5-2015

Kaleidoscopic View of Voices Shaping Female and Male Adolescents' Dynamic Mathematics Identity within Single-Sex and Coeducational Environments

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KALEIDOSCOPIC VIEW OF VOICES SHAPING FEMALE AND MALE ADOLESCENTS' DYNAMIC MATHEMATICS IDENTITY WITHIN SINGLE-SEX AND COEDUCATIONAL ENVIRONMENTS

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Curriculum and Instruction

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by
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April 2015

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ABSTRACT

With amendments made to the Title IX legislation in 2006, public schools in the United States were permitted to establish single-sex classes as an option for students to enroll voluntarily. Yet, our understanding of how single-sex mathematics classes affect female and male adolescent students in the United States is sparse. The purpose of this study is to contribute to this limited body of scholarship by gaining insights into the similarities and differences in how middle grade female and male students' narrate their mathematics identity within a single-sex and coeducational mathematics classrooms, as well as how class type may be shaping these adolescents' mathematics identity. Grounded in the theoretical work of Gilligan (1982), Bakhtin (1981, 1986) and Evans (2008), students' mathematics identities were understood as being composed of an interplay of "voices," voices vying for audibility (Evans, 2008), and moving in and out of one another while simultaneously shaping each participant's mathematics identity, similar to that viewed at the opening end of a kaleidoscope. Results support the notion that mathematics identity is a complex and individualistic construct. Yet, in considering participants' voices as distinct entities, it appears as though they are more similar than different. But participants in this study must make sense of their multiple voices, their mathematics identity, within the broader context of society and the classroom setting, external influences shaping how they perceive and narrate themselves as mathematics students. One such factor is the class type (single-sex or coeducational), which appears to be shaping some of the participants' mathematics identity in this study.

DEDICATION

To women and men, girls and boys, who feel “voiceless” in respects to their education and suppressed in expressing who they are as learners of mathematics.

ACKNOWLEDGMENTS

Some may argue that one's dissertation is a lonely process. I would argue otherwise. I have lived and formed relationships with my participants through my data. I have additionally lived with the insights and living words of my committee members – Drs. S. Megan Che, Cassie Quigley, William Bridges, Nicole Bannister, and Diane Perpich – of which each has informed my work in unique ways. Dr. Megan Che, my advisor and committee chair, I thank you for challenging my narrowed views of the world by opening my eyes to the experiences and ideas of others, which has invoked in me a deeper appreciation and well-rounded understanding of the world, and for providing me the space to develop as a researcher. Dr. Cassie Quigley, I thank you for introducing me to narrative inquiry, for informing my member checking process, and for pushing me forward in moments of uncertainty. Dr. William Bridges, I thank you for your patience and assistance throughout my scholarly work on single-sex education. Dr. Nicole Bannister, I thank you for your guidance, support, and perspective as a new faculty member and colleague throughout my work, as well as for your positive attitude, which was, and continues to be, uplifting. Dr. Diane Perpich, I thank you for your guidance in developing my theoretical framework and for your interest in my work.

I thank each participant in my study. Thank you for sharing your experiences and thoughts and for allowing me the opportunity to share your narratives of who you are as mathematics students. I thank Ms. Ely and Ms. Mole for allowing me into their classrooms and supporting my work. And finally, I thank my parents for their hand in my successes, for their encouragement, and for their love.

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CHAPTER 1

INTRODUCTION

“There's really no such thing as the 'voiceless'. There are only the deliberately silenced, or the preferably unheard.” -Arundhati Roy

Introduction

I get the question wrong
I feel embarrassed
I didn’t do
I got confused
I was confusing myself
I am not
I got it wrong
I got really mad
I felt very embarrassed

I think
I would make more friends
I wouldn’t get as teased
I could possibly learn better
I could possibly concentrate
I would pick an all girls class

I just do math
I get it
I feel good
I get questions right
I am really good
I am quick at learning
I get it quick
I am quick
I think I am quick
I get right on the ball
I guess I am smart
I try to pay attention
I do make good grades
I listen
I get good grades

What voice or voices do you hear? Whose voice or voices do you hear? What emotions do these I-poems invoke in you as a reader? What resonates with you as a former mathematics student, an educator, or even as a parent? These I-poems are representative of *a* female student enrolled in a 7th grade coeducational mathematics class. They represent her as a mathematics student as narrated and voiced by her and through her own understanding of herself and her actions. Likened to what one may view at the end of a kaleidoscope, her mathematics identity is complex, dynamic, and emergent, and set within a public coeducational middle school in which single-sex mathematics classrooms are an option.

Research Questions

In this exploratory study, I seek to uncover and understand adolescent students' dynamic mathematics identity enrolled in either a single-sex mathematics classroom or a coeducational mathematics classroom within the same public middle school. The first research question, and subsequent questions, for this study are exploratory in nature. The second research question is to privilege the narratives and voices of each participant in this study.

1. How, if any, might classroom type (i.e., an all-female, an all-male, and coeducational) shape female and male students dynamic mathematics identity?
    a. What voices shape the mathematics identities of the female and male students?
    b. How might these voices be similar and different between and across sex and class type (i.e., an all-female, an all-male, and coeducational)?

2. How might the interplay of multiple voices embody female and male's dynamic mathematics identity?

The notion of "voice" and the concept of a dynamic mathematics identity are discussed in detail below.

Theoretical Framework

In this study, "voice" is the basic unit for understanding one's emerging mathematics identity. One's physical voice is an instrument of expression, grounded in language (Bakhtin, 1981, 1986), and representative of one's "self" (Evans, 2013; Gilligan, 2011). Voice is a "speaking personality" or a "speaking consciousness" (Holquist & Emerson, 1981, p. 434). It is a "pathway that brings the inner psychic world of feelings and thoughts out into the open air of relationship where it can be heard by oneself and by other people" (Brown & Gilligan, 1992, p. 20). A voice may be macro (e.g., a nation or societal stereotypes) or micro (e.g., identity or family) social structures or more than likely an interplay between the two (Evans, 2013). As argued by Evans (2013), we, our identity, *are* not composed of our voices, but we are continuously *becoming* our voices. We are shedding previous voices and establishing new voices. Through transformation of language into voices, we make our identities known. "[L]anguage becomes dialogue, and subjects become voices. In other words, voices are never merely persons talking to one another; rather, they are the vocal forces that provide us with our ever so clamorous lives [identities]" (Evans, 2013, p. 162).

Beginning with the work of Gilligan (1982, 2011), a care-focused feminist (Tong, 2008), her goal was to challenge human development theories that omitted the experience

and development of women, which portrayed men as human and positioned women as different. She argued that psychological theorists such as Freud, Erik Erickson, Piaget, and Lawrence Kohlberg relied on male norms of behavior as opposed to human (female and male) norms of behavior to develop standards of psychological expectations. Not only were these theorists' work derived from studying the lives of males, but was interpreted through the minds of males. The result was women being viewed as less morally developed than men; something was wrong with women since they deviated from the male norm. Thus, men were positioned as the dominant gender and women as the subordinate gender. Such a view has predominately been a taken-for-granted assumption within numerous cultures and have become tied to enactment of "appropriate" gender roles (Gilligan, 2011), leaving men and women, boys and girls, feeling pressured to conform and to reject their "true" sense of self, leading to a loss of voice and at times of doubling of voice to fit both gender worlds.

To counter, Gilligan (1982) argued that the voice of women was missing from the developmental work of the theorists, and once this voice was accounted for, it would challenge the belief that men and women are morally different. Using her own empirical research, Gilligan (1982; Tong, 2008) illustrated how Lawrence Kohlberg's six stages of moral judgment from childhood to adulthood, developed after his work with 84 boys, was flawed in regards to women's moral development. Through his work, women did not morally proceed past stage three (Gilligan, 1982), "the interpersonal concordance or 'good boy-nice girl' orientation" (Kohlberg, 1969). This stage is conceived in terms of interpersonal terms, helping and pleasing others so to avoid their disapproval (i.e., ethic

of care). Traits deemed "good" for women to possess, yet position them as subordinate to men. The latter three stages of Kohlberg's six stages of moral development are concerned with "doing one's duty" as to uphold the laws, principles, and social order for the welfare of the public (Kohlberg, 1969). Characteristics attributed to men (i.e., ethic of justice).

Yet as stated by Gilligan (2011) it is absurd to assume that males do not care and women are not concerned with issues of justice. In a democratic society, both justice and care are human ethics and neither men nor women should be viewed as the morally inferior gender. In embracing the different voice omitted from moral development theories, new conclusions can be drawn that are applicable to women and men, voices will complement one another rather than oppose one another. In other words, gender lines become blurred and the either/or perspective common to most worldviews may begin to dissipate.

For Bakhtin, unlike Gilligan (1982, 2011) who embraced and accounted for two voices (i.e., ethic of care and the ethic of justice), he assumed that individuals have two voices in which one voice speaks *through* another; in which a voice does not exists in complete isolation from other voices (Wertsch, 1991). Bakhtin (1981, 1986) argued that individuals words and utterances are not their own, but partly someone else's. Individuals are dependent on the words and utterances of others, constructed and orchestrated from a collection of social relations, dialogues, and experiences.

> Our speech [voice], that is, all our utterances (including creative works), is filled with others' words, varying degrees of otherness or varying degrees of "our-own-ness," varying degrees of awareness and detachment. These words of others carry

> with them their own expression, their own evaluative tone, which we assimilate, rework, and re-accentuate. (Bakhtin, 1986, p. 89)

At the most basic level is the living word, whose meaning can only be shaped once produced by a voice in dialogical exchanges between two or more individuals, a speaker and a listener (Bakhtin, 1981, 1986). The living word has more than one meaning and is saturated with others' viewpoints, value judgments, and shared thoughts. It has already been articulated, disputed, and evaluated in various ways throughout history. Yet once the living word enters a tension-filled environment, as it is assimilated through one's internal persuasive discourse, the living word does not remain in an isolated and barren state. It becomes "half-ours and half-someone else's" (Bakhtin, 1981, p. 345). As a broad example, to make sense of the technical vocabulary of mathematics, words as defined within a dictionary, students transform the meaning of these words through use of their vernacular or everyday language. Within this transformation, students may take on the voice of an "expert" in the mathematics classroom; or on the other hand, students may take on the voice of a "dimwit" in the mathematics classroom (Roth, 2009). More specifically within this study, the living word was being shaped and transformed between researcher and participant rather than between or among members of the mathematics classroom.

Similar to the living word, language is not static and unitary, but an overabundance of social languages (e.g., professional, age group, regional) coexisting and intersecting with one another in many different ways (Bakhtin, 1981). The intersection of these social languages are explained by Bakhtin's (1981) discussion of

hybridization, defined as a "mixture of two social languages within the limits of a single utterance, an encounter, within the arena of an utterance, between two different linguistic consciousnesses, separated from one another by an epoch, by social differentiation or by some other factor" (p. 358). Take the following quote from a participant as an example, "I do feel like I deserve what I get because what I put into it is what I get out of it. And if I don't study, it's my own fault." This statement can be viewed within a social language of a student, but also within a social language of an adult such as a parent or a coach. The living words and social languages of others are simultaneously the words and social languages of one's own, and their respective and varying meanings become intertwined within one's voice(s) (Wertsch, 1991).This idea is important for recognizing voice as a dynamic hybrid of voices living within one another (Evans, 2008).

Expanding on Bakhtin's notion of hybridization, Evans (2008, 2013) argued for one voice, our "lead voice," which is the voice we "immediately and pervasively identify" (Evans, 2008, p. 193). It is a hybrid of voices composed of *all* societal influences, voices of others that affect who we are, our identity. These many voices are vying against one another for audibility and are constantly in interplay with one another as we reject some voices and accept other voices. Within this interplay, one may produce a new voice (Evans, 2008), which will change all other voices; and hence, alter one's identity. Likewise, as one's voices are shot through with the voices of others, one's identity is shot through with the identity of others. In light of the work of Gilligan (1982, 2013), one may consider how the voices and identity of males are shot through with the voices and identity of females, and vice-versa (Adair, 2012).

Also pertinent to this study is the consideration of how students "lead voice" may be silenced by a dominant, patriarchal voice claiming for instance that "girls are bad at math" (Evans, personal communication, February 26, 2014). Evans (2013) referred to this dominant voice in society as an oracle, "a voice that is raised to the level of a universal and necessary truth, as the one true God, the pure race, or any other non-revisable discourse" (p. 170). Not only do oracles diminish the audibility of other voices by elevating fear and hatred of voices that differ from their basic doctrines, but prevents the creation of new voices. This is similar to Bakhtin's (1981) notion of authoritative discourse, defined as "the *word* [emphasis added] of a father, of adults and of teachers" (Bakhtin, 1981, p. 342). It imposes an innate, authoritative position that has been historically acknowledged and accepted. This authoritative discourse, as Bakhtin (1981) argued is not only complete, static, and dead, but has a single meaning and "demands our unconditional allegiance" (p. 343). In a mathematics classroom, this may be the word of the "expert" teacher, the curriculum, or the field of mathematics based on the modernistic perspective of scientific truths and of mathematics as a male domain. This is further supported by the moral development work conducted by Gilligan (1982, 2011) in which girls and women were silenced by their patriarchal counterpart.

In summary, I employ three theoretical perspectives in developing the framework for the analysis of female and male's dynamic mathematics identity as composed of their narrated "voices."

1. The work of Gilligan (1982) emphasized that of the missing *voice* from human development theories, the voice of women. Thus, the voices of

adolescent *females* and males are accounted for in this study, not to position one gender as inferior to the other, but to challenge how students may be viewed by a historical belief that mathematics is more suitable for males than females. Additionally, the voices of *students* are acknowledged, voices that are typically silenced by institutional policies and teachers to name a few.

2. Through the cumulative work of Bakhtin (1981, 1986), it can be argued that one's voice(s) is composed of and shaped by the words, utterances, and social languages of others that have lived before us and that presently live with us, yet are transformed from within the consciousness of an individual.
3. Evans (2008) provided a viewpoint from which to examine a hybrid of voices, which are in interplay with one another, moving in and out of one another while shaping one's mathematics identity.

