinen, 2012), is related to student achievement.

Teacher expectations of student behavior are important in a classroom as time on task and misbehavior has been shown to affect student achievement (Pintrich & Blumenfeld, 1985). The role of the teacher is not limited to the facilitation of information, but includes encouraging proper behavior through modeling and discouraging misbehavior (Page & Smith, 2012) as "student behavior can affect the participation of the whole class" (Harris, 2008, p. 66) which has an impact on student achievement. A side effect of student misbehavior can be seen by the way that students respect or disrespect the teacher and the rules of the classroom (Cooper, 2012).

Two statements on the questionnaire measured the student's perception of behavior management. Both were taken from the *Student Perceptions Survey* conducted by the Bill and Melinda Gates Foundation (2012).

<u>*24. Student behavior in this class is under control.*</u> (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 4)

<u>*25. The students in this class treat the teacher with respect.*</u> (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 9)

Language Modeling. Within a classroom environment, the tone of the class is determined mostly by the teacher, as the teacher utilizes behavior management to encourage and engage the students. The language of the classroom is also contributor to this environment. A successful classroom is described in the *Professional Development and Appraisal System Scoring Criteria Guide* (Texas Education Agency, 2009) as one in which the teacher is supportive, courteous and respectful in all interactions. Likewise, the teacher must model, through actions and language, "courtesy and respect through patience and active listening" (p. 102).

Language modeling includes two-way thought and idea sharing between teachers and students. The two-way sharing can be within the classroom at large (Weiss, 2001) or individually (Sax, 2005). Students sharing thoughts in a whole-class environment sends "an important message to students, that their ways of thinking are recognized as significant and therefore worthwhile" (Karsenty, Arcavi, & Hadas, 2007, p. 164). Student contributions may not only replicate previous discussions, but encourage the students to capture the relationships between thinking and "making thinking public" (De Freitas, 2013, p. 289). For students who are not as comfortable sharing thoughts with others, individual teacher-student interactions allow teachers to informally assess student understanding (Luna & Revilla, 2013) and to determine any possible interventions in the learning process (Fuentes, 2013).

Two statements on the questionnaire measured the student's perception of language modeling. Both were taken from the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* conducted by the Bill and Melinda Gates Foundation (2012).

<u>23. My teacher wants us to share our thoughts.</u> (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 27)

28. The teacher works with me by myself if I ask. (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 11)

Effective Engagement. Student engagement, and on the larger scale, classroom engagement, is one of the keys to student achievement and can be defined as the student's "patterns of action reflecting acceptance of and commitment to the learning goals and expectations of success in a given class" (Cooper, 2012, p. 493). An independent survey (Capern & Hammond, 2014) concluded that one of the most important behaviors of a teacher is "explain(ing) things I don't understand" (p. 53), which causes an increase in engagement, as the student feels more confident in their own abilities. Engagement in high school mathematics courses, such as Algebra 1, has a spiraling effect on Latina/Latino students. The more ill-prepared this population of students feel, the less motivated they become, and subsequently the less engaged, graduating from high school "without deep conceptual understanding of algebra concepts" (Ruiz, 2011, p. 301). Furthermore, an increase in engagement allows the students to become active participants in the learning process. The two-way interactions, teachers asking questions and students asking questions, allow students and teachers to see the students as an important link in the learning process (Beutel, 2010).

Two statements on the questionnaire measured the student's perception of teacher engagement. Both were taken from the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* conducted by the Bill and Melinda Gates Foundation (2012).

21. During a lesson, my teacher thinks we understand when we don't. (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 13) This statement was reverse coded.

22. My teacher asks questions to be sure we are following along during a lesson. (*Asking*

Students about Teaching: Student Perception Surveys and Their Implementation survey, statement number 16)

Positive Communication. The final aspect of teacher-student interactions studied was positive communication, one of the original behavioral categories measured in the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey (Bill and Melinda Gates Foundation, 2012). Positive communication in the *Professional Development and Appraisal System Scoring Criteria Guide* (Texas Education Agency, 2009) is explained under the Professional Communication domain as the appropriate and accurate used of “written, verbal, and non-verbal modes of communication with students” (p. 97). Positive communication is woven into the other four categories of behavior management, effective engagement, encouragement, and language modeling as communication is important in all aspects of leading students towards reaching performance goals, social interactions, and realizing mutual respect among all in the classroom setting (Beutel, 2010). Appropriate modes of communication include frequently asking students to “share ideas and thoughts” (Pianta, Hamre, & Allen, 2012, p. 374) as the teacher “confirms and acknowledges the pupils' work” (Alrø & Johnsen-Høines, 2012, p. 262), thus giving a positive support to the thought and academic improvement of the student (Kiefer, Matthews, Montesino, Arango, & Preece, 2013).

Two statements on the questionnaire measured the student’s perception of positive communication. Both were taken from the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* conducted by the Bill and Melinda Gates Foundation (2012).

26. The teacher respects my ideas and suggestions and encourages me. (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 31)

30. The comments I get on my work help me to improve. (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 35)

Encouragement. Teacher encouragement is expressed in multiple manners, two of which are affirmation of achievement and encouragement to participate. Teachers affirm student achievement through multiple avenues, including providing emotional support (Malecki & Demaray, 2003), mentoring (Cavazos & Cavazos, 2010), and collaborative participation in dialogue (Alrø & Johnsen-Høines, 2012). Another reason for encouraging students can be based in gender as research has shown girls are more likely than boys to attribute failure to their lack of ability even though their achievement is higher (Nicholls, 1979). In one of the few studies to actually examine the relation of classroom feedback to children's self-perceptions, Parsons et al. (1982) found that both teacher praise and criticism for work were positively related to self-concept of mathematics ability (Parsons, Kaczala, & Meece, 1982).

Two statements on the questionnaire measured the student's perception of teacher encouragement. Both were taken from the *Asking Students about Teaching: Student Perception Surveys and Their Implementation* conducted by the Bill and Melinda Gates Foundation (2012).

27. The teacher encourages me to participate. (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 17)

29. The teacher lets me know when I do well. (*Asking Students about Teaching: Student Perception Surveys and Their Implementation* survey, statement number 34)

Background Characteristics

The Student Survey included questions regarding students' background characteristics, age, ethnicity, and gender, and course enrollment information, course enrollment and course grade. The demographics of student age and student ethnicity were asked in order to get an overall picture of the students. Students were asked to identify their gender in order to analyze Research Question 1 as the partitions into which they were divided were classified first by gender.

> Research Question 1: What are the background characteristics of the high school students who participated in the study?

Course enrollment and course averages were collected from the students to help answer Research Question 3.

> Research Question 3: To what extent are high school students different in their mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?

Reliability and Validity of the Survey

The reliability was calculated using the coefficient Cronbach alpha for a series of dichotomous terms. Based on the reliability alpha calculated, two survey items were removed from the survey. According to George and Mallery (2003), the rule for alpha is as follows: > .90 (Excellent), > .8 (Good), > .7 (Acceptable), > .6 (Questionable), > .5 (poor), and < .5 (unacceptable). Statement ten (*I love to spend time with children*) and statement thirteen (*I am a cheerful person*) generated an unacceptable output (α=.470), thus they were removed. Consequently, the adjusted reliability based on gender was established through high internal consistency of Female Self-Concepts (α=.783), Male Self-Concepts (α=.704) and total survey Self-Concepts (α=.748). The reliability alpha of the adjusted survey instrument was within acceptable ranges, indicating that “internal consistency reliability (was) low” (Litwin, 1995, p. 27).

The overall validity of the questionnaire was determined using three types of validity, face, content, and construct (Litwin, 1995). Face Validity is determined by a top-level review of the statements, to determine if they were fair and looked correct, based on the experience of the researcher's experience as a classroom teacher (Al-Adawi & Al-Balushi, 2016). Through a perusal of the Student Survey questions by the dissertation chair, the face validity of the statements proved to be valid. Content Validity is another, subjective measure of the appropriateness of the subject matter determined by a reviewer with some knowledge of the subject matter (Litwin, 1995). The Content Validity was tested through the approval of the primary researcher through a review of the statements for the Student Survey. The final validity, Construct Validity refers to the "degree that the actually measured construct fits the presupposed construct" (Huang & Hu, 2015, p. 99). The Construct Validity of the Student Survey for this study was a recursive action, as the questions were drawn from established, valid surveys.

Data Collection

Student data was collected via a traditional, paper Student Survey. The school district Director of Research, Assessment, and Accountability for the North Texas Independent School District (NTISD), after multiple electronic communications in April 2015, approved the Student Survey with a few changes to ensure student anonymity. Changes included removal of student names, adding a short introduction for the student to read, and altering the course information collection section to include separate lines for both the course enrolled and the estimated course grade. The *Informed Consent Document*, the traditional document for research studies, was changed to be presented as an *Opt-Out Form* per the Director, to match other research conducted within the NTISD. The *Opt-Out Form* was designed to be returned only if the parents did not want their child to participate. Another method of declination of participation was not returning the Student Survey. Once these changes to the Student Survey and *Opt-Out Form* were completed and approved, the Director moved the approval up to the discretion of the North Texas High School (NTHS) principal.

After a short electronic interaction with the NTHS principal, the surveys were prepared for distribution. School administration forwarded a copy of teacher class counts to the primary researcher for the distribution for Student Surveys in the 36 sections of Algebra 1, Geometry, and Algebra 2. Concurrently, a brief description of the research study was sent to the teachers, explaining their role in the research, distribution and collection of the Student Survey only.

The administration and collection of the Student Surveys was a simplified process for the teachers. For the administration of the Student Survey, 986 surveys were printed. On Wednesday, two weeks prior to the end of the Spring Semester, the researcher delivered the surveys to the school principal, along with return envelopes, to the school, in pre-counted bundles per teacher and section. Teachers were again instructed, via email, by the principal to distribute the Student Surveys on Friday, for a Monday return. Neither students nor teachers were given any incentive by the researcher. The following Friday, to allow students time to return surveys, teachers forwarded all returned Student Surveys to the Director of Research, Assessment, and Accountability through the inter-school mail. The Director subsequently returned the surveys via mail to the researcher within a week.

Upon receiving the returned Student Surveys, the data was transferred to a data sheet where the responses were coded and recorded. The survey questions which were not scaled were demographics and course information. The surveys were numbered randomly and the student responses were inputted into SPSS where an analysis of the variables and the subsequent data analysis was conducted. A cumulative score for each study participant was determined, and then categorized within the three gender partitions (i.e., gender typical, neutral, and atypical). Using these constructs, in combination with the student reported perceptions of teacher-student interactions and course grades, appropriate data analyses were conducted to investigate the relationships between the factors, using the independent variables and dependent variables for the two research questions.

Variables

Dependent Variables

For research question 2, **"To what extent are high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively,"** the dependent variable was the teacher-student interactions. A factor analysis was conducted to determine adjustment factors. A reliability test was conducted using Cronbach's alpha to test the reliability of the factors for the dependent, teacher-student interactions (N=457, α=.846). The reliability for the sample of male students (n=236) was calculated at .865. Male students in the neutral male type had the highest reliability rating (n=115, α=.854). Female students had a slightly lower overall reliability (n=221, α=.828) with female students in the atypical female type the highest individual partition calculation (n=71, α=.845). Table 2 reports the factor loadings and reliability coefficients of the adjustment factors that were used as dependent variables in this study. The teacher-student interaction variables were grouped into five constructs, behavior management, effective engagement, encouragement, language modeling, and positive communication.

Table 2

Factor Loadings and Reliability Coefficients of Adjustment Factors for the Dependent Variable

Factor Name	Total α	Female α	Male α	Statements	Factor Loadings
Teacher-Student Interactions	.846	.828	.865		
Behavior Management	.556	.462	.653	*Student behavior in this class is under control.	.539
				*The students in this class treat the teacher with respect.	.485
Language Modeling	.876	.884	.873	*My teacher wants us to share our thoughts.	.699
				*The teacher works with me by myself if I ask.	.764
Effective Engagement	.768	.767	.767	* During a lesson, my teacher thinks we understand when we don't.	.453
				* My teacher asks questions to be sure we are following along during the lesson.	.726
Positive Communication	.896	.908	.886	*The teacher respects my ideas and suggestions and encourages me.	.848
				*The comments I get on my work help me to improve.	.741
Encouragement	.843	.839	.852	*The teacher encourages me to participate.	.750
				*The teacher lets me know when I do well.	.709

The five constructs of teacher-student interactions were comprised of equal numbers of statements. The behavior management construct was comprised of two statements, "*Student behavior in this class is under control*," and "*The students in this class treat the teacher with respect*." The effective engagement construct was composed of two statements, "*During a lesson, my teacher thinks we understand when we don't*" and "*My teacher asks questions to be* *sure we are following along during the lesson*." The encouragement construct was comprised of two statements, "*The teacher encourages me to participate*" and "*The teacher lets me know when I do well*." The language modeling construct was composed of two statements, "*My teacher wants us to share our thoughts*" and "*The teacher works with me by myself if I ask*." The positive communication construct was comprised of two statements, "T*he teacher respects my ideas and suggestions and encourages me*" and "*The comments I receive on my work help me to improve*." The students were asked to report agreement or disagreement with statements on a 7-point scale: *1=strongly disagree, 2=moderately disagree, 3=slightly disagree, 4=neither disagree nor agree, 5=slightly agree, 6=moderately agree, 7=strongly agree,* as shown in Table 3.