Mathematics Identity

Identity in general is an abstract and complex construct and identity in regards to mathematics education is no different (Cobb, Gresalfi, & Hodge, 2009; Roesken, Hannula, & Pehkonen, 2011), and often an overlooked factor in learning mathematics (Bishop, 2012). In this study, similar to the work of other mathematics researchers (Baron, Bell, Corson, Kostina-Ritchey, & Frederick, 2012; Bishop, 2012; Jilk, 2010; Wood, 2013), identity is viewed as sociocultural and discursive in nature. A sociocultural view places identity formation within the global and local context of participation in one's everyday experiences in the world (e.g., Wenger, 1998). Those concerned with studying identity on a broader level are apprehensive with how social, political,

institutional, and historical events influence the enactment of identity (Bucholtz & Hall, 2005, Gee, 2001; Holland, Lachicotte Jr., Skinner, & Cain, 1998; Horn, 2008). In mathematics education, this work has focused on such aspects as sexuality, gender, race, and ability grouping (Epstein & Johnson, 2008; Martin, 2000; Solomon, 2007a). Within this study, one's gender may influence how students perceive themselves as doers of mathematics. At a local level, researchers are more concerned with how identity is enacted within smaller contexts such as classrooms, as a member of a community, or as part of a social interaction (Leander, 2002; Walshaw, 2013; Wenger, 1998; Wood, 2013).

Another view posits identity as being enacted through language and discursive practices (e.g., Gee, 2011). Sfard and Prusak (2005) view one's identity as the narrative itself. One's collection of stories is her or his identity. In other words, we become our stories (McLean, Pasupathi, & Pals, 2007). Others view identity as being represented in narratives (Boylan & Povey, 2009; Davis, 2008; Polkinghorne, 1988; Somers, 1994). One's narratives serve as a lens into how he or she makes sense of the world and provides others a window into individual's lives and identities. Within every dialogic exchange, individuals seek to "shape a particular identity in the mind of his or her audience" (Markus & Wurf, 1987, p. 325). Utilizing interviews to elicit participants' narratives on various aspects of mathematics and their mathematics classroom, I too contend that I can gain an understanding of how participants' view themselves and make sense of their participation and identity enactment within a local context, one's mathematical classroom, whether single-sex or coeducational, as participants' voices are grounded in a geographical place (Evans, 2008).

This study will add to the current literature of mathematics identity by considering how mathematics class type (i.e. all-female, all-male, and coeducation) may influence male and female student's dynamic mathematics identity. Drawing on the definition of Martin (2000) and Bishop (2012), I define mathematics identity as a belief or a view that an individual has about him or herself in regards to mathematics at a micro- and a macro-level. Similar to the view that *identity* is not static, but multiple and dynamic, and are shaped and reshaped within the environment, within interactions with others, and at times within a single lesson (Bishop, 2012; Gee, 2001; Wood, 2013), I argue that one's *voice* or *voices* are multiple, dynamic, and constantly in flux. The voices are imbued with the words and utterances of others, constructed and orchestrated from a collection of social relations and experiences (Bakhtin, 1981; Evans, 2008). In the context of this study, these may include teachers, parents, peers, administrators, and mathematics as a curriculum. These voices constitutes a single self, a single identity, and may lead to a "thickening of identity" (Burke, 2003; Holland & Lave, 2001; Wortham, 2004), the process in which an individual's voices becomes increasingly united over a period of time to form one's identity, and in some cases, "act as self-fulfilling prophecies" (Sfard & Prusak, 2005, p. 19). In regards to this study, one's mathematics identity in a single-sex or coeducational classroom may become solidified and may become associated within taken-for-granted assumptions and characteristics such as a voice saying, "Because I am a girl, I am not a math person" (Mendick, 2005, 2006).

Kaleidoscopic View of Mathematics Identity

To help make sense of the complexity of one's mathematics identity, I view this construct as a kaleidoscope. In what follows, I will deconstruct the various parts of a kaleidoscope and discuss how it relates to and forms my understanding of one's mathematics identity. To begin, at one end of the kaleidoscope is an opening hole that is used for viewing. The individual looking through the open hole is influenced by his or her own lens, beliefs, culture, historical background, and role; and thus, determines what is viewed at the other end of the kaleidoscope. For example, a researcher will more than likely view one's mathematics identity differently than a parent or a teacher. In addition, what a viewer sees of one's mathematics identity is limited or bound by the viewing tube, which is a long narrow tube composed of three strips of mirrors. I liken this to tunnel vision in that one cannot extend what they see beyond the walls of the viewing tube.

Another feature of a kaleidoscope is the turning mechanism, which alters and manipulates what one views with each slight shift and is controlled by a viewer's hand or in this context, controlled by the various voices of others (Bakhtin, 1981). In other words, this feature represents the different external influences, words, and social languages that students transform into one's own voice(s) through "her or his [sic] own intention, her or his own accent" (Bakhtin, 1981, p. 293), which in turn shapes students' mathematics identity at any particular moment in time. These external factors may include, but are not limited to, the voice of society, the voice of a teacher, the voice of a family member, or the voice of mathematics as a static body of knowledge.

At the other end of the opening hole is the object box that typically holds various colors of beads, glass, or other reflective and transparent material. The object box for me is a mere reflection of one's "true" mathematics identity as reflected from mirrors contained within the viewing tube and will never reflect the same exact image or mathematics identity twice. Therefore, the viewer is only able to capture one's mathematics identity in one brief moment in time as the voices composing that identity are in interplay with one another, constantly moving in and out of one another in fluid motion as new voices are given audibility and other voices are muted (Evans, 2008). In addition, light is a necessity to view the image at the end of the kaleidoscope, whether situated outside in the sunlight or in a well-lit room. In a similar fashion, the viewer is unable to glimpse one's mathematics identity in darkness. In this study, light symbolizes the setting in which one's mathematics identity is being viewed and formed, whether a single-sex mathematics classroom or a coeducational mathematics classroom. One's mathematics identity does not only develop and anchor themselves within these classroom types, but also reciprocally shape and establish these classrooms (Evans, 2008).

Rationale

The rationale for conducting this study is three-fold. One, it can be argued that factors such as self-concept, motivation, mathematics achievement, and classroom interactions may influence how female and male students perceive themselves as learners of mathematics (Axelsson, 2009), which reciprocally influence how they may or may not participate within a mathematics classroom (Nasir, 2002; Nasir & Hand, 2008). Recently,

researchers (Boaler, 1999; Boaler & Greeno, 2000; Cobb et al., 2009; Goos, 2004; Horn, 2008) have examined students' perceptions of what it means to be a doer of mathematics within a traditional mathematics classroom versus a reform mathematics classroom. Within a mathematics classroom, regardless of class type, these two variations in approaches to teaching directly or indirectly shape the perceptions, experiences, and voices of students, as well as how they identify themselves as a mathematics student. The implicit and explicit norms in a classroom may shape adolescents' voices as mathematics learners as being competent or non-competent (Cobb et al., 2009) or as *being* the smart one versus *being* the dumb one (Bishop, 2012); as viewing and labeling themselves and others as "good" or "bad" at mathematics (Hodgen & Marks, 2009; Solomon, 2007a).

In examining the intersection between how one perceives and voices his or herself mathematically and the gendering of being/doing good at mathematics, Mendick (2005, 2006) discovered that male and female students tend to position themselves and to be positioned by others into a gendered masculine-feminine dichotomy. This dichotomy parallels the two extremes of being identified as good at mathematics and as not being good at mathematics, respectively. Some of the binary oppositions voiced by students included fast/slow, competitive/collaborative, active/passive, naturally able/hardworking, and reason/calculation (Mendick, 2005, 2006). The researcher contributed the distinct characteristics of what constitutes someone good at mathematics to popular culture and media, and is concerned that little has changed in the historical gendering views of mathematics as a male field in present day students. This historical belief has in return made females mathematics students feel "invisible" (Rodd & Bartholomew, 2006),

excluded (Solomon, 2007b), and marginalized (Solomon, 2007a), all similar adjectives indicating a lack of participation and a missing voice in a male dominated "math club" (Bartholomew, Darragh, Ell, & Saunders, 2011). Together, these studies insinuate that male and female students, regardless of age, class type, or mathematics curriculum, may form their mathematics identity based on the visible marker of gender (Jones & McEwen, 2000).

Two, with the passing of the No Child Left Behind Act in 2001 in which Congress approved public schools to offer innovative programs including "same-gender schools and classrooms, consistent with applicable law" (as cited in Salomone, 2006, p. 779), the visible marker of gender is more prevalent and may shape how students' form and voice their mathematics identity differently than what has previously been documented in research. This was followed by the passing of revised regulations of Title IX legislation on November 24, 2006, which stated that schools were permitted to establish single-sex classes to "provide a diversity of educational options to parents and students and to meet the particular, identified educational needs of students" (United States Department of Education [USDOE], 2006, p. 62530). Furthermore, the regulation required classes and schools to identify and meet the "educational needs of students of both sexes…evidenced by limited or deficient educational achievement" (USDOE, 2006, p. 62535). Due to these two policy changes, the United States saw a proliferation in the number of states implementing single-sex schooling options (National Association for Single Sex Public Education [NASSPE], 2013). In the 2010-2011 school year, states across the United States offered single-sex or single-gender classes (used interchangeably

based on state policy or initiatives) within approximately 524 schools (150 elementary, 188 middle, and 186 high schools) ranging from physical education classes to mathematics classes to English classes (Office of Civil Rights, 2014). Yet in many instances, policy makers and administrators implement single-sex classes without including the perspectives and voices of those most affected – students (Kombe, Kingree, & Che, 2014).

And relying solely on "evidence-based" research (St. Pierre, 2006), or even personal ideologies and gendered personal and historical experiences, have led to several arguments for and against single-sex education (Bigler, Hayes, & Liben, 2014; Bigler & Signorella, 2011; Mael, Smith, Alonso, Rogers, & Gibson, 2004; Pahlke, Bigler, & Patterson, 2014). For example, proponents argue that single-sex education may decrease gender inequities in the classroom, promote an atmosphere of academic learning, and diminish distractions for male and female students. On the other hand, opponents contend that single-sex education does not prepare students for society, reinforce traditional gendered stereotypes, and is too expensive and wasteful.

In the United States, part of the argument for single-sex education is to remove distractions from the opposite sex as a means to increase students' focus on learning. A notion is that adolescents create a culture focused on how they look and not on academic attainment. Mael (1998) refers to this as "the rating and dating" culture. In his study of adolescent society in ten high schools in the United States, Coleman too asserted, "Boys and girls together distract each other. Whether this distraction takes the form of dressing to impress the other gender, competition for teacher time and attention, or sexual

harassment, there is no question that distractions exist" (as cited in Streitmatter, 1999, p. 36). Girls and boys too confirmed that having class with members of the opposite sex is distracting and being enrolled in single-sex classes afforded them the opportunity to focus on their work (Streitmatter, 2002). In general, the girls perceived the boys to be an academic barrier to their success as students, while boys perceived the girls to be a sexual distraction. It has even been noted by Smithers and Robinson (2006) that some schools advocate for students to be educated together in the elementary and high school years, but educated separately during the middle years. And even though no reasons for this "diamond" pattern where given, one may rely on research to speculate as to why.

The third rationale for conducting this study is grounded in the scholarly research in middle school settings, which has been described as the "beginning of a downward spiral" (Eccles & Midgley, 1990, p. 134). Students transition to a middle school is met with a more complex schedule, more rules and procedures, more students, a shift to a departmental program of several teachers (Weldy, 1995), and an increase in academic pressures (Cleary & Chen, 2009). Drawing upon the Pearson-Environment Fit theory, Eccles and Midgley (1990) argued that the middle school environment poses a possible mismatch between various students' psychological needs such as academic motivation and self-perceptions and the organizational characteristics of the school itself. This structural change in students' social environment was considered by Eccles and Midgley (1990) as the most powerful explanation for middle grade students decline various aspects such as academic achievement (Alspaugh, 1998), attendance (Balfanz, Herzog, & MacIver, 2007), self-regulatory strategies and behavior (Cleary & Chen, 2009), self-

perceptions, (Eccles & Wigfield, 1997; Wigfield, Eccles, Mac Iver, Reuman, & Midgley, 1991), intrinsic motivation, and interest in schools (Eccles &Wigfeld, 1997). Beyond the change in environment, students at this age are also experiencing hormonal and physical changes of puberty, a desire to be accepted by their peers and participation in peer-related activities, and a heightened awareness of how one looks (Eccles & Wigfeld, 1997).

In regards to mathematics during this time period, research has shown a decline in students' self-concept (Ma & Kishor, 1997; Wigfeld et al., 1991), self-confidence (Eccles & Midgley, 1990), interests in mathematics (Cleary & Chen, 2009; Eccles & Midgley, 1990; Wigfeld et al., 1991), and perceived value of mathematics for their future (Cleary & Chen, 2009). These deteriorations in affective variables may negatively shape middle school students mathematics identities, attitudes toward mathematics, as well as impede students' mathematical achievement (Ma & Kishor, 1997).

CHAPTER 2

REVIEW OF RELATED LITERATURE

The scholarly research to date on single-sex education is still evolving in that validated and replicable results in single-sex education have yet to transpire and is fraught with methodological issues, including lack of randomization and lack of controls for variable such as socioeconomic status or ethnicity (Arms, 2007; Pahlke, Hyde, & Allison, 2014). Additionally, the majority of the research has been conducted in countries other than the United States, such as England (e.g., Sullivan, 2009) and Belgium (e.g., Brutsaert & Houtte, 2002, 2004), where single-sex education has been historically established. Furthermore, the majority of the studies examine single-sex education within private school settings (e.g., Lee & Marks, 1990; LePore & Warren, 1997) rather than within single-sex classrooms within a public coeducational school; leading to inappropriate comparisons and generalizations (Arms, 2007). Lastly, the variables studied range anywhere from academic achievement (e.g., Lee & Bryk, 1986) to delinquency (e.g., Caspi, 1995) to homework completion (e.g., Marsh, 1991). This makes it difficult to summarize the findings or to gain a clear understanding of single-sex education to either support or oppose single-sex schooling.

> It is hard to be particularly confident about what can be learned from the available data. Most of the outcomes are not consistently found even when fairly strict controls are applied to the quality of the research. Most areas have some contradictory findings, and even those that don't are not wholly consistent. For

> instance, three of the seven studies on self-concept fund positive outcomes for girls, but four found no significant outcomes. (Bracey, 2006, p. 37)

Furthermore, the research variables are typically examined through quantitative measures such as achievement on standardized tests (e.g., Belcher, Frey, & Yankeelov, 2006) or attitudinal surveys (e.g., Brown & Ronau, 2012). Tests and instruments in which participants may manipulate the results so to be a part of a study (or not) or answer in such a way as to provide the researcher with expected results (Shadish, Cook, & Campbell, 2002). To support this claim, consider the following quote from one of the participants' in my study. "I mean on the survey, I was not trying to sound sexist. That's why I tried to like even out as much as I could" (Colin/P9/L39-40). The majority of scholarly research on single-sex education is focused on the end product and not on the daily student-student or student-teacher interactions, students' learning process, or students' experiences. However, there are exceptions. For instance, Che, Wiegert, and Threlkeld (2011) examined the different mathematical strategies of girls and boys enrolled in single-sex mathematics classrooms when solving a proportional reasoning word problem. The researchers were less concerned with whether the answer to the word problem was correct.