Table 3
Teacher-Student Interactions: Dependent Variables

Variable	Coding/Scale
Behavior Management (Construct) • Student behavior in this class is under control. • The students in this class treat the teacher with respect. Language Modeling (Construct) • My teacher wants us to share our thoughts. • The teacher works with me by myself if I ask. Effective Engagement (Construct) • During a lesson, my teacher thinks we understand when we don't. • My teacher asks questions to be sure we are following along during the lesson. Positive Communication (Construct) • The teacher respects my ideas and suggestions and encourages me. • The comments I receive on my work help me to improve. Encouragement (Construct) • The teacher encourages me to participate. • The teacher lets me know when I do well.	7-point scale 1=*strongly disagree* 2=*moderately disagree* 3=*slightly disagree* 4=*neither disagree nor agree* 5=*slightly agree* 6=*moderately agree* 7=*strongly agree*

For research question 3, "**To what extent are high school students different in their mathematics performance by gender behavior types (i.e., gender typical, neutral, and**

atypical) for female and male students, respectively,” the dependent variable is the mathematics performance (course grade).

Independent Variables

There were a total of 23 independent variables used in this study. The independent variables were organized according to the research questions: Gender Behavior Type, Background Characteristics, and Course Identification. Table 4 lists the coding scale for the independent variables.

Table 4
Self-Concept, Background Characteristics, and Course Identification Independent Variables

Variable	Coding/Scale
Gender Behavior Types	
Social Interaction (Construct)	7-point scale
• I try to avoid arguments. (reverse coded)	1=disagree strongly
• I am self-reliant.	2=moderately disagree
• I am aggressive if needed.	3=slightly disagree
• I am shy. (reverse coded)	4=neither disagree nor agree
Leadership (Construct)	5=slightly agree
• In general, I am analytical.	6=moderately agree
• I will take any opportunity to act as a leader.	7=strongly agree
• I have a strong personality.	
• I am ambitious.	
• I make decisions easily.	
Competition (Construct)	
• I get satisfaction from competing with others.	
• I am a competitive individual.	
• In general, I will go along with the group rather than create conflict. (reverse coded)	
• I dread competing against other people. (reverse coded)	
• I don’t really enjoy challenging others even when I think they are wrong. (reverse coded)	
Gender Specific Traits (Construct)	
• I often remain quiet rather than risk hurting another person. (reverse coded)	
• I am willing to take risks.	
• I do not use harsh language. (reverse coded)	
• I am soft spoken. (reverse coded)	

Table 4 (continued)

Variable	Coding/Scale
Background Characteristics	
Age	Continuous Variable
Ethnicity	
	1=African American/Black
	2=Hispanic
	3=White
	4=Pacific Islander
	5=American Indian
	6=Asian
	7=Multi-racial
Gender	
	1=male
	2=female
Course Information	
Course Enrollment	
	1=Algebra 1
	2=Geometry
	3=Algebra 2
Mathematics Performance (Course Average)	
	1=below 70
	2=between 70 and 79
	3=between 80 and 89
	4=90 and above

Gender Behavior Type. The Self-Concept data from the Student Survey was analyzed using a cumulative score for each of the participants for eighteen of the first twenty questions as two questions were discarded based on a factor analysis. The Self-Concept statements were grouped into four constructs, social interaction, leadership, competition, and gender specific traits. The social interaction construct was comprised of four statements: "*I try to avoid arguments*," "*I am self-reliant*," "*I am aggressive if needed*," and "*I am shy*." The leadership construct was comprised of five statements, "*In general, I am analytical*," "*I will take any opportunity to act as a leader*," "*I have a strong personality*," "*I am ambitious*," and "*I make decisions easily*." The competition construct was comprised of five statements, "*I get satisfaction* *from competing with others*," "*I am a competitive individual*," "*In general, I will go along with the group rather than create conflict*," "*I dread competing against other people*," and "*I don't enjoy challenging others even when I think they are wrong*." The gender specific traits construct was comprised of four statements, "*I often remain quiet rather than risk hurting another person*," "*I am willing to take risks*," "*I do not use harsh language*," and "*I am soft spoken*." The coding for each of the constructs was done on a 7-point scale: *1=strongly disagree, 2=moderately disagree, 3=slightly disagree, 4=neither disagree nor agree, 5=slightly agree, 6=moderately agree, 7=strongly agree.*

Background Characteristics. This section of the Student Survey extracted background characteristics from the student participants. Age was coded as a continuous variable, the numerical value of age, *14=14 years old, 15=15 years old, 16=16 years old, 17=17 years old, 18=18 years old, and 19=19 years old.* Ethnicity was coded as *1=African American/Black, 2=Hispanic, 3=White, 4=Pacific Islander, 5=American Indian, 6=Asian, 7=Multi-racial.* Gender was coded as *1=male and 2=female*.

Course Information. Students were surveyed in the three major mathematics courses offered at NTHS, Algebra 1, Geometry, and Algebra 2. These classes were chosen for analysis because of the intellectual requirements of Algebra and Geometry. Algebra and Geometry are the first courses students are exposed to in which abstract reasoning and use of symbols to represent concrete items (Fong, Jaquet, & Finkelstein, 2014). Student participants self-identified the course enrollment, Algebra 1, Geometry, or Algebra 2. The course enrollment was coded as *1=Algebra 1*, *2=Geometry*, and *3=Algebra 2*. The student course grade was coded as *1=less than 70*, *2=between 70 and 79*, *3=between 80 and 89*, and *4=90 and above*.

Data Analysis

I conducted descriptive analysis, one-way ANOVA, and multiple linear regression analyses to answer my research questions. The following section explained in detail analyses performed for each of the research questions. For research question 1, I conducted descriptive analysis, such as frequencies, percentages, and cross-tabulations to analyze the background characteristics of the student participants. Research question 2 was concerned with the differences in their perceptions of interactions with teachers among students' gender behavior types in each of the gender groups (i.e., female and male). Research question 3 was designed to determine the differences between gender partitions in regards to mathematics performance. These differences were determined using one-way ANOVA analyses with the appropriate *post hoc* tests. I applied a multiple linear regression analysis to answer research question 4 to explore which variables predict the students' mathematics performance (see Table 5).

Table 5
Analysis Methods for Research Questions

Research Question	Dependent Variable	Independent Variables	Analysis
RQ1: Background Characteristics of the sample	NA	NA	Descriptive
RQ2: Differences in teacher-student interactions by gender behavior types	Teacher-Student Interactions	Gender behavior types (i.e., typical, neutral, atypical)	Descriptive One-Way ANOVA and post-hoc
RW3: Differences in mathematics performance by gender behavior types	Mathematics Performance	Gender behavior types (i.e., typical, neutral, atypical)	Descriptive One-Way ANOVA and post-hoc
RQ4: Factors predicting mathematics performance	Mathematics Performance	Gender, age, race/ethnicity, gender behavior types, teacher-student interaction	Step-wise multiple regression

Research Question 1

Research question 1, **"What are the background characteristics of the high school students who participated in the study?"** was answered using descriptive statistics. Frequency and percentage were reported per background characteristics, age, ethnicity, and gender.

Research Question 2

The second research question, **"To what extent are high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?"** was analyzed using one-way ANOVA tests with appropriate *post hoc* analyses. Descriptive statistics were reported first to provide an overall understanding of the sample students' concepts of their interaction with mathematics teachers. A one-way ANOVA test was then conducted in each gender group (female and male) to compare whether there was any difference between students in all three gender behavior types regarding their perceptions of teacher-student interaction. The teacher-student interaction was compared as a whole and examined in each of the five constructs, including behavior management, effective engagement, encouragement, language modeling, and positive communication, and each construct consisted of two statements. Corresponding *post hoc* tests were conducted to investigate which specific gender behavior groups were different in teacher-student interaction and its underlying constructs.

Research Question 3

One-way ANOVA analyses were used to answer research question 3: **"To what extent are high school students different in mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?"** Descriptive analyses were first conducted to provide a summary of the sample students' mathematics performance. Following the descriptive statistics, a one-way ANOVA test was conducted in each gender group (female and male) to investigate whether there was any difference between students in all three gender behavior types regarding their mathematics performance. Corresponding *post hoc* tests were performed to investigate which specific gender behavior groups were different in mathematics performance.

Research Question 4

Inferential statistics were used to analyze research question 4: **"What are the specific factors that predict high school students' mathematics performance?"** Multiple linear regression analyses were used to estimate the coefficients for the independent variables, the gender behavior types, and used to predict the value of the dependent variable, mathematics performance was represented by course grade. The background characteristics were added into the regression model first. The second model included the background characteristics, gender behavior types, and the teacher-student interactions.

Defining Gender Behavior Types

The lens of gender type behavior was used to partition the students into three sections. The data from the student survey was analyzed using a cumulative score for each of the participants for eighteen of the first twenty statements. Two statements were discarded based on a factor analysis. By focusing on the cumulative survey score, individual statements were not the sole determination of partition enrollment. The students were divided into three partitions, gender atypical, gender neutral, and gender typical, for both female students and male students, based on two dimensions (i.e., Extraversion, Agreeableness) of the Five-Factor Model personality (Costa & McCrae, 1985) traits as determined by the Student Survey. The interactions between the partitions and the remaining sections of the Student Survey, teacher-student interactions and course grades, were used to inform the remainder of the data analysis.

Factor analysis was conducted to determine the possible inclusion and exclusion of statements regarding students' gender behaviors. Based on the factor analysis, two statements were excluded from the analysis. The two statements, *10. I love to spend time with children*, and *13. I am a cheerful person* were both classified as feminine characteristics in the original *Bem Sex Role Inventory* (Bem, 1977). However, in the current study, the majority of the respondents (71.1%) answered with a 4 or more, indicating that, regardless of gender, they did enjoy spending time with children. Similarly, statement number thirteen was classified as a feminine trait on the *Bem Sex Role Inventory* (Bem, 1977). In the current study, 90.0% of the respondents answered with a self-report of 4 or more, indicating that the majority of the respondents believed they were cheerful. A Cronbach alpha of .470 with an Inter-Item correlation of .370, validated the decision to exclude the two statements from the overall analysis of data as an alpha less than .5 is considered unacceptable (George & Mallery, 2003). A reliability analysis of the remaining 18 statements returned a Cronbach alpha of .748.

A score for each participant was determined by the summation of statements one through twenty, excluding statements 10 and 13. Each statement was allotted the same importance in the overall calculation, thus the weight for each within the summation score was equal and no one behavior could skew the participant total score. The expected cumulative range of scores was from a minimum of 18 (indicating gender typical female behavior and gender atypical male behavior) to a maximum of 126 (indicating gender atypical female behavior and gender typical male behavior). The actual cumulative range of scores were 46 to 123 (female participants) and 51 to 119 (male participants).

Defining Teacher-Student Interacti*ons*

Data from the student perceptions of teacher-student interactions, statements 21 through 30 on the Student Survey, provided insight into classroom activities from the perspective of the student. Five teacher-student interaction constructs were created by grouping two statements per construct and adding the individual scores for each statement, with a total possible cumulative score ranging from a value of "2" to "14". Behavior management was the first construct, combining the scores of two of the statements, "*Student behavior in this class is under control*," and "*The students in this class treat the teacher with respect*." The second construct was encouragement, combining the scores of the two statements "*The teacher encourages me to participate*" and "*The teacher lets me know when I do well*." Effective engagement was created with a combination of scores from the statements "*During a lesson, my teacher thinks we understand when we don't*" and "*My teacher asks questions to be sure we are following along during the lesson*." The fourth construct, language modeling, was created using the scores from the statements "*My teacher wants us to share our thoughts*" and "*The teacher works with me by myself if I ask*." The final construct, positive communication, was created using the statements "*The teacher respects my ideas and suggestions and encourages me*" and "*The comments I receive on my work help me to improve*."

Defining Mathematics Performance

Frequencies for course grades were collected and analyzed using the gender behavior types (i.e., gender typical, neutral, and atypical) for both female and male students. Factor analysis and multiple regressions for each partition by gender and course were conducted to determine the predicting factors for student course grades.

Chapter Summary

This chapter began with an overview discussion of the research questions and the associated null hypothesis for each. Following the overview, the Methodology of the research design was presented. The study site was described, along with the variables, followed by the Instrumentation section. The Instrumentation section of the chapter outlined each of the categories studied within Self-Concept and Teacher-Student Interactions. Individual survey statements in each category were described. The Self-Concept category included statements examining social interactions, leadership, competition, and gender behavior type. Teacher-student interaction categories followed with statements to examine student perception of behavior management, encouragement, effective engagement, language modeling, and positive communication. The Data Analysis section of the chapter described the partitioning of the data, along with the presentation, reliability, validity, and scoring of the statements. A brief examination of the Research Questions in regard to data analysis concluded this chapter.

The following chapter will present in detail the results of the research study, followed by a discussion in the concluding chapter of this document.

CHAPTER FOUR:

RESULTS

Overview

The primary goal of this dissertation was a quantitative examination of the relationships between students' gender behavior types, interactions with teachers, and their mathematics performance for both female and male students in a traditional, coeducational public high school in Texas. It is important for mathematics educators to understand how students relate to mathematics, and how the relationship between the student and the teacher affects the learning. The findings of this study can also provide significant insights into designing curriculum that best satisfy student needs and strategies that can be adopted to increase or maintain a high level of student achievement.

This chapter begins with an analysis of the self-concept behavior spectrum, dividing the students into gender typical, neutral, and atypical behavior types per gender. The chapter then uses the partitions of typical, neutral, and atypical gender behavior, for both male and female students, to analyze teacher-student interactions and mathematics performance. The chapter concludes with an analysis of predictors of mathematics performance.

Student Self-Concepts on the Gender Behavior Spectrum

The student gender behavior type was created using data drawn from eighteen of the first twenty questions on the Student Survey. The survey questions were scored on a Likert-like scale, from 1 to 7. The lower end of the scale, 1 through 3, indicated disagreement with a statement. The middle of the spectrum, 4, indicated a neutral response. The upper end of the scale, 5 through 7, indicated agreement with the statement. The questions were scored using the high end of the spectrum as representative of masculine traits, the low end of the spectrum as representative of feminine traits, and the middle of the spectrum as representative of neutral traits, or those that are shared equally among both genders, as determined through the literature review (Bem, 1977).

Extending the point values from eighteen of the twenty questions, the gender behavior types were thus created using *partitions*. A *partition* of a dataset is the numerical and distance attributes of the data, based on the categorical attributes of the function defined by the neighborhood of the points (Dong, Cao, Chen, He, & Tai, 2009). The numerical and distance attributes of the dataset for this study described how the self-concept totals were distributed along the behavior spectrum. The function defined by the neighborhood of the points of this dataset was the clustering of the data about certain points (for example, seven students scoring 66 points), within the neighborhoods of the boundary points. The distribution was classified as a function since each student was only assigned to one self-concept total, though the self-concept totals could be assigned to multiple students. The definition of the neighborhood points was described by the boundary points of the data, 72 and 90, and the range of data values between such points.

The partitioning therefore was obtained through the clustering of the data within the neighborhoods of the boundary points. The atypical male and the typical female partitions had a non-included upper boundary of 72, representing a survey response of “4” on every question, determined by 4 points per question times 18 questions, thus 72 points. The lower boundary of the typical male partition and atypical female partition was 90 points, 5 points per question times 18 questions. The neutral male and neutral female partitions were the middle partitions. The lower boundary of the middle partition was one more than the upper boundary of the atypical male and the typical female partitions. The upper boundary was one less than the typical male and atypical female partitions, thus 89 points.

The partitioning of the sample was based on the survey responses and not on a division of the data into thirds, thus the results from the study were generalizable to larger datasets and not uniquely responsive with only the study participants. The male participants were clustered within the neutral behavior type (*n*=119). The female student were likewise clustered within the neutral behavior type (*n*=109) (see Table 6). A large percentage of study participants responding to survey questions with either an "agree" response or "neither disagree nor agree" response could be attributed response bias (Espino & Santamaría, 2013).

Table 6
Mean and Standard Deviations for Gender Behavior Types

Gender Type	Male (*n*=244)			Female (*n*=229)		
	n	*M*	*SD*	*n*	*M*	*SD*
Typical	91	98.06	6.91	27	63.11	6.57
Neutral	119	81.06	4.87	109	81.06	5.25
Atypical	34	66.12	5.16	73	100.14	7.69

Scored using a seven-point Likert scale (1= strongly disagree; 7 = strongly agree).

RQ1: Descriptive Analysis of the Sample

Research question 1, **"What are the background characteristics of the high school students who participated in the study?"** focused on the demographic and educational background of the students in Algebra 1, Geometry, and Algebra 2 from NTHS who returned completed surveys for the study. Descriptive statistics were used to describe the characteristics of the student participants, including gender, race/ethnicity, and age. The results of the descriptive analysis also provided educational information regarding mathematics courses in which the students were enrolled and their mathematics teachers.

Demographic Characteristics.

Gender. Among all NTHS high school students who participated in this research study, male students slightly outnumbered female students: 244 males (*p*=51.6%) and 229 (*p*=48.4%) female students.

Race/Ethnicity. Of the student participants, more students self-identified as African American/Black (*p*=42.1%), followed by Hispanic (*p*=23.7%). One out of eight students was identified as White (*p*=12.5%). The smallest ethnic groups were Asian or Pacific Islander (*p*=5.9%), and American Indian (*p*=0.6%). Many of the remaining students (*p*=14.4%), answered the ethnicity question as "Other" with multiple ethnicity combinations checked (see Table 7).

When analyzing the sub-population of ethnicities for all students, the largest sub-population, and the single population in which the male students outnumbered the female students, was African American/Black male students (*p*=44.3%), compared with African American/Black female students (*p*=39.7%). All other sub-populations by ethnicity and gender had student population counts within two participants.

Table 7
Descriptive Statistics of Race/Ethnicity of the Student Participants by Gender

Ethnicity	Male (*n*=244)		Female (*n*=229)		Total (*N*=473)	
	N	%	*n*	%	*n*	%
African American/Black	108	44.3	91	39.7	199	42.1
American Indian	1	0.4	2	0.9	3	0.6
Asian/Pacific Islander	13	5.3	15	6.6	28	5.9
Hispanic	57	23.4	55	24.0	112	23.7
White	30	12.3	29	12.7	59	12.5
Multi-racial	33	13.5	35	15.3	68	14.4
Missing	2	0.8	2	0.9	4	0.8

RQ2: Teacher-Student Interactions

The difference in student perceptions of teacher-student interactions was the focus of research question two, **"To what extent are high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?"** In this study, teacher-student interactions were measured along five constructs:

1) *behavior management*, which incorporated the active monitoring, redirection, and maintaining control of student behavior in the classroom.
2) *language modeling*, which included two-way thought and idea sharing between teachers and students.
3) *effective engagement*, which was one of the keys to student achievement as the student must accept and commit to the learning goals of a class in order to be successful
4) *positive communication*, which covered all forms of communication, including written, verbal, and non-verbal methods of communication
5) *encouragement*, which focused on the affirmation of achievement and encouragement to participate

A one-way ANOVA test was conducted in each gender group to examine if there were any differences between the three gender groups regarding their concepts on teacher-student interactions as a whole and on each of the interaction constructs. To better understand the teacher-student cumulative scores per gender, female and male students were analyzed separately. Thus, research question 2 was divided into two sub-research questions:

RQ2A: To what extent are female high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical)?

RQ2B: To what extent are male high school students different in their perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical)?

To address these sub-research questions, null and alternative hypotheses were developed and presented in the following section. The analysis results were also presented.

RQ2A: Teacher-Student Interaction among Female Students

The following null and alternative hypotheses were developed to guide the testing of differences in total teacher-student interaction and each of the interaction constructs among female students in all three gender behavior types.

H_{O1}: There is no difference in female high school student perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical).

H_{A1}: There is a difference in female high school student perceptions of teacher-student interactions by gender behavior types (i.e. gender typical, neutral, and atypical).

A one-way ANOVA test was conducted to examine if there was any difference between the three female student groups regarding their perceptions of teacher-student interactions. The teacher-student interactions were measured as a whole first and then each of its constructs was analyzed individually.

Total Teacher-Student Interactions. The total teacher-students interactions among the female participants ranged from a low of 10 to a high of 70. In the sample, the mean total score for all female participants fell within the range of *neither disagree nor agree* (*M*=49.08, *SD*=11.91), a cumulative score greater than 40 but less than 50. The mean score was at the upper boundary of this range, thus it was almost within the *agree* category. Atypical female students had the highest mean for the partitions (*M*=51.04, *SD*=12.04) followed by neutral female students (*M*=48.95, *SD*=11.47). Typical female students had the lowest score of the female study participants (*M*=46.38, *SD*=12.44) (see Table 8).

Table 8
Mean and Standard Deviations for Total Teacher-Student Interactions by Gender Behavior Types for Female Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	51.04	12.04	48.05	54.01
Neutral	48.95	11.47	46.66	51.24
Typical	46.38	12.44	42.40	50.26
Total	49.08	11.91	47.45	50.72

The *p*-value of the ANOVA test for this construct was larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in overall female student perceptions of total teacher-student interactions by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level of perceptions of teacher-student interactions with their mathematics teachers, $F(2,203)=1.975$, $p=.141$. Each construct was then analyzed for the gender female partitions to check for significance per construct which could have been not revealed by the total construct analysis (see Table 9).

Behavior Management. Behavior management was the first construct analyzed. This construct was composed of responses to the statements *"Student behavior in this class is under control"* and *"The students in this class treat the teacher with respect."* In the sample, the gender neutral female students (*M*= 9.64, *SD*=3.18) had the highest mean for student perception of behavior management. Atypical female students had a mean only 1.06 points lower than the neutral female students (*M*=8.58, *SD*=3.36). Typical female students had the same mean as the gender neutral students (*M*=9.64, *SD*=3.55) for student perceptions of behavior management. Within the construct of behavior management, all three gender female partition score reports were centered around 8.0, indicating *neither agree nor disagree* (see Table 10).

Table 9

One-Way ANOVA of the Teacher-Student Interactions for Female High School Students

Source	*df*	Sum of Squares	Mean Square	*F*	*p*
Total Teacher-Student Interaction					
Between Groups	2	555.006	277.503	1.975	.141
Within Groups	203	28518.591	140.486		
Total	205	29073.597			
Behavior Management					
Between Groups	2	2.398	1.199	.091	.913
Within Groups	212	2798.690	9.858		
Total	214	2801.088			
Language Modeling					
Between Groups	2	8.032	4.016	.407	.666
Within Groups	216	2129.293	9.858		
Total	218	2137.324			
Effective Engagement					
Between Groups	2	9.494	4.747	.553	.576
Within Groups	217	1862.592	8.583		
Total	219	1872.086			
Positive Communication					
Between Groups	2	2.128	1.064	.091	.913
Within Groups	215	2525.211	11.745		
Total	217	2527.339			
Encouragement					
Between Groups	2	11.192	5.596	.514	.599
Within Groups	211	2296.046	10.882		
Total	213	2307.238			

Table 10

Mean and Standard Deviations for Behavior Management by Gender Behavior Types for Female Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	8.58	3.36	7.38	9.77
Neutral	9.64	3.18	9.04	10.24
Typical	9.64	3.55	8.88	10.40

The *p*-value of the ANOVA test for this construct is larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in female student perceptions of behavior management by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level in behavior management perceptions with their mathematics teachers, $F(2,212)=.091$, $p=.913$.

Language Modeling. The second construct, Language Modeling, was created by combining two statements. The first statement, *"My teacher wants us to share our thoughts,"* is indicative of a teaching which uses various strategies such as discussions and student feedback to model student learning, as described in the *Professional Development and Appraisal System* manual (Texas Education Agency, 2009). The second statement in this construct, *"The teacher works with me by myself if I ask,"* was an example of a teacher acknowledging and responding to both verbal and nonverbal signals from students to assist the student to access resources (i.e., the teacher) for learning (Alderman, 2008). In the sample, the neutral female students (*M*=10.34, *SD*=2.91) had the highest mean for Language Modeling. Atypical female students (*M*=10.04, *SD*=2.91) had the middle mean while typical female students (*M*=9.87, *SD*=3.24) had the lowest mean for language modeling. Both neutral female students and atypical female students had means which were within the range for *slightly agree,* (cumulative score of 10.00-11.99) for language modeling (see Table 11).

Table 11
Mean and Standard Deviations for Language Modeling by Gender Behavior Types for Female Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	10.04	3.40	9.23	10.85
Neutral	10.34	2.91	9.77	10.90
Typical	9.87	3.24	8.89	10.84

The ANOVA test for Language Modeling had a *p*-value that was larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in female student perceptions of behavior management by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level in language modeling perceptions with their mathematics teachers, $F(2,216)=.407$, $p=.666$.

Effective Engagement. The third construct analyzed was the Effective Engagement Construct. This construct was composed of responses to the statements *"During a lesson, my teacher thinks we understand when we don't"* and *"My teacher asks questions to be sure we are following along during the lesson."* In the sample, the gender typical female students ($M=9.58$, $SD=3.07$) had the highest mean for student perception of effective engagement. Neutral female students had the middle value mean ($M=9.11$, $SD=2.77$) while the atypical female students had the lowest mean for student perceptions of effective engagement ($M=9.01$, $SD=3.07$) (see Table 12).

Table 12
Mean and Standard Deviations for Effective Engagement by Gender Behavior Types for Female Participants

Behavior Types			Confidence Interval	
	M	*SD*	Lower	Upper
Atypical	9.01	3.07	8.28	9.75
Neutral	9.11	2.77	8.58	9.65
Typical	9.58	3.07	8.66	10.50

The *p*-value of the ANOVA test for this construct is larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in female high school student perceptions of effective engagement by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level of effective engagement with their mathematics teachers, $F(2,217)=.553$, $p=.576$.