An additional problem within the field of research pertinent to this study is the lack of an explicit definition of researchers' use of the term gender; therefore, in many instances the concept of sex and gender are used synonymously (Damarin & Erchick, 2010; Glasser & Smith, 2008). This is also the case in regards to single-sex/single-gender education. For example, states may name such an initiative as a single-gender program,

yet separate students based on their biological orientation or their sex. Therefore, in many instances, it is up to the reader to interpret the researcher's meaning of gender, which I argue is not void of the reader's own definition of gender. While reading this manuscript, please keep this in mind as I draw upon the work of others and their lack of clarifying how they define gender. Personally, I define sex as one's biological foundation, male, female, or hermaphrodite. Therefore, the sex of an individual is a stable category that is often used to sort people (Bem, 1981; Glasser & Smith, 2008). I define gender as a performative act constantly in flux, a construction of gender through discursive interactions (Butler, 2004); yet also dependent on the local and differing communities of practice that one participates (Paechter, 2003, 2007).

In what follows, I present the most pertinent scholarship in relation to this study, which includes research in single-sex education settings in mathematics, as well as in other subject areas. But I also include relevant research on gender differences in mathematics, which has been offered as a reason for supporting the implementation of single-sex education (Bigler, Hayes, & Liben, 2014; Mael et al., 2004). The literature is presented as (a) gendered studies in single-sex settings, (b) gendered stereotypes and classroom interactions, (c) mathematics as a male domain, and (d) mathematics attitude and affect. Further, I made an effort to use the terms sex and gender as to mirror that of the researchers' scholarship discussed below.

Gendered Studies in Single-Sex Settings

As noted above, concerns have been raised as to whether separating students by sex perpetuate gendered stereotypes or break down typical gendered stereotypes.

Presently, there are little rigorous studies in single-sex mathematics classrooms to answer this question. However, the scholarly work of other researchers in other subject areas (e.g., science) and within different contexts (e.g., summer camps) could potentially impact future decisions and debates on the advantages or disadvantages of educating males or females together or separately.

Lee, Marks, and Bryd (1994), for instance, investigated how engenderment sexism, or socialization to gender, operated in independent single-sex and coeducational schools. Through survey questionnaires, school records, interviews, classroom observations, field notes, and documents supplied by the schools, the researchers concluded that the dominant form of sexism in single-sex schools was gender reinforcement, which was defined as the perception of the typical female and male behaviors or styles held by society. The researchers determined the dominant form of sexism in coeducational schools was gender dominance or the stance that males are superior to females. Additionally, the researchers inferred that the severest form of sexism was present in the single-sex all-boys schools. This conclusion was stated after noting such sexist incidents as visual displays of women's bodies, teachers' encouragement and engagement in active stereotyping, and the use of offensive and uncensored sexist language.

Other studies (Fabes, Pahlke, Martin, & Hanish, 2013; Glasser, 2012; Goodkind, Schelbe, Joseph, Beers, & Pinsky, 2013) have concluded that a middle school single-sex setting may reinforce and reify gender differences, the notion that boys and girls are on opposite ends of the gender dichotomy. For instance, Glasser (2012) examined how

teachers, students, and course descriptions in a public middle school single-sex science setting positioned the male and female students relative to one another. Glasser inferred that the girls in the public middle school were positioned hierarchically above the males as noted by how the teachers and students talked about the boys. The boys were viewed as lagging behind the girls, not hearing as well as the girls, more obnoxious than the girls, and as more of a distraction than the girls. Interestingly, as noted by the author, the boys may have been "positioned as deficient and needing help, [but] the girls might have been disadvantaged in some ways by being backgrounded and silenced relative to the boys' needs and behaviors" (p. 394).

An another example, Fabes and colleagues (2013) examined whether being enrolled in a gender-segregated class would increase 7th grade students, both girls and boys, tendency to reinforce gendered stereotypes such as boys are better at mathematics and girls are better in language arts. Results suggested that being enrolled in gender-segregated classes increased the likelihood that participants would respond in a stereotypic manner, and such gendered responses would increase by 14% with each additional gender-segregated class.

Gendered Stereotypes

Yet, the school culture, and more specifically the classroom setting, is not devoid from the wider societal beliefs that gender differences do exist; that males are the dominant group and females are the subordinate group (Dalley-Trim, 2007; Teixeira, Villani, & Nascimento, 2008). For example, boys were observed providing verbal assaults on other boys in the class, as well as exhibiting sexualized discourse and a

"predatory attitude" towards the girls (Dalley-Trim, 2007). This display of hegemonic masculinity (Connell, 1995) served to marginalize the female students, as well as male students deemed as "other", and the classroom setting perpetuated this feeling of dominance among the male participants.

Additionally, teachers may serve to maintain these erroneous beliefs in societal gender differences (Eliot, 2011; Morris, 2012), at times unknowingly (Garrahy, 2001), by perceiving and characterizing boys and girls differently, which place boys and girls on opposite poles of the binary continuum. It was suggested that boys may be viewed by teachers as more interesting and livelier in discussions (Warrington & Younger, 2000); more prominent (BenTsvi-Mayer et al., 1989); disorderly, unmotivated, and easily distracted by girls (Morris, 2009; Younger, Warrington, & Williams, 1999), and as challenging classroom authority (DeCastro-Ambrosetti & Cho, 2011). Girls, on the other hand, may be viewed by teachers as more committed, conscientious, and mature (Morris, 2012; Warrington & Younger, 2000); more organized, better equipped to conform to the demands of school (Morris, 2012; Younger et al., 1999); and possessing better social skills (BenTsvi-Mayer et al., 1989).

Perceptions of gender differences are not only unique to teachers in a classroom setting, but students too tend to position themselves within "appropriate" gender roles held by society at large, with females and males on opposite end of the continuum, namely feminine/masculine traits (e.g., Mendick, 2005, 2006). Skelton et al. (2009) alluded through interviewing 307 seven and eight year olds that boys talked about themselves as having control, public knowledge, and authority within the classroom.

Conversely, the girls talked about themselves within characteristics of body, caring, and emotional attributes. Such gender positioning has led to the notion that "[i]t is better to be a boy in these schools than to be a girl," which was an assertion stated after surveying 440 sixth through ninth grade students on the best and worst things about being a boy and a girl (Zittleman, 2007, p. 78). Moreover, as themes from the open-ended responses on the survey administered by Zittleman indicated, adolescent male and female students associated the best things about being a boy with masculine traits such as playing sports, strength, and entitlement, while the best things about being a girl were associated with such feminine traits as appearance, blameless, and emotional expressiveness. These results are similar to the findings by Skelton and colleagues (2009).

The impact of the gender of the teacher on boys and girls in the classroom has also been examined by researchers. There is not an overwhelming amount of evidence that determined that students taught by the same gender teacher performed academically higher (Carrington, Tymss, & Merrell, 2008; Dee, 2007; Helbig, 2012). Dee (2007) looked specifically at the impact of having a female teacher by subject area. But considering the subject area of mathematics, girls and boys were discovered to score statistically lower on mathematics tests when taught by a female teacher as compared to a male teacher, and that in general boys did not look forward to a mathematics class taught by a female teacher. However, it was noted that both boys and girls are more apt to exhibit positive attitudes toward school when taught by a female teacher (Carrington et al., 2008), as well as express a belief that they had better relationships with female teachers than male teachers (Marsh, Cheng, & Martin, 2008).

Division of Attention and Classroom Interactions

But moving beyond gendered perceptions of teachers and students, research findings consistently show that teachers' interactions with students favor male students (Einarsson & Granström, 2002), or in other words, "facilitates male-centredness in classrooms" (Liu, 2006, pg. 429). As Lindroos (1995) and Younger & Warrington (1996) concluded, teachers' style and attitude influence classroom interactions. For example, in a student-centered coeducational classroom setting, a female teacher created a marginalized space by creating two discursive spaces, one for the boys and another for the girls (Lindroos, 1995). Through observation, Lindroos (1995) documented that the teacher interrupted the boys less and employed a conversational style of discourse. The girls, on the other hand, were interrupted often by the teacher, as well as other students; and as expressed by the researcher, the teacher seemed eager to do the work for the girls and fashioned the girls within a marginal position within the classroom. Further, Younger & Warrington (1996) determined through the voices of students that teachers' attitude toward masculinity and femininity traits impacted the teacher-student interactions. For example, students discussed how teachers provided more positive attention to girls, as well as being more tolerant of girls than boys.

Additionally, in a meta-analysis conducted by Jones and Dindia (2004), the authors claimed from thirty-two empirical studies from 1970 to 2000 that teachers interact significantly more with boys than with girls; however, girls received more praise and males received more reprimands and critiques. Duffy, Warren, and Walsh (2001) too confirmed that teachers interact more with boys; females received more remediation

interaction than males and males received more criticism interaction than females. More specifically, teachers tend to direct more than half of their questions toward boys, and boys also accounted for a higher percentage of volunteers (Altermatt, Jovanovic, & Perry, 1998; Barba & Cardinale, 1991; Younger et al., 1999). For instance, Altermatt et al. (1998) determined that boys were asked 61% of all direct questions posed by the teacher and accounted for 63% of student volunteering, which were 1.59 male volunteers to 1.01 female volunteers per question. Barba and Cardinale (1991) went a step further, and utilizing the constructs of Bloom's Taxonomy concluded of 642 questions posed by teachers, boys were asked significantly more high-level questions (i.e., analysis, synthesis, and evaluation) than females, while girls were asked significantly more lower-level questions (i.e., knowledge, comprehension, and application) than males. To counteract teacher's overwhelming interactions with male students, Younger et al. (1999) determined that girls asked more questions during whole class discussion (70%) and individual work (59%) when compared to boys. Likewise, Barba and Cardinale (1991) ascertained that in order to gain the attention of teachers; girls raised their hands more (75%) than males (53%), which as supported by Teixeira et al. (2008) is typically done from the comfort of their own desks.

As noted above, male students dominant the classroom in regards to teacher-student interactions, but some of the attention received by male students may be due to behavior or discipline issues. A few studies noted that boys were in fact reprimanded more often than girls (Clark, Lee, Goodman, & Yacco, 2008; Duffy et al., 2001; Warrington & Younger, 2000; Younger et al., 1999). This was confirmed by BenTsvi-

Mayer et al. (1989), which concluded that teachers rated boys significantly higher in discipline problems. Differences in teachers' attention due to behavior or discipline issues are often noted by students as well. As noted by Zittleman (2007), students significantly rated the worst thing about being a boy was differential discipline treatment by teachers. In interviews conducted by Warrington and Younger (2000), female students complained that the disruptive behavior of boys had a negative effect on their learning and such behavior of boys took time away from the teacher in order to address the issues. In another study (Cullingford, 1993), boys believed they were treated unfairly by teachers because girls tended to get away with bad behavior. The boys believed they were "picked on" by the teachers, were punished more, and received fewer privileges than girls. This unfair treatment was confirmed by the girls in the study as well. On the other hand, other researchers did not conclude significant gender differences in teachers' judgments and responses to female and male students disobedient and hostile behavior (Kelter & Pope, 2012) or in teachers' impressions and responses of an appropriate or inappropriate behavioral incidents (Noltemeyer, Kunesh, Hostutler, Frato, & Sarr-Kerman, 2012).

Mathematics as a Gendered Domain

It may be inferred that the mathematical gender stereotypes at a macro (i.e. society) and micro-level of society (i.e. the classroom, the teacher, and peers) impacts how female and male students perceive of themselves as mathematics students. Consider the following statement, "I always perceive like men mathematicians with really long beards and sideburns and messy hair" (Epstein, Mendick, & Moreau, 2010, p. 53). This was a response from a female student when asked to describe her image of a

mathematician. In this study conducted by Epstein and colleagues (2010), the researchers revealed that participants aged 14-15 years typically viewed mathematicians as *male*. This is just one instance in which the field of mathematics is viewed by students as a male dominated domain. Research within mathematics education has shown that male and female students implicitly associate mathematics with males (Cvencek, Meltzoff, & Greenwald, 2011; Hyde, Fenema, Ryan, Frost, & Hopp, 1990; Nosek, Banaji, & Greenwald, 2002). For instance, on both implicit (i.e. unconscious) and explicit (i.e., conscious) association measures, boys and girls in grades one through five typically associated or equated math more often with boys than associating math with girls (Cvencek et al., 2011). This implied that young children are aware of the stereotype that "math is for boys." The researchers even determined that gender identity and math-gender stereotypes were evident in as early as first and/or second grade; thus, supporting Valian's (1998) assertion that gender schemas are developed in children prior to first grade. Students' mathematical gender biases, such as the belief that mathematics is a male domain (Hyde et al., 1990; Leedy, LaLonde, & Runk, 2003), become more important to adolescents, particularly females, as they progress through school and interact with others such as parents, teachers, and peers (Hill & Lynch, 1983). These gender-related role expectations become stronger as adolescents progress through school and potentially contribute to perceived gender differences (biases) in achievement and social domains (Muzzatti & Agnoli, 2007). Interactions with others has shown that students' mathematical gender biases, in such constructs as attitudes and achievement, may be explicitly or implicitly influenced by parents' and teachers' own expectations and

beliefs (Eccles & Jacobs, 1986; Eccles, Jacobs, & Harold, 1990; Gunderson, Ramirez, Levine, & Beilock, 2012), as well as peers mathematical attitudes and behaviors (Ryan & Patrick, 2001).

In a meta-analysis, Hyde and colleagues (1990) compiled articles written between 1967 and 1988 that utilized the Fennema-Sherman scale, which included such variables as confidence, usefulness of mathematics, and mathematics as a male domain. It was concluded that of the nine effect sizes, only one had a large effect size ($d = -0.90$), which the researchers stated, "effect sizes of this magnitude are almost unheard of in the meta-analytic literature on gender differences" (Hyde et al., 1990, pg. 310). This exception was the scale that measured the stereotyping of mathematics as a male domain, which indicated that males stereotyped math as masculine more often than females. Leedy and colleagues (2003) too confirmed that male students agreed with the notion of mathematics as a male domain statistically higher than their female counterparts did. Due to the overwhelming large effect size deduced by Hyde et al., Forgasz, Leder, and Gardner (1999) called for a reexamination of the Fennema-Sherman Mathematics as a Male Domain construct. Four studies were discussed in an article that indicated that items on the scale might no longer be valid. For example, results from one of the studies implied that men and women were viewed as equally capable in mathematics, while another determined difficulties in participants' interpretations of scale items on the Fennema-Sherman instrument.