Positive Communication. The next construct analyzed was the Positive Communication

Construct. This construct was composed of responses to the statements *"The teacher respects my ideas and suggestions and encourages me"* and *"The comments I receive on my work help me to improve."* In the sample, the neutral female students (*M*=10.14, *SD*=3.28) had the highest mean for high school female student perception of positive communication. Atypical female students had the middle value mean (*M*=10.03, *SD*=3.56) while the typical female students had the lowest mean for student perceptions of positive communication (*M*=9.89, *SD*=3.46) (see Table 13).

Table 13
Mean and Standard Deviations for Positive Communication by Gender Behavior Types for Female Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	10.03	3.56	9.18	10.88
Neutral	10.14	3.28	9.51	10.78
Typical	9.89	3.55	8.81	10.97

The *p*-value of the ANOVA test for this construct was larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in female student perceptions of positive communication by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar perception of positive communication levels with their mathematics teachers, $F(2,15)=.091$, $p=.913$.

Encouragement. The final construct analyzed was the Encouragement Construct. This construct was composed of responses to the statements *"The teacher respects my ideas and suggestions and encourages me"* and *"The comments I receive on my work help me to improve."* In the sample, the atypical female students (*M*=10.57, *SD*=4.46) had the highest mean for female student perception of encouragement. Neutral female students had the middle value mean (*M*=10.48, *SD*=3.12) while the typical female students had the lowest mean for student perceptions of encouragement (*M*=9.95, *SD*=3.46).

There was a failure to reject the null hypothesis for this since the *p*-value of the ANOVA test was larger than .05. Therefore, there was no difference in female student perceptions of encouragement by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar perception of encouragement levels with their mathematics teachers, $F(2,211)=.514$, $p=.599$ (see Table 14).

Table 14
Mean and Standard Deviations for Encouragement by Gender Behavior Types for Female Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	10.57	3.46	9.72	11.41
Neutral	10.48	3.12	9.87	11.09
Typical	9.95	3.26	8.90	11.01

RQ2B: Teacher-Student Interactions among Male Students.

The following null and alternative hypotheses were developed to guide the testing of differences in total teacher-student interaction and each of the interaction constructs among male high school students in all three gender behavior types.

H_{O2}: There is no difference in male high school student perceptions of teacher-student interactions by gender behavior types (i.e., gender typical, neutral, and atypical), respectively.

H_{A2}: There is a difference in male high school student perceptions of teacher-student interactions by gender behavior types (i.e. gender typical, neutral, and atypical), respectively.

A one-way ANOVA test was conducted to examine if there was any difference between the three male student groups regarding their perceptions of teacher-student interactions. The teacher-student interactions were measured as a whole first and then each of its constructs was analyzed individually.

Total Teacher-Student Interactions. The total construct of teacher-students interactions was analyzed for male study participants. The total range of scores was from a low of 10 to a high of 70. In the sample, the mean total score for all male participants fell within the range of *slightly agree* (M=50.21, SD=11.97), a cumulative score between 50 and 60. Typical male students had the highest mean of the teacher-student interactions (M=53.44, SD=12.06), followed closely by neutral male students (M=49.64, SD=10.81). Atypical male students had the lowest score of the male study participants (M=43.78, SD=12.77) (see Table 15).

Table 15
Mean and Standard Deviations for Total Teacher-Student Interactions by Gender Behavior Types for Male Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	43.78	12.77	39.18	48.39
Neutral	49.64	10.81	47.53	51.75
Typical	53.44	12.06	50.79	56.09
Total	50.21	11.97	48.61	51.81

The ANOVA test for the total teacher-student interaction construct had a p-value that was less than .05, therefore at least one of the gender behavior types (i.e., gender typical, neutral, and atypical) had a mean for teacher-student interactions that was different than the others. In other words, at least one of the student groups had a different interaction with the mathematics teacher than the other groups, within the total construct of teacher-student interactions, $F(2, 214)=8.225$, $p<.05$ (see Table 16). The Test of Homogeneity of Variances for Teacher-Student Interactions (p=.367) was greater than .05 (see Table 17), therefore the variances are assumed equal and the Tukey HSD test was applied. A statistically significant difference was found between typical male students and atypical male students ($p<.001$) and neutral male students and atypical male students ($p<.05$). There were not significant differences between the typical male students and neutral male students (p=.071).

Table 16

One-Way ANOVA of the Teacher-Student Interactions for Male High School Students

Source	*df*	Sum of Squares	Mean Square	*F*	*p*
Total Teacher-Student Interaction					
Between Groups	2	2210.876	1105.438	8.225	.000
Within Groups	214	28761.373	134.399		
Total	216	30972.249			
Behavior Management					
Between Groups	2	31.989	15.995	1.429	.242
Within Groups	227	2541.472	11.196		
Total	229	2573.461			
Language Modeling					
Between Groups	2	88.792	44.396	4.711	.010
Within Groups	231	2176.781	9.423		
Total	233	2265.573			
Effective Engagement					
Between Groups	2	19.838	9.919	1.172	.312
Within Groups	233	1972.145	8.464		
Total	235	1991.983			
Positive Communication					
Between Groups	2	42.052	21.026	1.877	.155
Within Groups	231	2588.238	11.204		
Total	233	2630.291			
Encouragement					
Between Groups	2	73.788	36.894	4.097	.018
Within Groups	223	2007.981	9.004		
Total	225	2081.770			

Table 17

Test of Homogeneity of Variances for Male Participants

Variables	Levene Statistic	*df1*	*df2*	*p*
Total Teacher-Student Interaction	1.008	2	214	.367
Behavior Management	.707	2	227	.494
Language Modeling	.147	2	231	.864
Effective Engagement	1.433	2	233	.241
Positive Communication	2.257	2	231	.107
Encouragement	2.421	2	223	.091

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vior Management. The first construct analyzed was the behavior management construct. This construct was composed of responses to the statements *"Student behavior in this class is under* *control"* and *"The students in this class treat the teacher with respect."* In the sample, the typical male students (*M*= 9.64, *SD*=3.55) and neutral male students (*M*=9.64, *SD*=3.18) had a higher mean for student perceptions of behavior management than the atypical male students (*M*=8.58, *SD*=3.36) (see Table 18).

Table 18
Mean and Standard Deviations for Behavior Management by Gender Behavior Types for Male Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	8.58	3.36	7.38	9.77
Neutral	9.64	3.18	9.04	10.24
Typical	9.64	3.55	8.88	10.40

The *p*-value of the ANOVA test for this construct was larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in male student perceptions of behavior management by gender behavior types. In other words, among all male high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level in behavior management perceptions with their mathematics teachers, $F(2,227)=1.429$, $p=.242$.

Language Modeling. The second construct, language modeling was created by combining two statements. Language modeling includes not only the aspect of verbal modeling provided by the teacher, but also of the acknowledgment of student needs for individual assistance (Newmann, 1992). The language modeling construct, therefore, was composed of statements which exemplify these two aspects of language modeling, *"My teacher wants us to share our thoughts"* and *"The teacher works with me by myself if I ask."* In the sample, the typical male students (*M*=10.47, *SD*=3.16) had the highest mean for language modeling. Neutral male students (*M*=9.97, *SD*=2.97) had the middle mean while atypical male students (*M*=8.55, *SD*=3.18) had the lowest mean for language modeling (see Table 19).

Table 19
Mean and Standard Deviations for Language Modeling by Gender Behavior Types for Male Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	8.55	3.18	7.42	9.67
Neutral	9.97	2.97	9.42	10.52
Typical	10.47	3.16	9.80	11.14

The ANOVA test for language modeling had a *p*-value that was less than .05, therefore at least one of the gender behavior types (i.e., gender typical, neutral, and atypical) had a mean for language modeling that was different than the others. In other words, at least one of the student groups had a different interaction with the mathematics teacher than the other groups, within the construct of language modeling, $F(2, 231)=4.711$, $p<.05$. The Test of Homogeneity of Variances for language modeling ($p=.864$) was greater than .05, therefore the variances are assumed equal and the Tukey HSD test was applied. A statistically significant difference was found between typical male students and atypical male students ($p=.007$). There were not significant differences between the typical male students and neutral male students ($p=.491$) and neutral male students and atypical male students ($p=.051$).

Effective Engagement. The third construct analyzed was the effective engagement construct. This construct was composed of responses to the statements *"During a lesson, my teacher thinks we understand when we don't"* and *"My teacher asks questions to be sure we are following along during the lesson."* In the sample, the typical male students (*M*= 9.35, *SD*=3.19) had the highest mean for student perception of effective engagement. Atypical male students had the middle value mean (*M*=8.97, *SD*=2.67) while the neutral male students had the lowest mean for student perceptions of effective engagement (*M*=8.72, *SD*=2.75) (see Table 20).

Table 20

Mean and Standard Deviations for Effective Engagement by Gender Behavior Types for Male Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	8.97	2.67	8.02	9.92
Neutral	8.72	2.75	8.21	9.23
Typical	9.35	3.19	8.68	10.03

The *p*-value of the ANOVA test for this construct is larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in male high school student perceptions of effective engagement by gender behavior types. In other words, among all male high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level of effective engagement with their mathematics teachers, $F(2,233)=1.172$, $p=.312$.

Positive Communication. The next construct analyzed was the positive communication construct. This construct was composed of responses to the statements *"The teacher respects my ideas and suggestions and encourages me"* and *"The comments I receive on my work help me to improve."* In the sample, the neutral male students (M=10.14, SD=2.99) had the highest mean for high school student perception of positive communication. Typical male students had the middle value mean (M=10.01, SD=3.61) while the atypical male students had the lowest mean for student perceptions of positive communication (M=8.87, SD=3.76) (see Table 21).

The *p*-value of the ANOVA test for this construct is larger than .05, so there was a failure to reject the null hypothesis. Therefore, there was no difference in male student perceptions of positive communication by gender behavior types. In other words, among all male high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar perception of positive communication levels with their mathematics teachers, $F(2,231)=1.877$, $p=.155$.

Table 21
Mean and Standard Deviations for Positive Communication by Gender Behavior Types for Male Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	8.87	3.76	7.54	10.21
Neutral	10.14	2.99	9.58	10.70
Typical	10.01	3.61	9.25	10.78

Encouragement. The final construct analyzed was the encouragement construct. This construct was composed of responses to the statements *"The teacher respects my ideas and suggestions and encourages me"* and *"The comments I receive on my work help me to improve."* In the sample, the typical male students (*M*=11.21, *SD*=2.97) had the highest mean for student perception of encouragement. Neutral male students had the middle value mean (*M*=10.62, *SD*=2.80) while the atypical male students had the lowest mean for student perceptions of encouragement (*M*=9.44, *SD*=3.68) (see Table 22).

Table 22
Mean and Standard Deviations for Encouragement by Gender Behavior Types for Male Participants

			Confidence Interval	
Behavior Types	*M*	*SD*	Lower	Upper
Atypical	9.44	3.68	8.11	10.76
Neutral	10.62	2.80	10.09	11.15
Typical	11.21	2.97	10.57	11.86

The ANOVA test for encouragement had a *p*-value that was less than .05, therefore at least one of the gender behavior types (i.e., gender typical, neutral, and atypical) had a mean for encouragement that was different than the others. In other words, at least one of the student groups had a different interaction with the mathematics teacher than the other groups, within the construct of encouragement, $F(2, 2231)=4.097$, $p<.05$. The Test of Homogeneity of Variances for encouragement ($p=.107$) was greater than .05, therefore the variances are assumed equal and the Tukey HSD test was applied. A statistically significant difference was found between typical male students and atypical male students (p=.013). There were not significant differences between the typical male students and neutral male students (p=.358) and neutral male students and atypical male students (p=.125).

RQ 3: Mathematics Achievement

Research question three, **“To what extent are high school students different in their mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical) for female and male students, respectively?”** focused on high school students’ mathematics performance, which was measured by student self-reported grades in three main mathematics courses offered at the high school. Information about high school students’ mathematics performance (course grades) and course enrollment was collected via the Student Survey. Mathematics performance was measured at four different levels: *1=below 70*, *2=between 70 and 79*, *3=between 80 and 89*, and *4=90 and above*. Mathematics courses used in this study consisted of Algebra 1, Geometry, and Algebra 2.

A one-way ANOVA test was conducted in each gender group to examine if there were any differences between the three gender behavior types regarding their mathematics performance. In order to compare the mathematics performance of the gender behavior types for both genders, the research question to analyze mathematics performance was divided into two sub-research questions.

RQ3A: To what extent are female high school students different in their mathematics performance by gender behavior (i.e., gender typical, neutral, and atypical), respectively?

RQ3B: To what extent are male high school students different in their mathematics performance by gender behavior (i.e., gender typical, neutral, and atypical), respectively?

To address these sub-research questions, null and alternative hypotheses were developed and presented in the following section.

RQ3A: Mathematics Performance among Female Students.

The following null and alternative hypotheses were developed to guide the testing of differences in mathematics performance among female students in all three gender behavior types.