With the development of two new instruments, *Mathematics as a Gendered Domain* and *Who and Mathematics* (Barkatsas, Forgasz, & Leder, 2001; Forgasz, Leder,

& Kloosterman, 2004), research has shown that male students perceive mathematics as a male domain, female students perceived mathematics as a neutral domain (Forgasz et al., 2004), and that older students hold stronger beliefs that mathematics is a male gendered domain than younger students (Brandell & Staberg, 2008). In examining the results from the 30 item instrument, *Who and Mathematics*, Forgasz et al. (2004) determined that there were statistically significant more gender differences ($p < .002$) found among the Australian students (13 items) than among the U.S. students (5 items). A few of the statistical significant items from Australia included having to work hard in mathematics to do well, needing mathematics to maximize future employment opportunities, and finding mathematics difficult. In the United States, examples included considering mathematics to be boring and thinking it is important to understand the work in mathematics. However, these findings are dissimilar to the conclusions of Simpson, Kombe, Che, and Bridges (2014). In this research study, female middle grade students more frequently considered mathematics as a female domain than male middle grade students, which typically considered mathematics as a neutral domain. The *Who and Mathematics* instrument was also piloted with Greek and Australian students, in which researchers (Barkatsas et al., 2002) deduced that traditional gender-stereotyped beliefs about mathematics as a male domain was a cultural dimension, one where mathematical beliefs were a reflection of a countries' societal norms, a parallel argument to the gender schema theory (Bem, 1981).

Moving forward to research studies that examined mathematical gender biases of the teacher, as opposed to teachers' general gendered stereotypes as presented above,

Helwig, Anderson, and Tindal (2001) did not detect statistical differences in teachers' ratings of boys or girls mathematical skills at the third or fifth grade level. While other studies (Riegle-Crumb & Humphries, 2012; Tiedemann, 2000, 2002) determined teachers' viewed boys as possessing statistically higher mathematics abilities than girls, and were described by teachers as more competitive, more logical, more adventurous, more independent in mathematics, volunteered more answers to mathematics problems, and enjoyed mathematics more than girls (Fennema, Peterson, Carpenter, & Lubinski, 1990). In contrast, girls were viewed by the teachers on the other end of the spectrum, namely less competitive and less logical as a few examples. It was even confirmed that teachers' attributed boys' success to talent statistically more than for girls (Fennema et al., 1990; Tiedemann, 2002), or as stated by Jungwirth (1991) that "boys 'know' and girls learn'" (p. 280). Jungwirth (1991) further concluded that boys had a tendency to dictate the "gender-related changes of interaction sequences" (p. 279) in teacher-student interactions in a mathematics classroom and that based on these interactions boys appeared more mathematically competent than girls did. He commented that the girls presented themselves in a manner of good rote learners who had no interest in mathematics outside the classroom setting.

Mathematics Attitude and Affect

In examining gender differences in mathematics attitude and affect, research suggests that boys have a positive disposition towards mathematics, which increase as boys age and progress through the school system (Hyde et al., 1990), while girls have a negative disposition towards mathematics. Studies have shown that male students believe

that mathematics is more useful and valuable (Else-Quest, Hyde, & Linn, 2010, Muzzatti & Agnoli, 2007), more enjoyable (Frenzel, Pekrun, & Goetz, 2010; Muzzatti & Agnoli, 2007), and exhibit higher levels of ego orientation or the belief that ability is a static trait (Seegers & Boekers, 1996) than female students. On the other hand, female students have reported having higher levels of mathematics anxiety from male students (Else-Quest et al., 2010; Frenzel et al., 2010), exhibit negative patterns of emotions toward mathematics such as hopelessness and shame (Frenzel et al., 2010; Stipek & Gralinski, 1991), and are less likely than male students to believe that they are good at mathematics (Lamb, 1997; McGraw, Lubienski, & Strutchens, 2006) or find mathematics as interesting (Lamb, 1997). Yet, females enrolled in a single-sex setting have been found to report lower stress levels (Brutsaert & Houtte, 2004) and a stronger sense of belonging (Brutsaert & Houtte, 2002) than females enrolled in a coeducational setting. In a study conducted by Brown and Ronau (2012) on male and female students' attitude toward mathematics, the researchers found no differences in attitude as measured by the Fennema-Sherman Mathematics Attitude Scales. This study differs from the majority of studies noted above in that Brown and Ronau (2012) examined possible differences in attitude toward mathematics based on students' enrollment in a single-gender class versus a mixed-gender class and not solely on differences between male and female students.

In exploring gender differences on various affective variables such as students' self-concept, self-esteem, and self-confidence towards mathematics, the results of the research appear to favor boys. In other words, boys have a tendency to report higher levels of assurance in their selves and in their ability to be successful in mathematics.

Consider the research on differences in boys and girls self-concept in mathematics. As stated by Bong and Skaalvik (2003), "Academic self-concept reflects an aggregated judgment or overall impression of one's competence in given academic domains" (p. 29). Researchers that examined students' self-concept based on gender, concluded that boys reported statistically higher levels than girls (Campbell & Beaudry, 1998; Else-Quest et al., 2010; Seegers & Boekers, 1996; Wilkins, 2004). Utilizing the Programme for International Student Assessment (PISA) 2003 data from 41 countries, Else-Quest and colleagues (2010) calculated the mean effect size of this difference to be 0.33, which is considered a small (d = 0.10) to medium (d = 0.50) effect size (Cohen, 1988). Furthermore, the researchers noted that in 97.4% of the countries the results were in favor of boys, with the results from the other 2.6% to be insignificant. Wilkins (2004), which used data from the Trends in International Mathematics and Science Study (TIMSS) for 41 countries, too concluded that internationally boys report statistically higher levels of self-concept than females. Wilkins (2004) also established a positive correlation (r = .11) between mathematics achievement and student level self-concept, which in the United States this correlation was r = .29. This result would suggest that students with higher self-concept in mathematics, in this case, boys as a whole, performed better on the mathematics portion of the TIMSS exam.

However, the scholarly findings that boys report possessing higher-levels of self-concept than girls cannot be supported by the research studies conducted in a single-sex setting. Of the studies that examined girls' and boys' self-concept in mathematics based on type of educational setting, a few researchers did not determine any significant

differences to favor either single-sex or coeducational settings (Marsh, 1991; Lee & Bryk, 1986; Riordan, 1990). Conversely, other studies are quiet mixed in their findings. Kessels and Hannover (2008) examined female and male's physics-related self-concept of ability. The results showed that females in a single-sex classroom reported a statistically higher self-concept of their abilities in physics than females in a coeducational classroom. Alternatively, the researchers did not conclude a significant difference for males' physics-related self-concept of ability based on enrollment in a single-sex or coeducation classroom. Sullivan (2009), on the other hand, suggested that males in coeducational settings had statistically higher self-concepts in mathematics, but no differences were noted in females mathematics self-concept based on enrollment in a single-sex or coeducational setting.

Self-esteem, in contrast to self-concept, can be defined as the "overall affective evaluation of one's own worth, value, or importance" (Blascovich & Tomaka, 1991, p. 115). In comparing girls' and boys' self-esteem, Else-quest et al. (2010) concluded that across 41 countries that participated in the PISA 2003 study, boys reported higher levels of self-esteem than girls did. The researchers calculated this difference as a mean effect size of 0.33. As noted above, this is a small to medium effect size (Cohen, 1988). The mean effect size across the countries ranged from 0.08 to 0.65 with 97.4% of the results from the 41 countries favoring males, while the remaining 2.6% of the results did not deduce any significant differences between boys and girls. However, other researchers that examined differences in self-esteem for male or female students enrolled in a single-sex and/or coeducational setting, did not conclude a statistical difference in students' self-

esteem in mathematics in grade 8, grade 10, grade 12, or from grade 8 to grade 12 (LePore & Warren, 1987) or in sixth grade male or female students' self-esteem in peer interactions (Belcher et al., 2006). Yet, Belcher and colleagues (2006), on the other hand, did infer that sixth grade students in single-sex classrooms had statistically higher levels of school-related self-esteem from students in coeducational classrooms.

Self-confidence can be defined as "students' perceptions of their ability to do well in math and to learn math quickly" (Else-Quest et al., 2010, p. 117). Studies that examined the possibility of gender differences in self-confidence are limited to studies within a coeducational setting. The results of these studies report that boys have higher self-confidence in their mathematical ability than girls (Else-Quest et al., 2010; Hyde et al., 1990; Lamb, 1997; Leedy et al., 2003; Lloyd, Walsh, & Yailagh, 2005; Morris, 2012; Muzzatti & Agnoli, 2007), but boys self-confidence may decrease as they progress from grade to grade (Muzzatti & Agnoli, 2007). Interestingly, Lloyd and colleagues (2005), as well as Morris (2012) determined that girls are under-confident and boys are over-confident relative to their mathematics achievement. To continue with findings from Else-Quest and colleagues (2010) as an example, the researchers determined that boys reported significantly higher self-confidence in mathematics than girls ($d = 0.15$). This small effect size (Cohen, 1988) was noted after analyzing results from 46 countries participating in the TIMSS 2003 exam. To date, there are no known studies that examine students' self-confidence in mathematics based on class type.

These affective variables, self-concept, self-esteem, and self-confidence, in one's mathematical ability may also impact students' motivation in learning the content

(Kloosterman, 1988), achievement levels in mathematics (Crombie, Pyke, Silverthorn, Jones, & Piccinin, 2003), and in their motivation to enroll in non-mandated mathematics courses (Lamb, 1997). In examining the differences in motivation based on one's gender, Else-Quest et al. (2010) concluded from the PISA 2003 results that boys reported statistically higher levels of intrinsic ($d = 0.20$) and extrinsic ($d = 0.24$) motivation than girls. The mean effect size across the countries for intrinsic motivation ranged from 0.01 to 0.60 with 82.1% of the results from the 41 countries favoring males, while the remaining 17.9% of the results did not deduce any significant differences between boys and girls. This indicates that in no country did females in general report participating in a mathematical activity because it is interesting and enjoyable. The mean effect size across the countries in extrinsic motivation ranged from 0.20 to 0.89 with 76.9% of the results from the 41 countries favoring males, with 2.6% of the results favoring females.

Many of these affective factors in mathematics may be dependent on students' locus of control, or the belief that they have control over their success or failure in mathematics. Considering research that examined male and females' locus of control based on type of educational setting, single-sex and coeducation schools, LePore and Warren (1987) and Marsh (1991) did not conclude any significant differences. On the other hand, significant higher scores in locus of control were noted for senior females (Lee and Bryk, 1986), white females, and at-risk males (Riordan, 1990) enrolled in single-sex schools than a comparison group of students in coeducational schools. But what do male and female students attribute their success or failure in mathematics? In general, boys have a tendency to contribute their success in mathematics to ability and

girls have a tendency to contribute their success to effort (Gilbert, 1996; Hyde et al., 1990; Stipek & Gralinski, 1991). In the meta-analysis conducted by Hyde and colleagues (1990), the researchers deduced the effect size for females attributing their success to effort to be 0.14, while the effect size for males attributing their success to ability to be 0.35. On the other hand, no statistical differences were verified between the attributions of success in mathematics for females or males in a single-sex setting, thus implying that "gender stereotyping was reduced at single-sex compared to co-ed schools" (Bornholt & Möller, 2003, p. 228). One study in particular examined attributions of success and failure immediately following a mathematical assignment, and unlike other studies noted above, the researchers did not find enough evidence to claim gender differences in attributing success to effort or in attributing failure to lack of ability (Seegers & Boekaerts, 1996).

Concluding Literature Remarks

In considering this body of research as a whole, caution is warranted for several reasons. One, the majority of the research studies examined males and females as two distinct, yet homogeneous groups. It is as if the results can be generalized to all male and female students without accounting for differences within the groups such as socioeconomic status and race, as well as avoid other driving factors such as context, history, power, and identities (Reichert, Kuriloff, & Stoudt, 2009; Skelton et al., 2009). Furthermore, when differences between the *average* female and *average* male are concluded, typically researchers does not consider which females and males are at risk and why (Mills, Francis, & Skelton, 2009). This can be further supported by Eliot (2011)

in his current analysis of neuroscience research on how males and females may differ. "Boys and girls have differing interests, but their basic cognitive, emotional and self-regulatory abilities vary far more within each gender than between the average boy and girl" (p. 363).

Two, in examining differences between males and females, regardless of setting or age, researchers are promoting gender stereotypes. In interpreting the results, one side of the dichotomy will be deemed superior to the other. As stated by Mills and colleagues (2009),

> The constant comparison of boys' social and academic outcomes with those of the girls is also indicative of the treatment of this gender debate as a zero sum game. For instance, that boys may be enjoying school less than girls does not mean that girls enjoy school; further, that the gap between girls and boys is supposedly widening does not mean that boys are achieving less: It could mean that girls are improving. (p. 43)

It is the tendency of the media to inflate these "known" differences or at least only highlight differences, and rarely considers how females and males are similar, which may lead to gender stereotypes. The more that parents, teachers, policymakers, and students hear of differences between females and males, the more ingrained these false beliefs become a part of the taken-for-granted assumptions of a society and potentially lead to ideologies based on the beliefs of others (Jackson, 2010; Pahlke, Bigler, & Patterson, 2014). It leads to the notion that because boys and girls perform differently, then they must learn differently and they are hardwired differently (Eliot, 2011). Teachers of

single-sex classrooms are encouraged to differentiate instruction (Chadwell, 2010; Sax, 2005), which may lead to teachers teaching to students' perceived strengths and not their weaknesses; therefore, widening the gap in what little differences may exist (Eliot, 2011).

Three, there is little to no published peer-reviewed qualitative research to date that considers the perception or the voice of adolescent students' experience in a single-sex mathematics classroom. As noted previously, most of the research to date is focused on the end product, data that can be collected and analyzed quickly via achievement tests, surveys, questionnaires, and so forth. Those interested in the field of education tend to rely on such "evidence-based" research (St. Pierre, 2006) to make such decisions and typically omit the voice of those impacted the most by federal, state, district, and school policies, the students. As argued by Cook-Sather (2002), Cotton (2008), and Martino and Zan (2010), to name a few, including the missing perspective and voice of students is an essential component to improve educational policy and practice, and the implementation of single-sex classes, particular in mathematics, is no different. Thus, due to issues in synthesizing the results provided in the literature base, no conclusions of the affordances or hindrances of single-sex education will be stated, but the researcher entrusts the reader to draw their own conclusions and form their own understandings of single-sex education, particularly single-sex mathematics education.

CHAPTER 3

METHODOLOGY

Study Design

The purpose of this exploratory study was to uncover and understand female and male's dynamic mathematics identity within single-sex and coeducational mathematics classes. Therefore, this research study falls under the umbrella of a qualitative research study, which is based on the view that reality is constructed by individuals interacting with their social worlds. As noted by Bogdan and Biklen (2007) and Lincoln and Guba (1985) there is not a simple definition to describe qualitative research. But, Bogdan and Biklen (2007) described qualitative research as having five features: (a) naturalistic, (b) descriptive data, (c) concern with process, (d) inductive, and (e) meaning.

A naturalistic study means that the researcher conducts the research within a natural occurring environment (i.e. not in a laboratory setting) and data is gathered from participants engaging in naturally occurring human behaviors. In this study, I conducted classroom observations in the participant's natural setting, the single-sex or coeducational mathematics class and further relied on participant's narratives of their experience because it is assumed that "human behavior [and identity] is significantly influenced by the setting in which it occurs" (Bogdan & Biklen, 2007, p. 5). The second feature, descriptive data, refers to the data collected, as well as the final text. The data gathered is not to be reduced to numbers and analyzed using statistical procedures, but are rich and detailed by nature. The interview and member checking transcriptions, as well as the field notes and researcher reflections gathered in this study maintained their written form and

were not be reduced to quantitative measures. The final text of the research findings are also descriptive in nature, using quotes and I-poems from the participants and including abundant detail of participant's voices in narrative form.

Concern with process rather than the outcome or product is the third feature of qualitative research. This is indicative of my data sources because it is possible to glean into individuals' identity through other means such as surveys (e.g., Hazari, Sonnert, Sadler, & Shanahan, 2010). The fourth feature, inductive, indicates that the researcher is not concerned with proving or disapproving a hypothesis, but in building abstraction from the bottom-up; an exploratory study, where the researcher is not concerned with broad generalizations, but with understanding the specific phenomenon being studied (Glesne, 2006). I entered the research study with an open mind to participants multiple voices and emerging mathematical identities and insights gleaned from participant's expressed mathematics identity are grounded within this study. The final feature is meaning. Researchers are interested in understanding the meaning people have constructed (Bogdan & Biklen, 2007; Glesne, 2006), that is, "how they make sense of their world and the experiences they have in the world" (Merriam, 2001, p. 6). As a researcher, I was interested in how male and females make sense of their classroom experience within a single-sex or coeducational mathematics class and how this may influence their emerging and dynamic mathematics identity.

This study utilized narrative inquiry, which is becoming a well-respected methodology in the field of education (Connelly & Clandinin, 1990; Webster & Mertova, 2007). Narrative inquiry is relevant for this study because it privileges the experiences of

the individual. Defined as the "study of the ways humans experience the world" (Connelly & Clandinin, 1990, p. 2), narrative inquiry serves as a means for researchers to gain an understanding and make sense of the stories of others as "truth" because experience is not something that can be observed (Clandinin & Connelly, 2000; Polkinghorne, 1988; Webster & Mertova, 2007). Polkinghorne (1988) described two types of narrative inquiry – descriptive and exploratory. Descriptive narrative, whose purpose is "to render the narrative accounts already in place" (p. 161), was used in this study because my intent is not to explain *why* something has happened, but to render narrative accounts or the multiple voices as they are told by participants.

Context

Context provides readers access to the worlds of others, in this case, access to the education worlds and experiences of students (Dyson & Genishi, 2005; Webster & Mertova, 2007). In addition, setting the scene provides readers context and background information from which participants' narratives and dynamic mathematics identities are drawn (Webster & Mertova, 2007). To provide access to my participants' educational world, I provide information on the history of the single-gender initiative within the state, demographics of the community and school district, demographics of the school – faculty and student body – and implementation of single-sex classes within the school, background of the teachers, classroom settings, and daily classroom routines.

State

Since the passing of the federal law in 2006, South Carolina has embraced the implementation of single-sex classes within coeducational public schools throughout the

state, and has implemented more single-gender education options than any other state in the United States ("Single-sex education spreads", 2008) and is currently in its eighth year of implementation. South Carolina is the only state that employed a statewide coordinator whose job was to support schools in developing, implementing, and maintaining single-gender programs, programs targeted at meeting the different educational needs of boys and girls due to differences in learning styles and overcoming gender gaps in academic performance (Chadwell & Rex, 2009). As claimed by Chadwell and Rex (2009), "In South Carolina, single-gender education has been a win-win-win choice. It has invigorated teachers, engaged students and involved parents" (section 3). Currently in the state of South Carolina, there are approximately 16 elementary (grades K-5), 12 middle (grades 6-8), and 2 high schools (grades 9-12) implementing single-gender classes in various subject areas such as physical education, English, and mathematics (personal communication, January 2, 2015).

Community

According to the 2010 U.S. Census, Lindell Middle School (pseudonym) is located in a community of 3,269 people with the majority of the population being White (86.7%) or African-American (9.1%). Furthermore, approximately 10.3% live below the poverty level, and about half of the working population is employed in manufacturing (25.9%) or educational and health care services (23.0%). Situated near a large university, the community is known for its friendliness and warmth and boasts the motto, "Where neighbors become friends" (Marketing, 2014).

The rural school district is composed of 16 elementary schools, 5 middle schools, and 5 high schools, and also offers educational courses for adults, a parenting and family literacy program, and a dropout prevention program (School District, 2014). According to the 2012-2013 school year dataset from the National Center for Education Statistics (2014a), the school district educated 16,546 students by 989 classroom teachers, which is a student/teacher ratio of approximately 17 to 1. In addition, the average per pupil funding was $7,672.

School

Lindell Middle School (pseudonym) is a Title I school comprised of grades six to eight and has been in operation since 1985. The school was recently awarded the Palmetto Silver Award from the State Department of Education for the 2013-2014 school year, which recognized the middle school for students high performance rates and growth on the Palmetto Assessment of State Standards (PASS) end of year exams, as well as closing the achievement gap of historically underachieving groups (State Department of Education, 2014). In 2007, various single-sex classrooms were implemented in the areas of mathematics, English as language arts (ELA), and science subject areas. These were implemented as a means to combat stagnant scores on standardized tests and to create enthusiasm among the teaching staff (personal communication with former principal, January 11, 2013). In the current school year, single-sex classes have continued to be implemented, but for different reasons. One, to help boys overcome their deficits in reading and writing skills, which will inherently lead to greater scores on standardized

tests; and two, to combat boys' dominance in certain subject areas such as mathematics and science (personal communication with present principal, September 23, 2014).

The middle school is composed of a teaching staff of 42 educators (see Table 3.1), in which the sixth, seventh, and eighth grades are composed of two teams each, an English as language arts (ELA), mathematics, science, and social studies teacher.

Table 3.1

Gender of Teacher per Subject Area

Subject Area	Number of Females	Number of Males
Electives	7 (17%)	3 (7%)
English as language arts	6 (14%)	0 (0%)
Mathematics	3 (7%)	3 (7%)
Science	6 (14%)	0 (0%)
Special Education/Resource	1 (2%)	1 (2%)
Social Studies	8 (19%)	4 (10%)
Total	31 (74%)	11 (26%)

Note. $N = 42$. Percentage of Teaching Staff in Parenthesis
Source. Personal communication with data entry individual at Lindell Middle School

The principal, Dr. Travis Mulligan (pseudonym), is beginning his first year at the middle school, in which he endeavors to meet the school's mission statement: "[T]o educate our students in a safe, academically challenging environment that prepares them for high school, careers, and life in the 21st century" (Information from school district, 2014). The student body is composed of approximately 500 students. Demographic information is provided in Table 3.2 (personal communication with data entry individual, September 23, 2014).

Table 3.2

Student Demographic Information

Grade Level	Number	Percent
Sixth	141	28%
Seventh	187	37%
Eighth	172	35%
Gender	Number	Percent
Female	235	47%
Male	265	53%
Ethnicity	Number	Percent
American Indian or Alaska Native	1	0.2%
Asian	3	0.6%
Black or African American	16	3%
Hispanic/Latino	23	5%
White	438	88%
Native Hawaiian or Other Pacific Islander	0	0%
2 or more races	19	4%
Lunch Status	Number	Percent
Free	271	54%
Reduced	37	7%
Total Free/Reduced	308	61%
Other	Number	Percent
English as Language Learners	13	4%
Special Education Students	34	7%

Note. $N = 500$. Source: Personal communication with data entry individual at Lindell Middle School

As a researcher, I chose to conduct my study at Lindell Middle School for several reasons. One was availability. The school offered single-sex mathematics classes, which is becoming more difficult to find public schools that offer single-sex classes within the state. Two was location. Lindell Middle School was a short driving distance; therefore, allowing me more opportunities to visit the school on a weekly basis to collect data. Three was stability. The school has offered single-sex classes for the past seven school years; thus, demystifying the "newness" of a new program. Four was prior relationships. I have collected data at Lindell Middle School for two years prior to my dissertation work

and have formed both personal and professional relationships with several faculty and staff. This in addition made me feel comfortable being in the school from the beginning; knowing the procedure for checking in and out every visit and where to locate classrooms were not anxiety-causing barriers to overcome.

Furthermore, I chose to conduct my research within the 7th grade mathematics classrooms because of limitation of choices and grade level of students. Single-sex mathematics classes were implemented at the 6th and 7th grade level and not at the 8th grade level. At the 6th grade level, students had to overcome being in a new school environment and the single-sex mathematics classes were new for these students. At the 7th grade level, students have been either previously enrolled in a single-sex mathematics class or were aware of single-sex classes within the school. I also had to conduct my research with both of the 7th grade mathematics teachers because of scheduling. Neither teacher taught a combination of the three class types, namely an all-girls class, an all-boys class, and at least one coeducational class.

Mrs. Ely

Mrs. Ely has taught for 18 years, nine of these years at Lindell Middle School where she teaches 7th grade mathematics. This was Mrs. Ely's fifth year teaching single-sex mathematics classes and she has experience teaching both all-girls and all-boys classes. She has a Bachelor's in Science degree in Elementary Education and a Master's of Education Degree in Teaching and Learning, more specifically in technology and online instruction. Mrs. Ely has attended minimal professional development sessions on

single-sex education. Furthermore, she is a proponent of implementing single-sex, or single-gender to use her words, mathematics classrooms within Lindell Middle School.

> I believe that single gender math classrooms provide a beneficial environment for boys or girls to learn in. Girls, in general, are far less intimidated in single gender classrooms. They become the "owners" of the course and are more willing to be a part of the discussions and to state their ideas without fear of guys making snide comments. Guys enjoy the competitiveness created by the single gender classroom. They also give their thoughts and ideas freely. Some of the quieter guys also find their voice in a single gender classroom without fear of being embarrassed in front of the girls. I think single gender classrooms are a great idea and I really enjoy teaching in these classrooms. (personal communication, October 30, 2014)

In general, students in Mrs. Ely's class sit in pairs. Two desks are placed side-by-side and are arranged to face the front of the classroom. At the beginning of the year, students were allowed to choose where they sat in the classroom; yet, this seating position is now assigned. At the front of the room are two whiteboards and a Promethean Board, which is used most often during the daily classroom activities (see Figure 3.1 and Figure 3.2 below). Also situated in the front of the classroom are Ms. Ely's desk and a podium. To left of the room is a bulletin board entitled "Algebra," and contains various algebraic notations and definitions such as a fraction, represented as $^{5}/_{6}$, "shows how many parts of a whole." There is also a multitude of mathematics-related and inspirational posters hanging in the front and in the back of the room. These posters

include such quotes as “It’s always too early to quit,” “Life without Geometry is point-less,” “Take your best shot,” and “Even Einstein asked questions.”

Figure 3.1 Image of front of Mrs. Ely’s classroom.

Figure 3.2 Image of back of Mrs. Ely’s classroom.

Two of Mrs. Ely’s 7th grade mathematics classes were chosen for this study. First period was the all-boys mathematics class and was an hour-long period from 8:10-9:10. Twenty-three boys were enrolled in this accelerated mathematics class. Seventh period

was a coeducational class and was a 50-minute period from 2:20-3:10. In this class were enrolled 11 girls and 10 boys.

A typical class period does not differ based on class composition by the sex of the students. As students enter the classroom, a class starter known as Fantastic Five is posted on the board. This class starter is composed of five questions based on the five mathematical strands of number and operation, algebra, geometry, measurement, and probability and statistics. Students are required to keep their Fantastic Five work in a notebook with the questions written on the left hand side of the page and the answers on the right hand side of the page. After approximately 12 minutes, Mrs. Ely asks for student responses, with little to no explanation behind students' thought process encouraged. Immediately following review of the Fantastic Five problems, Mrs. Ely may either give a quiz, review homework problems from the previous night, or begin a new lesson; each of these scenarios with a set of distinct and mutual classroom norms. In general, the goal is in gaining procedural knowledge or step-by-step processes and rules rather than gaining conceptual understanding. Mrs. Ely elicits students' correct answers and rarely encourages students to explain their reasoning or consider different approaches or strategies in solving a problem. And the mantra, inherit in all student formal and informal assessments, is "no work, no credit." Lastly, with approximately 2 minutes left in class, students are to write their homework assignment, if any, in their agenda, and must also write a sentence using a mathematics vocabulary word from the day. Students are to underline the vocabulary word and are to use appropriate grammar and spelling. As a researcher, my view of Mrs. Ely's classroom was further supported and confirmed by

participants' response to the first interview question, what do you do on a typical day in your math class. For example, Matthew (P1/L23-25) stated,

> We start off with a fan[tastic] five and then we usually go into practice. We usually use the homework we had the other day. And then, we go over it. And we share how we got the answers. And then we get more homework, and then we have to- it like, it's like a cycle.

Ms. Mole

Ms. Mole has taught for 24 years, 11 of these years at Lindell Middle School where she teaches 7th grade mathematics. This was Ms. Mole's fifth year teaching single-sex mathematics classes and she has experience teaching both all-girls and all-boys classes. She has a Bachelor's in Science degree in Elementary Education, a Master's of Education degree in Instructional Technology, and is currently pursuing her Doctor of Education degree in Educational Leadership. Ms. Mole has attended a one-day professional development workshop on single-gender instructional strategies, in which the perspective was that students learn differently based on their gender (e.g., Cahill, 2014). In addition, she is a "huge proponent of single-gender, especially in middle school. Having one gender removed automatically eliminates hindrances to participation, confidence, concentration, security, etc. I believe every middle school should offer single-gender classes" (personal communication, October 30, 2014).

Ms. Mole's class is setup in stations (see Figure 3.3and Figure 3.4 below). Station 1 and Station 4 are situated at the front of the room, in the shape of a horseshoe. The students are positioned in front of the Promethean Board, which Ms. Mole uses at these

two stations to present new mathematical concepts. To the left of the Promethean Board is typically information on what students are to accomplish at each station for the day. To the right of the Promethean Board is a running list of assignments for each station rotation. Station 2 and Station 3 are situated at two tables in the back of room, and students sit facing the back wall. These two stations contain four laptops each. Students typically watch lesson videos and take quizzes from the online textbook website and/or work through problems from a mathematics computer program. At Station 5, situated on the left-hand side of the classroom, students sit at tables facing the front of the room and are assigned review problems from their textbook. On the right-hand side of the classroom is Station 6. Students at this station sit at tables facing the front of the room and complete a worksheet on a previous mathematical concept. The table positioned in the middle of room was used by students when there was not enough sits in one of the stations. Ms. Mole's desk is located in the front of the room.