H_{O1}: There is no difference in female high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

H_{A1}: There is a difference in female high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

Table 23
One-Way ANOVA of the Mathematics Performance of Female Participants

Source	*df*	Sum of Squares	Mean Square	*F*	*p*
Total Mathematics Performance – All Courses					
Between Groups	2	.186	.093	.116	.891
Within Groups	218	175.678	.806		
Total	220	175.864			
Algebra 1 Mathematics Performance					
Between Groups	2	.089	.044	.053	.949
Within Groups	92	77.637	.844		
Total	94	77.726			
Geometry Mathematics Performance					
Between Groups	2	.536	.268	.364	.696
Within Groups	67	49.307	.736		
Total	69	49.843			
Algebra 2 Mathematics Performance					
Between Groups	2	1.082	.541	.655	.524
Within Groups	53	43.757	.826		
Total	55	44.839			

The *p*-value of the ANOVA test larger than .05, so there is a failure to reject the null hypothesis. Therefore, there was no statistically significant difference in female student mathematics performance by gender behavior types. In other words, among all female high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level of mathematics performance in the mathematics courses, $F(2,218)=.116$, $p=.891$ (see Table 23).

RQ3B: Mathematics Performance among Male Students.

The following null and alternative hypotheses were developed to guide the testing of differences in mathematics performance among male students in all three gender behavior types.

H_{O2}: There is no difference in male high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

H_{A2}: There is a difference in male high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical).

A one-way ANOVA test was conducted to examine if there was any difference between the three male student groups regarding their mathematics performance. The mathematics performances were measured as a whole first and then by gender behavior types per course enrollment.

The *p*-value of the ANOVA test was larger than .05, so there is a failure to reject the null hypothesis. Therefore, there is no difference in male student mathematics performance by gender behavior types. In other words, among all male high school students, all three gender behavior types (i.e., gender typical, neutral, and atypical) had a similar level of mathematics performance in the mathematics courses, $F(2,233)=.302$, $p=.739$ (see Table 24).

Table 24
One-Way ANOVA of the Mathematics Performance of Male Participants

Source	*df*	Sum of Squares	Mean Square	*F*	*p*

Total Mathematics Performance – All Courses					
Between Groups	2	.464	.232	.302	.739
Within Groups	233	178.532	.766		
Total	235	178.996			
Algebra 1 Mathematics Performance					
Between Groups	2	2.509	1.255	1.536	.221
Within Groups	86	70.255	.817		
Total	88	72.764			
Geometry Mathematics Performance					
Between Groups	2	.144	.072	.098	.907
Within Groups	84	61.810	.736		
Total	86	61.954			
Algebra 2 Mathematics Performance					
Between Groups	2	.369	.185	.259	.773
Within Groups	57	40.631	.713		
Total	59	41.000			

RQ 4: Predictors of Student Mathematics Performance

Research question four, **"What are the specific factors that predict high school students' mathematics performance?"** intended to investigate whether students' background characteristics, concept on gender behaviors, and level of interaction with mathematics teachers predict their mathematics performance. In this dissertation study, students' mathematics performance was measured by student self-reported course grades in three main mathematics courses offered at the high school, Algebra 1, Geometry, and Algebra 2.

The following null and alternative hypotheses were developed to guide the testing of the specific factors that predict high school students' mathematics performance:

H_O: There are no specific factors that predict high school students' mathematics performance.

$\beta_1 = \beta_2 = \ldots = \beta_k = 0$

H_A: At least one factor can predict high school students' mathematics performance.

At least one β is not zero.

A step-wise multiple regression analysis was conducted to investigate which variables were significant predictors of students' mathematics performance. The independent variables were categorized into two groups, which were introduced into the multiple regression analysis by step.

The first group of independent variables was associated with students' background characteristics, including race/ethnicity, gender, and age. The race/ethnicity variable was previously coded into six categories, African American/Black, American Indian, Asian and Pacific Islander, Hispanic/Latino, White and Multiracial. Due to the low number of students who were identified as American Indians, these students were combined with multiracial students and formed a new category titled "Other". Then, the categorical variable "race/ethnicity" was transferred into four separate dummy variables. For instance, variable "African American/Black" was dichotomous coded as 1 when students were self-identified as African American/Black and 0 for the others. Similarly, dichotomous variables "Asian and Pacific Islander," "Hispanic/Latino," and "Other (including multiracial and American Indian)" were created. The race/ethnicity variables were entered into the multiple regression model as compared to White students. Age and gender (female) were also entered as independent variables in the model.

The other group of variables, which were entered as the second step in the regression analysis, included student gender behavior type and teacher-student interaction. Gender behavior was originally coded into three types, gender typical, neutral, and atypical. For the regression analysis, this categorical variable was dummy coded into two dichotomous variables. One was named "gender typical" (1=gender typical students; 0=others), and the other was named "gender atypical" (1=gender atypical students; 0=others).Both variables were entered in the regression analysis to compare with the students who classified as gender neutral. Teacher-student interactions was the final variable entered into the model.

Model 1

The background characteristics were entered first into the regression model. Results of the step-wise multiple regression indicated that none of the independent variables was a statistically significant predictor of the students' mathematics performance. The background characteristics only accounted for 1.9% of the variance of the dependent variable. In other words, less than 2% of the variance in mathematics performance could be predicted by students' gender, race/ethnicity, and age (see Table 25).

Model 2

Model 2 (full model) included the background characteristics (block 1) and the gender behavior type and teacher-student interactions (block 2). After the gender behavior type and teacher-student interactions were entered, the coefficients for the demographic characteristics remained statistically insignificant. Gender behavior types were not identified as significant predictors in the regression analysis. The results show that teacher-student interactions was a significant predictor of student mathematics performance, $F(9,459) = 3.190$, $p<.001$. In other words, students who had a higher level of interaction with their mathematics teachers were more likely to achieve a better grade in mathematics. However, as indicated by the R^2, only 5.9% of the variance in student mathematics performance could be explained by the model. This suggests that the prediction of this model is relatively weak and future research should explore different variables to improve the prediction of the model.

Table 25
Predictors of Mathematics Performance

Variable blocks	Standardized regression coefficients	
	Model 1	Model 2

Block 1		
African American/Black	-.076	-.076
Asian-Pacific Islander	.046	.046
Hispanic	-.069	-.054
Multi-racial	-.024	-.009
Age	-.058	-.073
Gender (Female)	-.071	-.067
Block 2		
Gender Typical Behavior Type		.005
Gender Atypical Behavior Type		.037
Teacher-student interactions		.200***
R	.139	.243
R^2	.019	.059
ΔR^2	.007	.040

** p<.05, ** p<.01, ***p<.001*

Chapter Summary

This chapter presented a detailed analysis of the data outputs for all four research questions after background characteristics, such as ethnicity, age, and gender, were described. The Self-Concept Spectrum was described and partitioned out into the six gender partitions, gender typical, gender neutral, and gender atypical, for female and male study participants. After the partitions were created they were the lens through which the teacher-student interactions and mathematics performance were calculated and measured, using both descriptive and inferential statistics. Finally, the predictors for mathematics performance, self-concepts and teacher-student interactions, were discussed.

The final chapter will discuss the meaning of the data in reference to the research questions, including implications for further study.

CHAPTER FIVE:

DISCUSSION

Overview

This chapter discussed the quantitative results and overall findings of the study. This chapter is divided into the following sections. A summary of the study begins the chapter. A discussion of the findings for the teacher-student interactions and mathematics performance is presented, followed by a conclusion. The implications for policy and practice follow the discussion and conclusion. Recommendations for future research conclude the chapter.

Summary of the Study

The primary goal of this dissertation was a quantitative examination of the relationships between students' gender behavior types, interactions with teachers, and their mathematics performance for both female and male students in a traditional, coeducational public high school in Texas. Using the gender behavior types as a lens, the study examined the existence of any differences in teacher-student interactions and mathematics performance by gender behavior type, and investigated factors that predict students' mathematics performance. Predictive factors for mathematics performance analyzed were the students' ethnicity, age, gender, gender behavior type, and teacher-student interactions.

Chapter 1 described an overview of the study. Gender traits and differences and how they affect students began the discussion followed by a description of the investigation of the student self-concepts, mathematics performance, and student perceptions of teacher-student interactions through the four research questions.

Chapter 2 presented a literature review of related literature. The orienting conceptual framework, the lens of gender behavior types, detailed how personality traits gleaned from the five-factor personality model (Antonioni, 1998). Personalities were categorized to determine the gender partitioning lens through which the remainder of the analysis was viewed. The theoretical framework, engagement theory, was used as a guide for the analysis of the student perceptions of teacher-student interactions.

Chapter 3 began with an overview discussion of the research questions and the associated null and alternative hypotheses for each. Following the overview, the methodology of the research design was presented, including the study site, instrumentation section, data analysis, and concluding with an examination of the research questions.

Chapter 4 presented the results of the research study. The results started with a presentation of background characteristics followed consecutively by data associated with each of the research questions. Each of the sets of data associated with the research questions was presented both as descriptive statistics and inferential statistics.

Chapter 5 summarized the research and provided a discussion and conclusion. The implications for policy, practice, and research followed the discussion and conclusion. Applications of the study concluded the chapter.

Discussion of the Findings

The findings of this study support the conceptual framework of Engagement Theory (Hoyt, 2010), when viewed through the lens of gender behavior types (Egan & Perry, 2001). More specifically, the students' perception of teacher-student interactions was a predicting factor in the mathematics performance of all students, regardless of their gender behavior type. In addition, among male high school students, a statistically significant difference was found between the three gender behavior types in two of the teacher-student interaction categories: *language modeling* and *encouragement.* No statistically significant differences in the level of interaction with teachers were found between the three gender behavior types for female high school students. The following sections focus on the research results related to students' background characteristics, teacher-student interactions and mathematics performance using the lens of gender behavior.

Background Characteristics

The sample of student participants for this research study was diverse, reflective of the high school students in NTHS, where this study was conducted, although it was not as diverse as the high school students throughout the state of Texas (Texas Education Agency, 2015). This found that 51.6% of the participants were identified as male and 48.4% as female. The ethnic distribution of the student participants was very similar to the population of NTHS, with African American/Black students composing the majority of the students at NTHS (p=42.1% of the study sample and p=46.5% of the NTHS population). The African American/Black population of NTHS was almost three times the likewise student population of the state at the high school level (p=12.6%). The Hispanic/Latino students had the second highest percentage in the sample (23.7%) which represented the distribution of the school (25.2%) but lower than the population of the state (52.0%). One reason for the over-representation between the school and state populations could be the location of NTHS: an urban setting.

Within the three mathematics courses offered, the course with the highest enrollment and the highest survey participation was Algebra 1. Taking into consideration the age of many students enrolled in Algebra 1, a common age of 14 or 15 as students are typically high school freshmen, and the maturity level of these students, a high Student Survey return rate for Algebra 1 is surprising. A possible explanation for the high course enrollment and high return rate for Algebra 1 could be the fact that more students were retaking the course, in years subsequent to the freshmen year, as seen in previous research (Howard, Romero, Scott, and Saddler, 2015). Howard et al. (2015) found in a longitudinal study that students who previously failed Algebra 1 and reenrolled in subsequent school years had distinctly different success in the course as they were more focused on the long term goal of graduating. Thus some of the course-repeating students who were enrolled in and returned the Student Survey could have been a little more mature and responsible.

Gender Behavior Types

Gender behavior type was the lens through which research questions two and three were analyzed. Partitions were created to classify the high school students into typical, neutral, and atypical behavior types per gender. The gender behavior types were placed within the spectrum aligning with prior research which concluded that certain characteristics were expressed by both genders (Leszczynski& Strough, 2008). The current research study determined that typical female and atypical male students populated the lower partition, with cumulative self-concept scores maximizing at 71. The female students within the atypical behavior type and the typical male students occupied the upper partition of the behavior spectrum, with cumulative self-concept scores beginning at 90 and increasing up to 123.

The most densely populated partition was the neutral type, with slightly more male participants (48.7%) than female participants (47.5%) within the partition. Such a large percentage of students within the middle partition illustrated thought processes of adolescents parallel to adults in the gendered expectations of women and men towards gender roles and expectations, as seen in a study by Kim and Karan (2004). Kim and Karen (2004), investigated a shift between the genders towards an equality of personalities and away from segregation of distinct gender roles, concluding that gender identity, and gender behavior types, rather than biological gender influences interactions with others in the educational and career aspects of participants' lives (Kim & Karan, 2004).

The gender behavior types populated the behavior spectrum. The lower end of the behavior spectrum consisted of the personality traits which were stereotypical feminine traits such as caution, modesty, weakness, and shyness (Arnott, 2008). This partition was populated by study participants who exhibited the typical female traits (20.4%) and the atypical male traits (14.0%). The upper end of the behavior spectrum, representative of stereotypical masculine traits, was populated by typical male participants (37.3%) and atypical female participants (32.1%). The typical male behavior type and atypical female behavior type was inclusive of students who held the self-concept which was akin to leadership and self-confidence, a stereotypical masculine trait (Leszczynski & Strough, 2008). Having more students within the atypical female and typical male behavior types than the lower partition returning the Student Survey is not surprising, as students within this gender behavior type (masculine) are more self-assured, and thus are more willing to share their ideas and feelings (Hoffman & Borders, 2001) whereas the students in the opposite (feminine) end of the spectrum, are more likely to be shy and introverted, thus not wanting to share thoughts and feelings (Gupta, Poulsen, & Villeval, 2013).

Teacher-Student Interactions

The biggest influence on student performance in mathematics classes for this study was teacher-student interactions. However, between the genders, female students and male students had differing perceptions of teacher-student interactions. Within the gender behavior types for both genders, the means for the teacher-student interactions varied, illustrating the range of perceptions between the gender behavior types, and indeed the genders, for teacher-student interactions.