Figure 3.3 Image of stations in Ms. Mole's classroom.

Figure 3.4 Image of the front of Ms. Mole's classroom.

On the right-hand side of the room is a bulletin board displaying the game Monopoly and the Wall of Fame in which student pictures are posted for academic benchmarks such as completion of a mathematical concept in the mathematics computer program. On the back wall are numerous inspirational and mathematics-related posters – "Be a problem solver, not a problem maker." "Math = Success. Go Figure!" "Math illiteracy affects 8 out of every 5 people."

Ms. Mole had two 7th grade mathematics classes that participated in the study. Second period, a 50-minute class period from 9:14-10:04, was the all-girls class. This class enrolled 17 girls. Ms. Mole's 7th period class was a coeducational class and was a 50-minute period from 1:24-1:14. There were 13 girls and 15 boys enrolled in this mathematics class.

A typical class period does not differ based on class composition by the sex of the students. Prior to entering the classroom, students check a chart posted to the right of the

classroom door, which indicated their station for the day. Each lesson or new mathematical concept is presented and practiced as part of a three-day cycle; therefore, students are rarely at the same station two subsequent days. Directions and assignments for each station are posted in the front of the classroom. Due to the complexity of this daily routine, the three-day cycle will be discussed in terms of one hypothetical student, Joe. On day one of the cycle, Joe is at Station 6, in which he individually completes a skills-based worksheet on a previous mathematical concept. If Joe has any questions, he must wait until Ms. Mole is not instructing students at Stations 1 and 4, and rarely does he ask another student at his station because talking to others is prohibited. After approximately 25 minutes, Joe rotates to Station 3 where he continuously works through a pre-algebra skills based program. On day two of the cycle, Joe is at Station 4. At this station, Joe learns a new mathematical concept through step-by-step instructions. He has an opportunity to work out example problems and interact with Ms. Mole in the "safe zone," before receiving his skills-based assignment. On day three of the cycle, Joe is at Station 3, where he is required to watch two lesson videos from the online textbook, take detailed notes, followed by a five-question multiple-choice quiz. After approximately 25 minutes, Joe rotates to Station 5. At this station, similar to Station 6, Joe individually completes skills-based problems from the textbook on a previous mathematical concept, and receives little to no help from Ms. Mole or a peer. As confirmed succinctly by Hannabell (P1/L17-19), "We either go to the horseshoe and she teaches us like something new every week. Or we'll do computers and then we'll switch and do our math book. Or we'll do the other station and we'll do computers and then a worksheet."

Participant Selection

Participants for this study were selected based on two criteria. One, the participants returned signed parental consent forms and accompanying student assent forms (see Appendix A). Two, participants were selected based on results from the *Mathematics as a Gendered Domain* instrument (Forgasz et al., 2004), which was administered to all students in each of the four classes to measure the extent to which they believe in the stereotype of mathematics as a gendered domain, specifically a male, a female, or a gender-neutral domain (Appendix B). This instrument was selected for several reasons. One, it brings gender, or sex, to the forefront of one's beliefs about mathematics; thus, highlighting the salient and visible factor of the different class types. Two, it was my initial assumption as a researcher that one's beliefs in mathematics as a gendered domain was a dominant voice. Three, the instrument was delineated into three gendered subscales rather than one continuum scale such as the *Mathematics as a Male Domain* subscale (Fennema & Sherman, 1976) or as an instrument with no definite subscales such as the *Who and Mathematics* instrument (Forgasz et al., 2004).

The instrument is composed of 48 statements, further constructed of three subscales with 16 items each randomly ordered throughout the instrument. The three subscales are mathematics as a male domain (MD), mathematics as a female domain (FD), and mathematics as a gender-neutral domain (ND). An example of a statement from the MD scale is "More boys than girls care about doing well at mathematics." An example of a statement from the FD scale is "Girls are more likely than boys to believe they are good at mathematics." And an example of a statement from the ND scale is

"Being good at mathematics comes as naturally to girls as to boys." Participants were asked to respond to each statement based on a 5-item Likert-scale ranging from strongly agree (SA) to strongly disagree (SD). The paper-based survey was administered by the researcher during the participant's homeroom classroom, which they had once a week with their respective mathematics teachers. Prior to administration, the researcher sent home approved parental information letters describing the survey (see Appendix C) and read the verbal consent (Appendix D) to students, emphasizing that taking the survey was optional. The surveys took approximately 10-15 minutes to complete.

For each subscale, Forgasz, Leder, and Kloosterman (2004) conducted item-total correlations to conform internal consistency. For mathematics as a male domain, Cronbach's alpha was .90. For mathematics as a female domain, Cronbach's alpha was .90, while the Cronbach's alpha for mathematics as a gender-neutral domain was .84. With reliability coefficients greater than .70, the three subscales are considered to have high reliability scores and are deemed as stable subscales (Bandalos & Finney, 2010). Moreover, as noted by Forgasz and colleagues (2004), these results are similar to the split-half reliability of .87 of Fennema and Sherman's (1976) mathematics as male domain subscale from the *Mathematics Attitude Scales* instrument. The instrument of which the *Mathematics as a Gendered Domain* was developed in response; more specifically due to the wording of items and the notion that participants were not allowed to view mathematics as a female domain (Forgasz et al., 2004). Similar reliability results were confirmed by Duru (2011) in his translation of the instrument into Turkish. The authors of the instrument also conducted content and construct validity during the initial

development of the instrument, as well as concurrent validity through the extent to which participants perceived their current mathematical ability (Forgasz et al., 2004). However, the results from the validity analysis are not published; yet was verbally confirmed by one of the developers of the instrument (G. Leder, personal communication, July 16, 2014).

To analyze the results, the Likert Scale was first converted into numerals: 1 = strongly disagree, 2 = disagree, 3 = not sure, 4 = agree, and 5 = strongly agree. The results for each participant were entered into an Excel spreadsheet and mean scores were calculated for each subscale and resulted in a mean score ranging between 1 and 5. A subscale mean score of 3.00 indicated that the participant is not sure of whether they agree or disagree with mathematics as a gendered or gendered neutral domain. On the other hand, a subscale mean score greater than 3.00 indicated an agreement with mathematics as a female, male, or gender-neutral domain, while a subscale mean score less than 3.00 indicated disagreement with mathematics as a female, male, or gender-neutral domain. For instance, a mean score of 2.34 on the FD subscale would signify a disagreement that mathematics was stereotyped as a female domain. Looking across the three subscales for each participant, the highest mean subscale score will highlight the participant's current perception of mathematics. Continuing with the example above, suppose a participant scored a mean score of 2.34 on the FD subscale, 2.89 on the MD subscale, and 3.45 on the ND subscale. This implies that the participant believes that mathematics is a gender-neutral domain and that mathematics is not a female or male

domain. Permission to use this instrument was granted by the developer (H. Forgasz, personal communication, July 16, 2014).

Participants

Due to time constraints of collecting and analyzing the data as a doctoral student (Bogdan & Bigler, 2007) and due to the exploratory nature of this study, I decided to ask 12 adolescents to participate as part of this study (Francis et al., 2010). Additional interviews were conducted to confirm or disconfirm, refine and strengthen insights from this study, and are to be analyzed in subsequent analyses (Eisenhart, 2009). Therefore, twelve 7th grade students were purposively selected to participate in this study. The students were enrolled in one of the mathematics class types, all-female, all-male, or coeducational, and instructed by one of the two teachers described above. More specifically, participants in each of the class types were stratified into four groups (Cohen, Manion, & Morison, 2011; see Table 3. 3) based on his or her results (i.e., male-domain, female domain, or neutral domain) from the *Mathematics as Gendered Domain* instrument (Forgasz et al., 2004).

Table 3.3

Participant Selection by Class Type and Gendered Domain

Class Type	Strata		
	Male Domain	Female Domain	Neutral Domain
All-Female	1	1	1
Female in Coed	1	1	1
All-Male	1	1	1
Male in Coed	1	1	1

This served as the basis for selecting a representative group across class type and gender. In addition, this reduced researcher selection bias. Participants were not selected based on researcher's subjectivities being shaped during observations while "casing the joint" (Dyson & Genishi, 2005) or based on suggestions from the classroom teachers. Relying on results from the instrument also ensured some variety in how the participants' viewed mathematics as a gendered domain.

The available participants were first narrowed by those who returned both parent consent and student assent forms (Appendix A) within each class type, and by gender in the coeducational classes. This stratification of participants was aligned with the purpose of this study, examining female and male's dynamic mathematics identity in single-sex and coeducational classrooms. Then utilizing a quantitative sampling technique, participants were mechanically selected (Fraenkel & Warren, 2006) based on the results from the three *Mathematics as Gendered Domain* domains (Forgasz et al., 2004); more specifically, based on highest mean score in one of the domains. For example, a male student in a single-sex mathematics classroom with a highest score in the female domain, the male domain, and the neutral domain on the instrument was selected to participate in this study. Participant self-reported information, along with her or his highest domain score, is provided in Table 3.4

Table 3.4

Participant Self-reported Information and Highest Domain Score

Participant Name	Gender	Class Type	Ethnicity	Ability Rating	Selected Score		
					ND	FD	MD
Colin	M	SS	W	4	4.69		
Trevor	M	CE	W	4	4.56		
Matthew	M	SS	A	5		4.13	
JJ	M	CE	W	5		4.75	
Justice	M	SS	W	5			3.69
Cameron	M	CE	O	4			4.00
Savannah	F	SS	W	5	4.88		
Katrina	F	CE	W	4	4.75		
Hannabel	F	SS	W	5		3.94	
Emmeline	F	CE	M	5		4.44	
Jennifer	F	SS	W	3			3.19
Dottie	F	CE	W	3			3.12

Note. All participant names are pseudonyms. F = female. M = Male. SS = single-sex. CE = coeducational. A = Asian. M = Mixed. O = Other. W = White. 5 = excellent. 4 = good. 3 = average. ND = neutral domain. FD = female domain. MD = male domain.

Data Sources

Interviews

The purpose of conducting interviews is to discover a phenomenon that cannot be explored through observation (Polkinghorne, 1988), in this study, how male and female adolescent student's talk about themselves as a mathematics student within a single-sex or coeducational mathematics setting. The intent of this primary data source was to gain the perspective or the lived experience of another through individual narratives. Interviews are vital to the Listening Guide, which centers on the voice of participants and are viewed a one of the primary ways into participant's inner thoughts and feelings (Sorsoli & Tolman, 2008). Narrations of perceived experiences allow the researcher to gain a better understanding of who the participants are on multiple levels or through

listening to multiple voices. As noted by Merriam (2001), the interviewing process itself is a means to probe into the minds of individuals and to gain an understanding of how the students interpret the environment around them.

The interview protocol was semi-structured in nature and included several unique questions gained from observations or gleaned from researcher's field notes of each individual participant. In a sense, these additional questions were my interpretation of student's mathematics identity synthesized over my time observing participants in the classroom (Angrosino, 2007). The questions were searching and open-ended as a means to elicit participant's reflection and recall of personal experiences (Freeman & Mathison, 2009; Polkinghorne, 1988; Webster & Mertova, 2007) and to confirm and disconfirm my views of the voices composing and influence participant's mathematics identity. Additionally, questions and/or scenarios based on observations served as a means to establish a participant-researcher relationship. These questions included participant behavioral patterns or common occurrences such as raising her or his hand (or not) to volunteer an answer to a mathematical problem, as well questions unique to a participant, such as the participant who attempted to hide the fact that she did not complete her homework assignments by propping her workbook up against her desk. The interviews were conducted during participants enrichment period (11:00 – 11:54), in a teacher workroom located near the two seventh grade mathematics classrooms or in a room located in the school library. The student interviews were between 15-30 minutes and were conducted in November 2014. The interviews were audio-recorded using the Sony voice recorder, model UCD-SX712.

Prior to finalizing the interview protocol, three doctoral students in mathematics education read through the interview introduction and each question, and made comments, suggestions, and additions in regards to several things: (1) syntax and word choice appropriate for adolescent students; (2) omission, addition, or combination of questions; and (3) the arrangement of the questions. After making changes based on the feedback from the doctoral students, I piloted the interview questions with a focus group of seventh grade middle school students representative of the expected study sample: two females in coeducational mathematics class, two females in a single-sex mathematics class, one male in a coeducational mathematics class, and two males in a single-sex mathematics class. The goal of the focus group was to consider the wording and interpretation of my questions, as well as to practice making supportive comments and posing spontaneous questions. During the focus group, I practiced using language that was clear and explicit (Freeman & Mathison, 2009), and used words and phrases familiar to the participants. For example, I used the word "math" rather than "mathematics" within the interview questions as to position mathematics as informal. At the conclusion of the focus group, rather than asking students if there was anything else they would like to say, the students were asked what questions they might include within the interview. The intent was to elicit additional information that I did not consider in constructing my initial interview protocol. For example, one focus group participant stated, "Pretty much the same questions that you asked us." Approval from the Institutional Review Board to conduct and audio-record the focus group was unnecessary because the information gleaned from the focus group was not analyzed or disseminated. However, an

informational letter was sent home to parents of the students willing to participate in the focus group (see Appendix E).

Immediately following the focus group, I wrote my intentions in asking each question, particularly in regards to the initial four guiding and interrelated voices of a students' mathematics identity discussed below (i.e., self-confidence in mathematics, sense of belonging, mathematics as a male domain, and gender roles in the classroom). Next, I listened to the audio file of the focus group interview, writing students' responses and comparing my intentions for each question with students' actual responses. From this, several questions were reworded. For instance, "Describe yourself as a math student" was restated as "Give me at least three adjectives that describe you as a math student. Explain your reasoning for each adjective." In addition, I omitted a few questions because two or more initial questions elicited the same response or was irrelevant to the purpose of this study. The last step in finalizing the interview protocol was to read through each participant's field notes and write personal questions unique to each participant. In reading through the field notes, I also added additional questions common across all participants. For instance, "Suppose your teacher hands you a test taken the previous day, what are you feeling in the moment before receiving the test? Why? What are you feeling in the moment after receiving the test? Why?" See Appendix F for the final interview protocol.

As a researcher, I was cognizant of the inherent researcher-participant or adult-child relationship that places the participant as *always Othered* (Lahman, 2008). Regardless of the measures taken by the researcher, the participants will be placed in a

position of inferiority. During the interview process, such a position may make it difficult for participants to be open and honest, and say things they believe the researcher wants to hear. It is suggested that one way to minimize the power relationship is to spend time with the participants in their natural setting (Lahman, 2008). Through the continuous classroom observations, the participants became more familiar with me as a researcher and as an individual outside of the classroom setting; therefore, minimizing, but not eliminating, the participants' discomfort or feeling of unequal power.