Descriptive statistics of female student perceptions of teacher-student interactions revealed means differences by gender behavior types, with higher means for atypical female students than the other female students. A higher mean for atypical female students indicated that female students expressing atypical behavior types, such as leadership and self-confidence, perceived a higher level of positive interactions with the mathematics teacher than the female students in the neutral and typical behavior types. The findings for atypical female students were similar to results found by Petty, Harbaugh, and Wang (2012) in a study of student characteristics and mathematics achievement. In the Petty et al. (2012) study students who exhibited tendencies to seek out interactions with teachers, in confrontational, non-aggressive, and positive situations, reported positive interactions with mathematics teachers. Moreover, these students also reported higher mathematics achievement.

There were no statistically significant differences in female student perceptions of total teacher-student interactions by gender behavior types. In other words, female high school students in different gender behavior types had similar perceptions of teacher-student interactions. Another study that took a different approach to teacher-student interactions, focusing on the social and motivational support on mathematics achievement (Ahmed, Minnaert, van der Werf, 2010), and found that there is an association between teacher-student support and mathematics achievement for female students.

The overall mean for female students' perceptions of teacher-student interactions was 49.08, which, even though the numerical value of the teacher-student interaction was in the neutral category, when considering the standard deviation, the female students' teacher-student perceptions fell within the lower boundary of *slightly agree.* Falling within the *slightly agree* category via the standard deviation could have possibly indicated that student perceptions of teacher-student interactions were positive influences on interaction. This result is similar to results found by Sakiz, Paper, and Hoy (2012) in a research study of female high school mathematics students which indicated that positive teacher support in mathematics classrooms encouraged student engagement.

The perceptions of the three male behavior types for teacher-student interactions had a higher range of means than their female counterparts. Typical male students had a mean score higher than the other two behavior types, situated firmly within the *agree* category, suggesting a stronger expression of positive interactions with the mathematics teacher as compared to atypical female students. However, the overall mean for all male students fell within the neutral range of scores, a connotation that male students as a group perceived the teacher-student relationships as neutral, neither positive nor negative. With the majority of male students expressing neutrality towards perceptions of teacher-student interactions and only one sub-group of male students expressing a positive perception, this study is similar to another study by Capern and Hammond (2014). In the previous research by Capern and Hammond, male students were reported as appreciating individual relationships with teachers, such as the typical male behavior students in this study, while maintaining an emotional distance from the teachers.

Notwithstanding the fact that more students fell within the neutral category for teacher-student interactions using descriptive statistics, teacher-student interactions had a statistically significant effect on male students. The typical male students reported higher perceptions of teacher-student interactions than atypical male students, indicating more perceptions of positive interactions between the typical male students and the mathematics teachers. This supports research conducted by Sakiz, Pape, and Hoy (2012) which found that male students who express more gender typical behavior experience higher levels of positive teacher-student interactions.

Two constructs of teacher-student interactions, language modeling and encouragement, returned statistically significant differences of mean scores between male high school students in all three gender behavior types as well. Language modeling in this research study showed significant differences between all three male behavior types. The construct measured thought sharing and independent assistance between the mathematics teacher and the student, both of which supported engagement and positive interactions in the classroom. These results were similar to previous research indicating language modeling provided instructional support in classrooms (Federici & Skaalvik, 2014).

Similar to language modeling, the encouragement construct had a significant difference between all male behavior types. Both neutral and typical male students reported positive interactions with teachers in the domains of participation measurement and positive feedback. A similar study (Karsenty, Arcavi, & Hadas, 2007), which focused on student teachers and the interactions with mostly male students, discovered that encouragement was an important element in the relationships between atypical male students and mathematics teachers.

Mathematics Performance

Mathematics performance in this research study varied between genders, with students reporting course grades with a mean of 2.66 for female participants and 2.50 for male participants, for all participants. The higher course grades for female students than male students supports previous research that female students typically outperform male students in mathematics courses (Sáinz & Eccles, 2012). These findings are not supported by previous research which showed that male students “dominate in the fields of science, technology, engineering, and mathematics" (Lane, Goh, & Driver Lin, 2012, p. 221).

Within the gender behavior types, the female students' mathematics performance was reflective of the overall gender mathematics performance. Gender typical and gender neutral female students reported the highest percent of student course grades within the grade range of *80 to 89* for both Algebra 1 and Geometry; gender neutral female students also reported within the *80 to 89* range for Algebra 2. Gender atypical female students had varying success in the three mathematics courses, with highest course grades in Algebra 1 (*70-79*) differing from Geometry (*80-89*) and Algebra 2 (*80-89*). Male students in all three gender behavior types reported most course grades in the *70-79* grade range for Algebra 1 and *80-89* for Geometry and Algebra 2 for all three male behavior types. As the descriptive statistics showed similarities between the gender behavior types in regards to mathematics performance, statistically significant differences between the three behavior types were not found for either gender. Therefore, there were no statistically significant differences in female and male high school student mathematics performance by gender behavior types (i.e., gender typical, neutral, and atypical), which means that all students had a similar level of mathematics performance within and between genders. Therefore, gender was not a determining factor for mathematics performance,

Predicting Factors for Mathematics Performance. Two models were tested as predictive factors for mathematics performance based on background characteristics, gender behavior types, and teacher-student interactions. The first model used background characteristics, ethnicity, age, and gender. The second model, the full model, included all the factors in model 1 plus the gender behavior types and student perceptions of teacher-student interactions.

The results of the regression analysis indicated that background characteristics were not statistically significant predictors of mathematics performance. This result was counter to research which indicated that ethnicity was a predictive factor in mathematics performance (Leaper, Farkas, & Brown, 2011). Gender behavior types were non-predictive factors of mathematics performance, similar to prior research which showed that gender characteristics were not predictive of mathematics performance (Georgiou, Stavrinides, & Kalavana, 2007).

While background characteristics and gender behavior types were not predictors of mathematics performance, interaction between teachers and students, measured through various student perceptions, were shown in this study to be a predictive factor in student mathematics achievement. The results echoed many educational research studies in student achievement (e.g., Petty, Harbaugh, & Wang, 2013). However, it also points out that the other aspects of teacher-student interactions, such as effective engagement, are not as important as the relationship between the teacher and the student. Thus, of all the factors researched in this study, background characteristics, gender, behavior types, and teacher-student interactions, the only factor predicting high school students' mathematics performance was student perception of teacher-student interaction. However, teacher-student interaction did not provide a strong prediction for the outcome variable, mathematics performance, as only 4% of the variance in mathematics performance could be explained by teacher-student interaction, along with other independent variables.

Conclusion

The purpose of this study was to explore the gender behavior types for both female and male high school students. Using the gender behavior types as a lens, the study examined differences in teacher-student interactions and mathematics performance by gender behavior type, and investigated factors that predict students' mathematics performance The results of this study suggest that there was a small influence on teacher-student interactions by gender behavior types, and the main predictor of mathematics achievement was student perceptions of teacher-student interactions.

This study built on previous research regarding gender behavior types (Kochel, Miller, Updegraff, Ladd, & Kochenderfer-Ladd, 2012; Egan & Perry, 2001) and Engagement Theory (Hoyt, 2010). More specifically, gender behavior types have been used to describe gender typicality and atypicality, feeling one is typical or not typical, respectively, of one's gender category (Leaper, Farkas, & Brown, 2012) and gender neutrality, possessing both typical and atypical behavior for one's gender category (Egan & Perry, 2012). Engagement Theory is a broad educational theory with many researchers adding to the definition. Hoyt (2010) described Engagement Theory as the integration of thought and action with the student as the focus of the engagement, while another definition focused on the interaction between teachers and students to achieve significant mathematics performance (Ahmed, Minnaert, van der Wef, & Kuyper, 2010).

Implications for Policy and Practice

Understanding the importance of teacher impact on student mathematics performance is essential in understanding not only how to create an environment in which students can feel their thoughts and opinions are important, but how to create an environment in which they feel safe to not only fully accept who they are but to embrace their limitations and change them into advantages. Teachers impact students on many levels, but this research study has shown that the way teachers interact with all high school students, through asking students to share thoughts, working with students individually, encouraging participation, and providing comments to improve work, have greater impacts on student achievement and mathematics performance than any other factor in the classroom.

Teachers spend many days at the beginning of every school year sitting through professional development sessions which are meant to help the teachers in the classroom, but rarely are these sessions truly applicable to the classroom once the teacher closes the door and faces the students. Schools should take advantage of research such as this study to help teachers, from new teachers to experienced teachers, to understand how to connect with students from the very first day of the school year. The art of teaching is a solitary one, and many teachers feel lost once they are buried under loads of papers, books, and computer programs. By taking the time to implement policies to help teachers to see the students as more than just another name on the roll, and to teach the teachers to interact with students, administrators will help the teachers to implement practices to assist the students to reach the goal of achievement in the mathematics classroom.

Recommendations for Future Research

This study contributes to the literature on gender behavior types, teacher-student interactions, and high school mathematics performance. While this study supports some prior research on teacher-student interactions (e.g., Beutel, 2010), other aspects of the study do not are contradictory within existing literature, such as the influence on mathematics performance by gender behavior types (e.g., Bem, 1977, 1981). Through comparisons of this study with previous research, limitations of this research study have been identified and recommendation for future research have been proposed.

As most of the survey research studies a limitation of the dissertation is the fact that the questions were personal opinions about the self and the classroom teacher, and thus likely to change based on current feelings and actions of the participants (Mercer, Nellis, Martínez, & Kirk, 2011). Future research could include administering the student survey questionnaire multiple times during the school year. Multiple surveys would allow the researcher to determine a year-long mean for the self-concepts. Increasing the study to be longitudinal would be another change, and allow the researcher to track changes in all three categories, self-concept, teacher-student interactions and mathematics performance over a period of time.

Interpretation of the questions was another limitation, as the students were not able to ask about the terminology of each of the questions, and thus had to interpret the meaning independently (Harris & Houston, 2010). In order to minimize the impact on the survey of terminology misinterpretation, the research could be expanded to include a qualitative aspect for a random group of students. Another possible solution would be to make the survey online, so that students could use internet resources to define words which are unfamiliar.

The self-report of mathematics course grades had two limitations. The first was the lack of guarantee for an accurate report of course grades by the students. The second limitation is that the students did not report the actual numerical grade, but responded within a grade range. Future research, therefore, could include more in-depth teacher participation, in which the teacher records the course grade as a number instead of a grade within a range. Recruiting teachers to participation would help to improve on the collection of student course averages (Sáinz & Eccles, 2012).

A final limitation of the research study was the predictive ability of the variables to explain variances of mathematics performance. Future research should explore different variables to improve the prediction of the model, or focus on particular ethnic groups or one mathematics course.

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Appendix A

Student Survey

Student Survey

You have been selected to participate in a study that is being conducted by a doctoral student who is attending the University of Texas at Arlington.

This survey will only take about 10 minutes of your time.

No identifying information is being collected and participation is voluntary. However, if you do participate, please return your completed survey to your math teacher.

We are interested in your opinions and perceptions and look forward to including your information in the final report that will be presented at the University of Texas at Arlington. Again, no information about you individually is being collected or will be reported. All of the results will be summarized in the report.

Instructions: Use the following response scale in answering the items below. Make sure to read each item carefully and fill in the number that represents your answer.

1 = strongly disagree	5 = slightly agree
2 = moderately disagree	6 = moderately agree
3 = slightly disagree	7 = strongly agree
4 = neither disagree or agree	

1. I get satisfaction from competing with others. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
2. I am a competitive individual. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
3. I often remain quiet rather than risk hurting another person. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
4. I try to avoid arguments. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
5. In general, I will go along with the group rather than create conflict. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
6. I dread competing against other people. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
7. I don't enjoy challenging others even when I think they are wrong. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
8. I am self-reliant. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
9. In general, I am analytical. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
10. I love to spend time with children. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
11. I am aggressive if needed. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
12. I will take any opportunity to act as a leader. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
13. I am a cheerful person. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
14. I am willing to take risks. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
15. I do not use harsh language. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
16. I have a strong personality. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
17. I am soft spoken. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
18. I am ambitious. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
19. I make decisions easily. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
20. I am shy. . . . . ① ② ③ ④ ⑤ ⑥ ⑦

-- Next Side Please

1= strongly disagree
2 = moderately disagree
3 = slightly disagree
4 = neither disagree or agree
5 = slightly agree
6 = moderately agree
7 = strongly agree

Please answer the following questions about your mathematics teacher.

21. During a lesson, my teacher thought we understood when we didn't. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
22. My teacher asked questions to be sure we were following along during the lesson. ① ② ③ ④ ⑤ ⑥ ⑦
23. My teacher wanted us to share our thoughts. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
24. Student behavior in that class was under control. . . . . . . ① ② ③ ④ ⑤ ⑥ ⑦
25. The students in that class treated the teacher with respect. . . . . .① ② ③ ④ ⑤ ⑥ ⑦

26. The teacher respected my ideas and suggestions and encouraged me.. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
27. The teacher encouraged me to participate. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
28. The teacher worked with me by myself if I asked . . . . . . ① ② ③ ④ ⑤ ⑥ ⑦
29. The teacher let me know when I did well. . . . . ① ② ③ ④ ⑤ ⑥ ⑦
30. The comments I received on my work helped me to improve. . . . . .① ② ③ ④ ⑤ ⑥ ⑦

These questions ask about you and your parent or guardian. Please fill in the circle next to your answers or the circle that represents your answer. Select as many options as needed.