As a researcher, I was also aware of how my actions, my interview questions, and my language might influence the responses of the participants and accounts of their experiences. Yet as noted by Huberman (1995) and Way (2000), even though I had the power to write the interview questions and interpret the participants' responses, the participants had the power of deciding what to tell me and what not to tell me about their experiences in a single-sex or coeducational mathematics classroom (Gergen & Gergen, 1988; Polkinghorne, 1988). I was also cognizant of how the location of the interview, the time of day, and the time of the school year shape the interview (Clandinin & Connelly, 2000; Freeman & Mathison, 2009). The location was in a teacher workroom or school library void of noisy and visual distractions, and a place familiar to participants. The time of the interview, during the middle of the school day, should not conflict with after-school activities and possible traveling conflicts. Additionally, participants were not fatigued nor felt rushed to complete the interview during this time of day. Additionally, Huberman (1995) would even argue that I must consider my non-verbal cues and gestures, my tone of voice, and my interruptions and encouragements that may influence

the interview process and co-construction of participants' narrative. Therefore, throughout the interview, I made a conscious effort to lean forward, make eye contact, maintain a positive tone and disposition, and allow for silences, thus minimizing interruptions. Knowledge is power, and it is important that I relinquish my power as researcher and perceived expert while communicating with the participants prior to, during, and even at the conclusion of the interview process.

Prior to conducting the interview, the participants were made aware of the significance of their participation in the study (Freeman & Mathison, 2009; Rogan & de Kock, 2005). They hold the knowledge and expertise of the phenomenon under study. Furthermore, while conducting the interview, there were also things that I as a researcher did to build a relationship with the participants as collaborator of a co-constructed narrative. By listening, I supported participants' responses by making supportive comments and clarification statements, posing spontaneous questions, as well as share personal stories of similar experiences (Polkinghorne, 1988; Rogan & de Kock, 2005). As a way to conclude the interview, I invited participants to debrief and reflect on the interview experience (Josselson, 2007). For example, "What questions do you have for me as we end our time together?" (p. 545). I concluded the interviews by expressing my appreciation for their willingness and openness to share their experiences with me and made them aware of how their experiences would be utilized within the research study at large.

Member Checking

Member checking is the process of asking each participant to confirm or disconfirm individual voices and the interplay of voices composing his or her mathematics identity gleaned from the narratives (Creswell & Miller, 2000; Glesne, 2006; Lincoln & Guba, 1985). It is viewed as "the most crucial technique for establishing credibility" (Lincoln & Guba, 1985, p. 314). Similarly, Webster and Mertova (2007) would contend that member checking supports the trustworthiness and authenticity of the narrative research study. I used member checking for three reasons: (1) relinquish my power as a researcher (Buchbinder, 2010; Lincoln & Guba, 1985), (2) triangulate the data (Creswell & Miller, 2000), (3) continue to include the missing perspective and voice of students (e.g., Cook-Sather, 2002), and (4) reflect on how the various voices fit together or what Saldaña (2014) termed as thinking connectively.

Due to the age of my participants, I did not present them with the final results prior to obtaining their reactions and opinions (e.g., Lareau, 2011). I conducted validation interviews in January 2015 (Buchbinder, 2010). As the interviews, this process was conducted during participants' enrichment period (11:00 – 11:54) in the teacher workroom and lasted between 25-45 minutes. I personally felt that the adolescent participants would not enjoy reading a narrative of their mathematics identity; thus, during the validation interviews, participants were asked questions after reading their respective I-poems and word trees (see Appendix G for member checking protocol). I-poems were constructed as part of the data analysis process utilized in this study, the Listening Guide (Gilligan, Spencer, Weinberg, & Bertsch, 2003). I-poems allowed each

participant to reflect on how they represented his or her self as a learner of mathematics in a single-sex or coeducation mathematics classroom. Word trees are visual, spatial representations of that allow one to examine the ways that a particular word or phrase are connected to other words and phrases narrated within their interviews, similar to a suffix tree (Wattenberg & Viégas, 2008). An example of a word tree can be found in Appendix H. I constructed each word tree through the free website, Revelation, Inc. (2013). The word trees were created from step three of the Listening Guide (Gilligan et al., 2003). In this step, using different colored pencils, I underlined the different voices composing one's mathematics identity. Participants' were asked to reflect on word trees selected by the researcher and representative of their differing and cohesive voices not apparent in their I-poems; for instance, the participant's relationship with her or his teacher or with another peer in the classroom. The validation interviews were audio-recorded and transcribed. At the conclusion of each validation interview, I also documented my thoughts and reflections on the process. These were maintained in a research journal described below.

Classroom observations

Classroom observations, a primary tool of narrative inquiry (Connelly & Clandinin, 1990), were conducted for each participant in each of the four classrooms one to two times a week for approximately eight weeks from the beginning of September to the end of October, which accumulated 10 to 13 observations per participant. This is a short amount of time in the field, but as noted by Bogdan and Biklen (2007), doctoral students are under "time-space compressions," which make it difficult to spend time in a

space to gather sufficient data. The purpose for the classroom observations was to freeze specific moments in time to then use to help fill in missing gaps (Bogdan & Biklen, 2007; Clandinin & Connelly, 2000), to design interview questions specific to participants (Webster & Mertova, 2007), and to corroborate aspects of their interview (Gergen & Gergen, 1988; Polkinghorne, 1988; Webster & Mertova, 2007). As described by Connelly and Clandinin (1990), field notes serve as an active recording of my construction of events and behaviors.

While in the field, I observed and noted participants' behaviors, and comments and direct quotes made in class. These observations were translated into two column notes and maintained in my researcher journal (Glesne, 2006). The first column was descriptive in nature and the second column was reflective, containing researcher comments while conducting observations. Within 24 hours, I read through and typed up my notes, clarifying and expanding on the notes. A third column contained analytic memos, a place to document my reflections about the participants, the process of collecting the data, my subjectivities and assumptions, ethical dilemmas, and future research directions to name a few (Bogdan & Biklen, 2007; Glesne, 2006; Saldaña, 2009). I typed separate field notes for each participant to corroborate with the participant's interviews. See Appendix I for an example of my three-column field notes.

The field notes also included a title page with the following information: title represented of the day's observation, date and time, class type and period, participant pseudonym, and the number representing the set of notes for the participant within the entire study (Bogdan & Biklen, 2007). The files were saved as

ParticipantPseudonym_DateOfObservation_NumberInSet. Moreover, in the process of typing field notes, I questioned how my field notes on the first participant within each class period impacted how I constructed my subsequent participant field notes (Emmeline_9.23.12_2, Analytic Memo #1). Therefore, I altered the process to begin each day's field notes with a different participant per class period.

Prior to formal participant observations, I was in the classroom "casing the joint" (Dyson & Genishi, 2005) or "learn[ing] the ropes" (Bogdan & Biklen, 2007). In other words, I was becoming acquainted and acclimated with the classroom environment and routine practices, the teacher's instructional practices and dispositions toward students and mathematics. This also served as a means for the students to become more at ease with my presence. This took place in August while collecting consent forms and administrating the survey. I also took pictures of the classroom arrangement and decor, as well as note the location of shared materials. Furthermore, I became aware of the classroom schedule and routines. For example, Ms. Ely began each period with the Fantastic Five. Such routines became predictable around the third observation, as noted in my autobiographical notes from September 3, 2014. "I could pretty much predict what the teachers were going to do. There is no excitement. Students are as robots – doing what they told – yet more disturbing is they do so in a lifeless manner." The information gathered from casing the joint are written within the final text, more specifically within the context of the two classroom settings, as to allow the reader access to the classroom. The intent is for my readers to situate themselves mentally and visually within the classroom settings, to see the classroom through my eyes as a researcher. Additionally, I

used this time to practice my note taking skills in general and by selecting three random students in a classroom to observe on one occasion. I also positioned myself in various locations in the classroom to find an optimal place to observe, while not be a distraction to students within the classroom.

Researcher Journal

As noted above, I maintained my field notes in a researcher journal. Furthermore, I kept autobiographical notes to document my behavior and emotions throughout the process of collecting data or a series of metanarrative reflections known as problematics (Peshkin, 2000). These situated me within the research process and allowed me to document my own experience. And even though the term "problematics" carries a negative connotation, these autobiographical notes contained personal successes and failures, questions, and frustrations to name a few. I also documented my childhood memories as a mathematics student because the "Othered in research is intensified first by adult memory of childhood" (Lahman, 2008, p. 282). My childhood memories have the potential to distort or enhance my observations and perceptions of the participants. Beyond documenting my childhood memories, I also documented my experiences as a previous mathematics teacher and researcher in single-sex mathematics classrooms; how this may have obscured my focus and interpretations of various components of the classroom. My interpretation of the data, as well as how the final text is composed, will be imbued with my thoughts, feelings, reactions, and memories written in my researcher journal (Clandinin & Connelly, 2000; Glesne, 2006). These will be explicitly stated

within the first step of the analysis process as I document my thoughts of feelings in response to a participant's narrated experience.

Data Collection

The study took approximately nine months to complete including data collection, data analysis, and data dissemination (see Table 3.5).

Table 3.5

Monthly Timeline of Study

Time	Activities
August 2014	• Recruited teachers • Cased the Joint (Dyson & Genishi, 2005) • Collected consent forms • Administered survey • Selected Participants
September – October 2014	• Conducted classroom observations • Maintained researcher notebook • Made dissertation edits and additions
November 2014	• Interviewed each participant • Transcribed interviews
December 2014	• Analyzed data (the Listening Guide) • Continued dissertation edits and additions
January 2015	• Continued analyzing data • Continued dissertation edits and additions • Conducted validation interviews
February 2015	• Transcribed validation interviews • Continued analyzing data • Continued dissertation edits and additions

March 2015	• Submitted dissertation
April 2015	• Defended dissertation

Data Analysis

The Listening Guide, once known as the Reader Guide (Brown, Debold, Tappan, & Gilligan, 1991), stemmed from Gilligan's work on noted differences in moral development between men and women (Brown & Gilligan, 1992; Gilligan, 1982; Gilligan et al., 2003). From this work, it was suggested that males spoke as if they were autonomous individuals, not concerned in forming relationships with others and able to think for himself. The females, on the other hand, spoke of a world compromised of relationships and human connections and lacked an ability to think for herself (Gilligan, 1982, 2011). The females resisted speaking freely and openly about their feelings in order to maintain relationships and to get ahead in a patriarchal society (Gilligan, 1982, 2011). The Listening Guide was developed to provide a safe space for females to speak freely about their "forbidden" experiences such as sexual desires and to give a voice to a group typically marginalized and underrepresented in a world dominated by a White patriarchal society (Brown & Gilligan, 1992; Sorsoli & Tolman, 2008). Beyond this feminist standpoint, the Listening Guide was constructed as a tool in response to prescribed static categories and coding manuals that did not allow for multiple codings of the same text (Brown et al., 1991; Gilligan et al., 2003). As noted by Sorsoli & Tolman (2008), these coding manuals tended to simplify the complex, as well as hide the unanticipated and undertheorized features of participants' experiences.

The Listening Guide is utilized by researchers to examine a range of phenomena including Black women's silence and depression (Beauboeuf-Lafontant, 2008), girls' sexual desires (Tolman, 1994) and unwanted sexual experiences not labeled as sexual assault or rape (Koelsch, 2012), working-class girls definition of femininity (Brown, 1997), women's transition to motherhood (Todorova & Kotzeva, 2003), and women's experiences of military service in combat zones (Tekoah & Harel-Shalev, 2014). These research studies, as was intended by Brown and Gilligan (1992), provided a space for females to speak openly about their experiences with violence and repression, to talk about moral dilemmas within their lives. The Listening Guide has also been employed in rare incidents with boys; for example, to investigate boys' avoidance of intimate friendships with other boys (Chu, 2005; Way, 2012). Yet, more recently, it appears as though more researchers are using the guide within educational contexts as a way to not only examine conflicting issues such as cultural dissonance in classroom interactions at the collegiate level (Wilcox, 2010) and experiences within a suicide prevention education program (Ohlmann, Kwee, & Lees, 2014); but to also investigate relationships, students' relationships with their teachers and peers (Quigley & Hall, 2014; Raider-Roth, 2005) and preservice teachers relationships with self in forming a professional identity (Schonmann & Kempe, 2010). The Listening Guide is a method that is adaptable and has the potential to support the development of novelty (Byrne, Canavan, & Millar; 2009). As an example, Byrne and colleagues (2009) included their participants, teenagers who dropped out of school, to aid in interpreting and analyzing the research data.

A synthesis of the research employing the Listening Guide shows a limited number of research studies with both male and female participants and within an educational setting or educational lens. Furthermore, only a third of the research studies are conducted with adolescents participants. Schonmann & Kempe (2010) are the only researchers to use the method to investigate and understand the multiple voices that compromise one's identity. In addition, the Listening Guide has not been used by mathematical researchers to examine mathematical identity construction within a classroom. Therefore, this study will add to the literature on the use of the Listening Guide as a method and as another approach to investigate mathematics identity of adolescent students.

In analyzing the interviews, the researcher reads through a text at least four times. Each sequential reading is known as a "listening", a listening to a participant's telling of her or his experience within a particular context and in relation to answering the research question(s) (Gilligan et al., 2003). Each listening is to bring the researcher into an active relationship with a participant. The analysis of the interviews commands a researcher who is able to consider and uncover the hidden experiences and multiple voices within a participant's narrative (Sorsoli & Tolman, 2008). As stated by Tolman (2001), The Listening Guide is "distinctly different from traditional methods of coding, in that one listens to, rather than categorizes or quantifies, the text of the interview" (p. 132).

In general, the first two steps or listenings in analyzing the interviews are prescribed and involve listening for the plot and listening for the self within a participant's narrated experience, respectively. These two steps are considered a

relational method because it brings the researcher into a responsive relationship with the participant (Brown & Gilligan, 1992). Step three consists of listening for two or more contrapuntal voices, which signifies that "although they [voices] are not necessarily opposites, the two voices are strongly differentiated and embody different perspectives" (Sorsoli & Tolman, 2008, p. 498). Contrapuntal voices may be in conflict with each other, with the self, with the voice of another person, or with the voices inherent in one's culture (Gilligan et al., 2003). Moreover, the researcher is to consider how individual's contrapuntal voices might be situated within the macro-discourse of race, gender, class, ability, and age (e.g., Beauboeuf-Lafontant, 2008; Walby, 2013). For the listenings within the third step of the analysis, the researcher underlines or selects the different voices with different colors to make a visual representation of the movement between the voices. The fourth step is to compile thematic patterns across the individual stories, as well as to highlight distinct differences among the stories. The four steps will be described in detail below.