31. What is your age? ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱
32. What is your ethnicity?
◯ African American ◯Hispanic ◯ White ◯ Pacific Islander
◯American Indian ◯ Asian ◯ Other ___________

33. What is your gender? ◯ Male ◯ Female

34. What math class are you enrolled in?
Algebra 1 ______Geometry _____ Algebra 2 ______

35. What is your estimated average in this class?
Less than 70 _____ 70-79 _____ 80-89 _____ 90 or above _____

Appendix B

University of Texas at Arlington Institutional Forms

Office of Research Compliance
(817) 272-3723 (P) (817) 272-1111 (F)

THE UNIVERSITY OF TEXAS
AT ARLINGTON

IRB Form # 2D
Application for Research Including Children as Research Subjects

Principal Investigator: Sheila Fleming
Protocol Title: Self-Concepts, Teacher-Student Interactions, and Mathematics Achievement in an All-Girls' Public School

This form should be submitted in conjunction with IRB Form #1 when children (0-17 years of age) are used as human subjects in a research protocol.

The following questions will assist the IRB in determining that the research fulfills all the requirements of the federal regulations at 45 CFR Part 46, Subpart D and 21 CFR Parts 50 and 56 for inclusion of children as research subjects. Special risk/benefit determinations must be discussed and documented by the IRB in order for children to be included as research subjects. Exemptions from the regulations of human subjects involved in research do not apply for children subjects *except* during research that is strictly observation of public behavior and the Principal Investigator does not participate in the activities being observed. If you believe your research to be exempt, please complete and submit IRB Form # 1A (in lieu of IRB Form #1) along with this application for research including children as research subjects.

Definitions:

Children – Persons who have not attained the legal age for consent to treatment or procedures involved in the research investigations under the applicable laws of the jurisdiction in which the research will be conducted.

Minimal Risk Research - Research in which the probability and magnitude of harm or discomfort anticipated in the research are not greater in and of themselves than those ordinarily encountered in daily life (of normal subjects) or during the performance of routine physical or psychological examinations or tests.

Assent – A child's affirmative agreement to participate in the research investigation. Mere failure to object should not, absent affirmative agreement, be construed as assent.

Consent/Permission – The agreement of the parent(s) or guardian to the participation of their child.

Parent – A child's biological or adoptive parent.

Guardian – An individual who is authorized under applicable State or local law to consent on behalf of a child to general medical care when general medical care includes research investigations.

For Completion by the Principal Investigator:

The IRB's first determination is whether or not the research is minimal risk or more than minimal risk. The second determination is whether or not there is a prospect for direct subject benefit. The IRB may approve the inclusion of children in research investigation activities only after making determinations specified in the appropriate sections of 45 CFR Part 46, Subpart D or 21 CFR Parts 50 and 56.

According to the definition given above, is the proposed research investigation **more than minimal risk**?

YES ☐ If yes, complete only Section A and the Signature Portion.

NO ☒ If no, complete only Section B and the Signature Portion.

Last Revised 03-04

SECTION A: **Please complete this section only if your research is MORE than minimal risk.**

Benefits are considered to be from ***the actual research****, not as compensation from the investigators (i.e. payment for participating.)*

Does your research present the prospect of ***direct benefit to the individual subject***?

YES ☐ If yes, complete **Part 1** of this section.

NO ☐ If no, complete **Part 2** of this section.

PART 1:

45 CFR 46.405 or 21 CFR 50.52: Research investigation involving more than minimal risk, but presenting the prospect of direct benefit to the individual subjects.

Determination:

1) Are the risks justified by the anticipated benefits?
YES ☐ NO ☐

2) Is the relationship of the anticipated benefit at least as favorable as alternative approaches?
YES ☐ NO ☐

3) Are adequate provisions made for obtaining assent of the children?
YES ☐ NO ☐

4) Will the informed consent of the parent(s) or guardian(s) be obtained?
YES ☐ NO ☐

In order to approve the research/clinical investigation under this category, questions 1- 4 above must be answered "YES."

PART 2:

45 CFR 46.406 or 21 CFR 50.53: Research investigation involving more than minimal risk with no prospect of direct benefit to the individual subjects, but likely to yield generalizable knowledge about the subjects' disorder or condition.

Determination:

1) Does the risk represent a minor increase over minimal risk?
YES ☐ NO ☐

2) Does the intervention or procedure present experiences commensurate with those inherent in the subjects' actual or expected medical, dental, psychological, social or educational experience?
YES ☐ NO ☐

3) Is the intervention or procedure likely to yield generalizable knowledge about the subjects' disorder or condition that is vital to understanding or ameliorating the subjects' disorder or condition?
YES ☐ NO ☐

4) Are adequate provisions made for obtaining assent of the children?
YES ☐ NO ☐

5) Will the informed consent of the parent(s) or guardian(s) be obtained?
YES ☐ NO ☐

IRB FORM 2D, CHILDREN SUBJECTS
IRB Protocol # 2014-0824

Office of Research Compliance
(817) 272-3723 (P) (817) 272-1111 (F)

In order to approve the research/clinical investigation under this category, questions 1 - 5 above must be answered "YES."

SECTION B: Please complete this section only if your research is NOT more than minimal risk.

45 CFR 46.404 or 21 CFR 50.51: Research or clinical investigation not involving greater than minimal risk.

Determination:

1) Are adequate provisions made for obtaining assent of the children? Verbal assent should be given to children 5 - 6 years of age while written assent should be given to children from 7 - 17 years of age.

   YES ☒ NO ☐

2) Will the informed consent of the parent(s) or guardian(s) be obtained?

   YES ☒ NO ☐

In order to approve the research investigation under this category, both 1 and 2 above must be answered "YES."

SIGNATURE PORTION:

I UNDERSTAND THAT I AM RESPONSIBLE FOR THE ACCURACY OF THE STATEMENTS MADE IN THIS FORM AND FOR THE CONDUCT OF RESEARCH INVOLVING CHILDREN AS SUBJECTS.

Sheila Fleming — 12/2/14

Principal Investigator — Date

[signature] — 12/2/14

Faculty Sponsor (If not the Principal Investigator) — Date

Please submit this form with your corresponding IRB paperwork to the Office of Research Compliance, Box 19188. If you have any questions, please contact the Office of Research Compliance at 817-272-3723, or see Research Compliance at: http://www.uta.edu/ra

Last Revised 03.04

UNIVERSITY OF TEXAS ARLINGTON | OFFICE OF RESEARCH ADMINISTRATION
REGULATORY SERVICES

May 13, 2015

Dr. Sheila Fleming
Educational Leadership & Policy Studies
The University of Texas at Arlington
Box 19575

IRB No.: **2014-0824**

Title: *Self-Concepts, Teacher-Student Interactions, and Mathematics Achievement*

EXPEDITED PROTOCOL MODIFICATION APPROVAL

The UT Arlington Institutional Review Board (UTA IRB) Chair (or designee) reviewed and approved the modification(s) to this protocol on **May 13, 2015** in accordance with Title 45 CFR 46. 110(b)(2). Therefore, you are authorized to conduct your research. The modification approval will additionally be presented to the convened board on June 9, 2015 for full IRB acknowledgment [45 CFR 46.110(c)]. The modification(s), indicated below, was/were deemed minor and appropriate for expedited review.

- The survey was changed so that student names are not given, students self-report grades, parent education level removed, and further instructions are given at the top of the page.
- The financial incentive (gift cards for three randomly chosen participants) removed per district request.
- The informed consent document will be sent home as a handout in which the parents will only return if students are not participating.
- The district is providing interschool envelopes for the teachers to return the completed surveys and any returned Not Participating Informed Consent Documents to the principal investigator via the Mansfield Independent School District Office of Research, Assessment, and Accountability director, Dr. T. Stegall.
- The study focus has changed to include coeducational participants, replacing the girls-only focus.
- The research site was changed to Timberview High School, in Mansfield Independent School District, Mansfield, Texas.
- Per district request, the teachers will be given the option to either send the surveys home with students to complete and return, or to allow time in the class period to complete the survey.
- Increase enrollment to 1,200 subjects.
- Change the title to: "Self-concepts, teacher-student interactions, and mathematics achivement."

REGULATORY SERVICES
SERVICES
The University of Texas at Arlington, Center for Innovation
202 E. Border Street, Ste. 201, Arlington, Texas 76010, Box#19188
(T) 817-272-3723 (F) 817-272-5808 (E) regulatoryservices@uta.edu (W) www.uta.edu/rs

MODIFICATION TO AN APPROVED PROTOCOL:

Pursuant to Title 45 CFR 46.103(b)(4)(iii), investigators are required to, "promptly report to the IRB ***any*** proposed changes in the research activity, and to ensure that such changes in approved research, during the period for which IRB approval has already been given, are **not initiated without prior IRB review and approval** except when necessary to eliminate apparent immediate hazards to the subject." Modifications include but are not limited to: Changes in protocol personnel, number of approved participants, and/or updates to the protocol procedures or instruments and must be submitted via the electronic submission system. Failure to obtain approval for modifications is considered an issue of non-compliance and will be subject to review and deliberation by the IRB which could result in the suspension/termination of the protocol.

INFORMED CONSENT DOCUMENT:

The IRB approved informed consent document (ICD), showing the stamped approval and expiration date of the article must be used when prospectively enrolling volunteer participants into the study. The use of a copy of any consent form on which the IRB-stamped approval and expiration dates are not visible, or are replaced by typescript or handwriting, is prohibited. The signed consent forms must be securely maintained on the UTA campus for the duration of the study plus three years. The complete study record is subject to inspection and/or audit during this time period by entities including but not limited to the UT Arlington IRB, Regulatory Services staff, OHRP/FDA and by study sponsors (if the study is funded).

ADVERSE EVENTS:

Please be advised that as the principal investigator, you are required to report local adverse (unanticipated) events to The UT Arlington Office of Research Administration; Regulatory Services within 24 hours of the occurrence or upon acknowledgement of the occurrence.

TRAINING

All investigators and key personnel identified in the protocol must have filed an annual Conflict of Interest Disclosure (COI) and have documented *Human Subjects Protection (HSP)* training on file with this office prior to protocol approval. HSP training certificates are valid for 2 years from completion date.

COLLABORATION:

If applicable, approval by the appropriate authority at a collaborating facility is required prior to subject enrollment. If the collaborating facility is *engaged in the research*, an OHRP approved Federalwide Assurance (FWA) may be required for the facility (prior to their participation in research-related activities). To determine whether the collaborating facility is engaged in research, go to: http://www.hhs.gov/ohrp/humansubjects/assurance/engage.htm

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UNIVERSITY OF TEXAS ARLINGTON | OFFICE OF RESEARCH ADMINISTRATION REGULATORY SERVICES

CONTACT FOR QUESTIONS:
The UT Arlington Office of Research Administration; Regulatory Services appreciates your continuing commitment to the protection of human research subjects. Should you have questions or require further assistance, please contact Alyson Stearns at astearns@uta.edu or Regulatory Services at regulatoryservices@uta.edu or 817-272-2105.

Sincerely,

Digitally signed by Christopher Ray
DN: postalCode=76019, o=The University of Texas at Arlington, street=701 South Nedderman Drive, st=TX, l=Arlington, c=US, cn=Christopher Ray, email=chrisray@uta.edu
Date: 2015.05.15 11:14:44 -06'00'

Christopher Ray, PhD, ATC, CSCS
Associate Professor, Department of Kinesiology
UT Arlington IRB Chair

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FUNDED GRANT / CONTRACT #________________ (If applicable)

Office of Research Compliance
Phone (817) 272-3723
Fax (817) 272-1111

THE UNIVERSITY OF TEXAS AT ARLINGTON

IRB Form #3

Application for Waiver or Alteration of Informed Consent Requirements

Except as provided below, written documentation of informed consent that embodies all the required elements of informed consent, as described in 45 CFR 46.116, is required for all research subjects. With sufficient justification, the IRB may approve a consent process that does not include or alters some or all of the elements of informed consent provided that it finds and documents specific requirements.

If requesting a **waiver or alteration of the requirements to obtain informed consent**, justify such in accordance with the following four criteria established under 45CFR46.116(d)(1-4) in Section A

If requesting a **waiver or alteration from the requirements for** written documentation of informed consent, justify such in accordance with at least one of the criteria established under 45 CFR 46.117(c)(1 or 2) in Section B

SECTION A

1. The research involves no more than minimal risk* to the subjects

2. The waiver or alteration will not adversely affect the rights and welfare of the subjects;

3. The research could not practicably be carried out without the waiver or alteration; AND

4. Whenever appropriate, the subjects will be provided with additional pertinent information after participation.

SECTION B

1. The only record linking the subject and the research would be the consent document and the principal risk would be potential harm resulting from a breach of confidentiality. In this case, each subject will be asked whether the subject wants documentation linking the subject with the research, and the subject's wishes will govern.

OR

2. The research presents no more than minimal risk of harm to subjects and involves no procedures for which written consent is normally required outside of the research context.

This research presents a minimal risk to the subjects. Per district request, the informed consent document is to be presented to the parents as a take-home hand out through which parents can remove their student from the survey upon returning the ICD hand out.

Principal Investigator **Date**

Sheila Fleming May 11, 2015

Last Revised 06/05

UT Arlington
Informed Consent Document

PRINCIPAL INVESTIGATOR
Sheila Fleming, graduate student
Dept. of Educational Leadership and Policy Studies
(817) 832-8789 (cell)
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FACULTY ADVISOR
Yi Zhang, Assistant Professor
Dept. of Educational Leadership and Policy Studies
(817) 272-9221
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TITLE OF PROJECT
Self-Concepts, Teacher-Student Interactions, and Mathematics Achievement

INTRODUCTION
You are being asked to allow your child to participate in a research study about their beliefs about themselves, interactions between the teacher and student, and semester averages in mathematics. Your child's participation is voluntary. Refusal to participate or discontinuing your child's participation at any time will involve no penalty or loss of benefits to which you or your child are otherwise entitled. Please ask questions if there is anything you do not understand.

This is an OPT-Out Consent Form. Only sign and return this form to your child's mathematics teacher if you DO NOT want your child to participate before ________________, ________________.

PURPOSE
The specific purpose of this research study is to determine if there is any relationship between teacher-student interactions and the student mathematics averages.

DURATION
This study will consist of a survey which should take approximately 10 minutes.

NUMBER OF PARTICIPANTS
The number of anticipated participants in this research study is 1,200 participants.

PROCEDURES
The procedures which will involve your child as a research participant include answering a 35 question survey. The averages will be used to determine any relationship between grades and students' beliefs about themselves.

POSSIBLE BENEFITS
This study will help to better understand the teacher-student relationships.

POSSIBLE RISKS/DISCOMFORTS
There are no perceived risks or discomforts for participating in this research study. Should your child experience any discomfort please inform the researcher, your child will have the right to quit any study procedures at any time at no consequence.

COMPENSATION
There will not be any compensation.

ALTERNATIVE PROCEDURES
There are no alternative procedures offered for this study. Your child may elect not to participate or may quit at any time with no consequences.

VOLUNTARY PARTICIPATION
Participation in this research study is voluntary. You and your child have the right to decline participation in any or all study procedures or quit at any time at no consequence.

CONFIDENTIALITY

IRB Approval Date: MAY 1 3 2015

IRB Expiration Date: FEB 0 2 2016

UT Arlington
Informed Consent Document

Every attempt will be made to see that your child's study results are kept confidential. Teachers will be given the option to send home the surveys or to have students complete in class. The student surveys will be collected and placed in an interschool envelope and subsequently returned to the principal investigator via the Mansfield Independent School District Office of Research, Assessment, and Accountability. Student responses will be confidential from your child's teacher. A copy of this consent form and all data collected from this study will be stored in 103D Trimble Hall, at the University of Texas at Arlington, for at least three (3) years after the end of this research. The results of this study may be published and/or presented at meetings without naming your child as a participant. Additional research studies could evolve from the information your child has provided, but your child's information will not be linked to your child in anyway; it will be anonymous. Although your child's rights and privacy will be maintained, the Secretary of the Department of Health and Human Services, the UTA Institutional Review Board (IRB), and personnel particular to this research have access to the study records. Your child's records will be kept completely confidential according to current legal requirements. They will not be revealed unless required by law, or as noted above. The IRB at UTA has reviewed and approved this study and the information within this consent form. If in the unlikely event it becomes necessary for the Institutional Review Board to review your student's research records, the University of Texas at Arlington will protect the confidentiality of those records to the extent permitted by law.

CONTACT FOR QUESTIONS

Questions about this research study may be directed to Sheila Fleming at (817) 832-8789, Sheila.Fleming@mavs.uta.edu, or Yi Zhang, Ph.D at (817) 272-9221, lyzhang@uta.edu. Any questions you may have about your child's rights as a research participant or a research-related injury may be directed to the Office of Research Administration; Regulatory Services at 817-272-2105 or regulatoryservices@uta.edu.

As a representative of this study, I have explained the purpose, the procedures, the benefits, and the risks that are involved in this research study:

____ ____________

Signature and printed name of principal investigator or person obtaining consent **Date**

ASSENT

By reading this form, you are consenting to your child's participation in the survey.

This is an OPT-Out Consent Form. Only sign and return this form to your child's mathematics teacher if you DO NOT want your child to participate before ____________, ____________.

____ ____________

Parent's signature and printed name **Date**

IRB Approval Date: MAY 1 3 2015

2

IRB Expiration Date: FEB 0 2 2016

Appendix C

District Communications

From: Fleming, Sheila Gayle [mailto:sheila.fleming@mavs.uta.edu]
Sent: Monday, April 27, 2015 2:28 PM
To: [redacted]
Subject: School Research

Hello.
I am a doctoral student at the University of Texas at Arlington. I am interested in conducting research at one of the high schools to help fulfill my dissertation requirement.

I am looking at student self-concepts (leadership, social interactions, competition, gender traits such as outspoken versus shy), students' perceptions of teacher-student interactions, and mathematics achievement in Algebra 1, Geometry, and Algebra 2. This would be conducted via a survey instrument. I would not have any contact with students other than disseminating the survey. To eliminate any student contact, I am open to allowing the teacher to hand it out. The survey would not take much class time as the students will take it home, in order to get parent permission, and then return the completed survey to the teacher. I have three $50 Fandango gift cards to give to three students, one chosen at random from each of the courses, from returned surveys, as an incentive to participate.

I would like to be able to conduct the survey before the end of the semester and then to collect student mathematics averages for Spring 2015. The survey is attached. Thank you for your consideration. If you have any questions, please feel free to email me or call me at (817) 832-8789.

Sheila Fleming
[redacted]
graduate student, The University of Texas at Arlington
Department of Educational Leadership and Policy Studies

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Tue 5/5/2015, 8:23 AM

Sheila,

Let's see if we can work together to make this work.

1. Remove student names from surveys. That way, the data you collect will be anonymous and you will get better responses.
2. At the top of the survey, please add the following statements:

   You have been selected to participate in a study that is being conducted by a doctoral student who is attending the University of Texas in Arlington.
   This survey will take only about 10 minutes of your time.
   No identifying information is being collected and participation is voluntary. However, if you do participate, please return your completed survey to your math teacher tomorrow.
   We are very interested in your opinions and perceptions and look forward to including your information in the final report that will be presented to the University of Texas. Again, no information about you individually is being collected or will be reported. All of the results will be summarized in the report.

3. Include a line for students to indicate the math class they are enrolled in: Algebra I ____ , Geometry _____, Algebra II _____

4. Include a place on the survey where students can write in their (estimated/anticipated) average for the course (or have them write in their semester 1 or last six-weeks average). *I know this is not the best way to obtain data but for the purpose of your study, it will work. It is also easier than trying to "match" student's names with actual semester averages that are maintained in district databases.*

5. Prepare 150+ surveys for each math teacher to distribute based on their course enrollment.
6. My department will provide instructions to the teachers (via the principal) that will ask them to distribute the surveys and to take them up the next day. Once they collect the surveys, the teachers will put the surveys in a large envelope that has the label "Return to

Dr. [redacted] in the [redacted] Research, Assessment & Accountability Department."

7. Once I receive the surveys back from the schools, I'll notify you so you can come and pick them up.

Additionally, in order for [redacted] to participate, I need a written approval letter from your university that shows their support of your study. Please include the proposal so I will have a clearer idea regarding the purpose and benefit of your study.

Also, one of the requirements of the [redacted] is that the district and campuses are not identified by name in your report. Secondly, we request that you provide a copy of the final report to my department when your study is completed.

If my suggestions meet with your approval, please let me know and I will help you move forward to the next step once you have provided me with the additional documentation. Also, if needed, please feel free to call me to discuss further.

Thanks,
[redacted]
Director
Research, Assessment & Accountability

Mon 5/11/2015, 8:28 AM
Fleming, Sheila Gayle;
[redacted]
Inbox

You forwarded this message on 5/11/2015 1:07 PM

Action Items

Hi, Sheila,

I think the changes you have made will work well. Just print the form as 2-sided so it is easier to distribute to students.

Once you have determined dates for distribution, go ahead and write the date on the consent form.
Here's a suggestion.

May 18 Teachers send consent forms home.
May 22 Teachers distribute surveys to students.
May 25 Teachers take up surveys (if students did not complete in class)

Teachers can allow the students to complete survey in class or take the surveys home and complete. Be sure to provide envelopes for the students to return surveys in.

If you can come by my office this week, I will give you enough interschool envelopes so teachers can return completed surveys to my office. Then, you can drop by my office and pick them up.
Lastly, I suggest removing the gift certificates from your plans. Since you are not collecting student names, you will not know who completed the survey and who did not. In this case, your survey is short enough to not really require an incentive.
Hope these suggestions help.
If you get university approval this week, let me know so I can contact [redacted] and let them know your study has been approved for distribution.
[redacted]

Reply all|

Thu 5/14/2015, 2:10 PM

[redacted];

Fleming, Sheila Gayle;

[redacted]

+1 more

Inbox

You forwarded this message on 5/14/2015 2:26 PM

Action Items

Hi, [redacted],

I am working with the University of Texas in Arlington and Sheila Fleming, a graduate student who is completing requirements for her doctorate. In order for her to meet this goal, she needs to survey some of the math students at [redacted] High School.

Please know that I consider all research requests carefully. Prior to recommending this study to you, I reviewed the items on the survey and spoke with the University. Based on the information I received, I approved the request and am recommending participation in this survey. Surveys will collect information related to student self-concepts (leadership, social interactions, competition, gender traits such as outspoken versus shy), students' perceptions of teacher-student interactions, and mathematics achievement in Algebra 1, Geometry, and Algebra 2.

Surveys will be printed by Ms. Fleming. These should be given to students currently enrolled in either Algebra I, Geometry, or Algebra 2. Surveys can be completed at school or at home and take only about 10 minutes.

Additionally, because students will be participating in the study (via the survey), the university requires the distribution of a "parent consent form." In order to limit the amount of effort teachers have to spend on this study, the University and I decided to use a passive consent form. Parents who do not wish their child to participate in the study will need to sign the form and return it to the math teacher. If parents are ok with their child taking the survey, the form will not need to be signed or returned.

Ms. Fleming will not have any contact with the students and she will not be collecting any identifiable information related to students or teachers.

Procedures: Ms. Fleming will bring the consent forms, the surveys, and the return envelopes to the campus administration office on Friday, May 15.
Please have someone give the surveys to the selected math teachers. (The teacher's name will be shown on the stack of surveys that will be delivered to your campus.)

The following schedule is recommended (but may vary a day or two if needed).

May 18 (Monday)
Teachers send parent consent forms home with the student

May 22 (Friday)
Teachers distribute surveys to students.

May 26 (Tuesday)
Teachers take up surveys (if students did not complete in class) and place completed surveys in the interschool envelopes so they can be returned to my office.

Note:

- Teachers may allow students to complete the survey in class or take the surveys home to complete.
- Students will return their surveys to their math teacher in a sealed envelope that will be provided by Ms. Fleming.
- No later than Tuesday, May 26th, teachers should take up the surveys.

- The teacher will not open the sealed envelopes but will return all surveys in the attached interschool envelope which has been labeled so that the surveys will be returned to my office.

Thank you for assisting my department and this student regarding this study. If you have any questions or need additional information, please feel free to call my office or my cell at [redacted].

[redacted]

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Letter to teachers concerning study participation

Hello.

My name is Sheila Fleming and I am a doctoral student at the University of Texas at Arlington. I am currently in the dissertation phase of my program in Educational Leadership and Policy Studies. My research focuses on student self-concepts, student perceptions of teacher-student interactions, and mathematics achievement.

I have been given permission through the Mansfield ISD Office of Research, Assessment and Accountability to conduct a survey through your mathematics classes, if you will agree to hand out and collect the Informed Consent Handouts and surveys for me.

I am waiting on final approval through my university to conduct the survey. Once this approval comes through, I will be delivering Informed Consent Handouts and surveys to you to distribute to your students. Right now, the plan is for you to distribute the Informed Consent Handouts to students at the beginning of next week. Students will only return the handouts if their parents DO NOT consent to their participation in my study. At the end of the week, or the beginning of the next, the students will be given the surveys. It is up to your discretion to send the surveys home to be completed or to have the students complete them in class. The surveys are not very complicated and should take less than ten minutes of class time. The completion of the surveys in class is my preference, since students may not return the surveys if they take the surveys home. Once all surveys have been taken and/or returned, you will have an interschool envelope to return the surveys to [redacted] in the Office of Research, Assessment and Accountability on a predetermined date.

If you wish to send the surveys home, please email me at Sheila.Fleming@mavs.uta.edu so that I may provide envelopes for students to return the surveys to the classroom. Dr. Stegall has already provided me with a student count for your class period. If you do not want to participate in the study, please email me as well.

I am attaching the survey to this email.
If you have any questions, please feel free to contact me.

Thank you.

Sheila Fleming
Graduate student, University of Texas at Arlington
Educational Leadership and Policy Studies
Sheila.Fleming@mavs.uta.edu