The audiotaped interviews were transcribed by the researcher verbatim using the transcription software, Transana 2.53 (Fassnacht & Woods, 2013). The choice to transcribe the interviews myself, rather than send to a transcription service, was to begin forming a relationship with my participants emphasized within the Listening Guide and to "address the additional degree of influence/interference introduced into the analysis process when transcription is assigned to someone other than the researcher(s)" (Tilley, 2003, p. 769). In addition, I utilized the Jefferson transcription notation (1984; see Appendix J) to highlight such things as a participant's pauses, inflections, hesitations,

unfinished sentences, and overlapping speech. The transcription also indicated body movements such as hand gestures and shifts in sitting position, which were observed and noted during the interview process. Noting fluctuations in speech patterns and changes in body movement may suggests to the researcher that a participant is not telling her or his entire story, uncomfortable in eliciting personal information relevant to the research question, or unable to immediately articulate; hence, aiding the researcher in uncovering a hidden "voice" (Evans, 2008; Sorsoli & Tolman, 2008). The transcribed interviews included a heading that stated the Participant's Pseudonym and time and date of interview. The interview files were saved as ParticipantPseudonym_Date_Interview. An example of part of a transcribed interview can be found in Appendix K.

Step One

In the first step of the Listening Guide, the listener or the researcher listens for the plot within a participant's narrated experience, as well as make explicit the researcher's interpretation and subjectivities of the interview. In listening for the plot, the researcher is to gain an understanding of what is occurring or unfolding, the who, what, when, why, and where of the narrated experience. As described by Brown and Gilligan (1992), the researcher is to attend to repetitive words and phrases, metaphors, contradictions, changes in tone of voice, and shifts in the use of first- , second-, and third-person narratives. In addition, I attended to participants' use of hedge words, such as *maybe* and *sort of,* words that indicate a level of uncertainty or doubt (Rowland, 1995). Researchers are also to "reflect on ourselves as people in the privileged position of interpreting the life events of another" (Brown & Gilligan, 1992, p. 27). I also listened to participants' silences because

"for in those absences is where the very fat and rich information is yet to be known and understood" (Mazzei, 2003, p. 358; Saldaña, 2014). In the first step, Brown and Gilligan (1992) suggest using a two-column format in which a participant's responses are in one column and the researcher's reactions and interpretations are adjacently aligned in the other column. In writing down one's response to a participant's narrated experience, the researcher makes their thoughts and feelings known. The goal is not to allow the researcher's interpretations and subjectivities of their initial listening to interfere with the analysis process (Mauthner & Doucet, 2003). I will also utilize my reflexive journal and three-column field notes in writing my initial responses. In Table 3.6, I have provided an example of the two-column note format from an interview with Katrina, a girl enrolled in one of the coeducational mathematics classroom.

Table 3.6

Example of Two-Column Researcher Reflection

I: How would you feel if Mrs. Ely asked you to put a problem on the board even if you did not volunteer? **K:** I would still (1.8) do it because I know she wants me to. And it would (1.6) she's probably doing it because if I got it right, you know, she would be proud of me. <And then, she> would want me to do it because she knows I'm smart and she would° want the right answer.	Do as asked, which I would do to as a student. But the reasoning is unexpected. First, "if I got it right" is a statement that does not invoke confidence. Second, seems as if seeking T's approval or attention. This is something you say of your parents. And the last sentence differs. It's like she is telling herself she is smart, that she **will** get the right answer. I get a sense of K viewing T as more than a teacher.

Step Two

In the second listening, the researcher listens for the self or the voice of the "I." The goal is for the researcher to hear how a participant talks of her or his self and to examine relationships and note repetitions in terms of self (Gilligan et al., 2003). This is a crucial step in the analysis in that it brings the researcher into a relationship with a participant, a connection is being formed because the researcher "encounter[s] not simply a text, but rather the "heart and mind" of another" (Brown & Gilligan, 1992, p. 28). As described by Edwards and Weller (2012), focusing on the "I" alerted them to an ontological experience of "standing alongside" participants instead of "gazing at them" (p. 215).

In this step, Gilligan and colleagues (2003) encourages the researcher to construct "I" poems, a dissemination technique developed by Elizabeth Debold. In reading or listening through the text, the researcher underlines every participant's use of "I" along with the verb and any accompanying important words or phrases. Each "I" phrase is taken out of the context of the text and positioned on a separate line of the poem in the same sequential order of the text. Stanzas are naturally formed from shifts in meanings or change in tone of voice. Additionally, depending on a participant's style of talking, it might be equally useful to produce you-poems or me-poems, or even we poems (Edwards & Weller, 2012). For example, Edwards and Weller (2012) noted how a daycare worker used *you* to refer to herself and her role in working with children. "You plan like a cooking activity for the children but you have to make sure all the ingredients are in the kitchen" (p. 207). For this study, I produced she-poems to consider how participant's

voices may be influenced by her or his teacher, her dispositions, instructional strategies, and actions. I also constructed we-poems to situate the participant's voices within the context of the classroom and his or her classmates.

In Table 3.7, I have provided an example of an "I" poem constructed from an excerpt from a coeducational female (Katrina) participant's response to a question about her involvement in the classroom, in particular, her hesitancy in raising her hand and vocalizing answers to a problem or question. The column on the left is from the original transcript with I-phrases underlined, while the column on the right is the I-poem.

Table 3.7

Example of an I-poem

I don't really like talking out in class. But I raise my hand because I don't like being a victim. So I raise my hand so that way I don't just randomly get called on. So that way I'll know what I'm talking about. And mumbling, I get nervous when I talk out loud.	I don't like talking out I raise my hand I don't like being a victim I raise my hand I don't just randomly I will know I am talking about I get nervous I talk out loud

From extracting the I-poems for each participant, I began conceptualizing possible voices shaping the mathematics identity of the participants in this study, and at this point in the analysis, voices were maintained as independent of one another; yet,

given formal names as to indicate that the various voices are alive and living within participants' mathematics identity. These voices are displayed in Table 3.8, along with a definition, and accompanying example narrated by one of the participants.

Table 3.8

Voices Emerging from Participants' I-poems

Voice	Defined	Example
Voice of Negative Affect	Voice expresses negative feelings experienced in the mathematics class	I feel fear I feel scared
Voice of Confidential Conflict	Voice expresses contradictory statements in regards to abilities in mathematics; at times includes vague terminology	I am good I am super I get A's I am a little not good I am bad I don't get it
Voice of Confidence	Voice expresses belief in oneself and one's abilities in mathematics	I am a calculator I know every problem I know every answer
Voice of Pride	Voice expresses a sense of superiority above and beyond being confident	I am top dog. I always compete I am smarter
Voice of Reliance	Voice expresses a dependency on another (peer and/or teacher), typically for help	I have somebody I wouldn't have that person I might struggle I wouldn't get as much
Voice of Effort	Voice expresses that participant works hard or puts forth effort to get grades	I will put forth I learn it better I will go home I will get on the computer
Voice of Visibility	Voice expresses taking an active role in the classroom	I am outgoing I pretty much say I don't think I know it I just tell her

Voice of Invisibility	Voice expresses taking a passive role in the classroom	I have stage fright I don't like I would rather not I don't like talking
Voice of Contingency	Voice expresses an if-then relationship	I know it I feel fine I don't know it I get nervous
Voice of a Victim	Voice expresses sense of being "picked on" by one's teacher and/or peers	I don't like being called out I get the question wrong I feel embarrassed
Voice of Neutral Domain	Voice expresses that girls and boys are equally capable of succeeding in mathematics	I do think girls are good I think boys are good I think maybe be equal
Voice of Female Domain	Voice expresses that girls are more capable of succeeding in mathematics than boys	I think girls are smarter I think girls are good I don't think boys are good
Voice of Male Domain	Voice expresses that boys are more capable of succeeding in mathematics than girls	I am not trying to be mean I think boys are more I think girls just don't I just know
Voice of "Good" Student	Voice expresses actions that are associated with being a "good" student	I am helpful I am always focused I am always on time I am always there
Voice of "Bad" Student	Voice expresses actions that are associated with being a "bad" student	I am unprepared I don't have pencils I leave my pencils I am late
Voice of Desire	Voice expresses a longing or a need, but spoken as if not present action	I am right at I hope I can bring I want to bring
Voice of Virtue	Voice expresses moral characteristics	I am trustworthy I am honest I would not lie

Step Three

The third step in the Listening Guide will require at least two readings or listenings in order to hear the voices in a participant's narrated experience. Each reading is intended to listen to only one voice, one for each voice composing one's emerging and dynamic mathematics identity. The goal is to gain an understanding of these multiple voices in relation to the research question(s), which inherently inform what the researcher is listening for. However, before the researcher reads the text, they must conceptualize and define the specific voices to be listened to, as well as determine guidelines or markers that will allow the researcher to know a particular voice when they hear it (Gilligan et al., 2003), which are discussed in more detail below. These predefined and guiding voices are not limited to two and are to be based on scholarly and theoretical work of others. For example, I might expect a male participant's narrative to include an "ability voice" or a voice that attributes his success in mathematics to ability. While on the other hand, I might expect a female participant's narrative to include an "effort voice" or a voice that attributes her success in mathematics to effort (Bornholt & Möller, 2003; Gilbert, 1996; Hyde et al., 1990; Stipek & Gralinski, 1991). These voices are not definite, but can be redefined or a new voice may be conceptualized based on the belief that important information from the participant's narrated experiences are being left out.

Also important in this study is the voice of resistance, a voice that challenges being narrowed, distorted, and constrained by gender stereotypes. The cultural norms and values of a patriarchal society, rooted in the psychological experiences of men, have typically silenced this voice. For example, girls and women have typically sacrificed their

own voice and sense of self than risk losing their relationships with others and experiencing a sense of isolation (Brown &Gilligan, 1992). In listening for this voice, I will note points of confusion and uncertainty, such as the use of "I don't know," which are markers of psychological resistance. Within the context of this study, resistance may arise within the various voices of participants, for example mathematics as gendered domain voice. Male participants for instance may speak of mathematics not a male domain, which is a societal stereotype, but as a gender neutral domain. For example, Matthew, a male enrolled in a single-sex mathematics class expressed a belief of mathematics as a female domain. In his interview, he stated that girls are good at math because they are pushed to do better by others (Matthew/P15/L20 & 24), while boys are not good at math because they always goof around (Matthew/P16/L5). This belief is also supported from his results from on the *Mathematics as a Gendered Domain* instrument (Forgasz et al., 2004), which he scored highest on the female domain construct, a score of 4.13.

With each reading, the researcher listens for a different voice and evidence of the voice is underlined in a different color. It is also not uncommon for one sentence to contain two or more voices; hence, two or more colors. Once the multiple readings and voices are identified, the different colors represent a visual representation of the relationship among contrapuntal voices and the voice of self. The relationships among the multiple voices may be in opposition to one another or complementary to one another.

Guiding voices. Through examining the research on gender differences and single-sex mathematics education, I initially considered mathematics identity as being

composed of at least four voices: (a) self-confidence in mathematics, (b) sense of belonging (c) mathematics as a gendered domain, and (d) gendered position(s) within the mathematics classroom. From this research, I formulated guiding voices that I expected to hear from the female and male participant's narratives. I also defined each voice and provided examples of sentences and phrases I expected to hear. Mathematics identity lies within the interplay (Burke, 2003; Evans, 2008; Roesken et al., 2011; Wood, 2013) of the four voices and are continually in motion, moving fluidly in and out of one's mathematics identity, vying to be heard. However, I expected the guiding voices changed over the course of the study. New voices were heard as part of participant's dynamic mathematics identity (Evans, 2008). Additionally, voices known in the research literature and included as part of this study were omitted and redefined.

***Guiding voice one*.** Male participants, regardless of class type, will voice high-levels of self-confidence in mathematics, while female participants, regardless of class type, will voice a lack of self-confidence in mathematics.

Self-confidence in mathematics is defined as "one's perceptions of their ability to do well in mathematics and to learn mathematics quickly" (Else-Quest et al., 2010, p. 117), which has been argued by Burton (2004) to be intimately associated with the social setting and students' experiences within them. Research suggests that boys report exhibiting higher levels of self-confidence in their mathematical abilities than girls (Else-Quest et al., 2010; Hyde et al., 1990; Lamb, 1997; Leed et al., 2003; Lloyd et al., 2005; Muzzatti & Agnoli, 2007). Utilizing items from Fennema and Sherman's (1976) Confidence in Mathematics Subscale, participants may speak of how math is easy/hard,

that they expect to obtain bad/good grades, and that they can do more/less advanced mathematical work. Hardy (2007) and Darragh (2013) noted how students perceive confidence in mathematics as being competent in mathematics, as being "smart." Self-confidence is also viewed and spoken of as a performative act (Hardy, 2007) in which behaviors such as volunteering to answer a question is seen as being confident in mathematics (Burton, 2004; Darragh, 2013).

In addition, one's self-confidence in mathematics is closely aligned with one's locus of control in mathematics or the extent to which individuals believe they have control of internal (e.g., intrinsic motivation) and external factors (e.g., number of hours studying) in regards to their successes and/or failures in mathematics. Synthesizing the research on, males in both single-sex and coeducational settings attribute their success to ability, while females in a coeducational setting attribute their success to effort (Gilbert, 1996; Hyde et al., 1990; Stipek & Gralinski, 1991). Research on females in a single-sex school suggests they equally attribute their success in mathematics to both ability and effort (Bornholt & Möller, 2003).

Guiding voice two. Male participants, regardless of class type, will voice a sense of belonging in the mathematics classroom. Female participants in the single-sex mathematics classroom will voice a sense of belonging in the mathematics classroom, while female participants in the coeducational classroom will not voice a sense of belonging in the mathematics classroom.

Sense of belonging is defined as the "extent to which students feel personally accepted, respected, included, and supported by others in the school social environment"

(Goodenow, 1993, p. 80), or in this case, the mathematics classroom. To date, there are few studies that differentiate between female and male's sense of belonging, but as noted by Darragh (2013) and Sakiz, Pape, and Hoy (2012), one's sense of belonging may be dependent on members (i.e., teacher and peers) of the classroom, which is important considering the differing class types in this study. In addition, I argue that one's sense of belonging is reliant on becoming (or not) a legitimate peripheral member of the community (i.e., mathematics classroom) (Lave & Wegner, 1991; Wenger, 1998), which may be created and maintained through power relations and other hidden insights (Contu & Willmont, 2003; Paechter, 2003, 2006) such as participating (or not) in the socio-mathematical norms, or normative and accepted practices, activities, and behaviors, of the classroom. (Yackel & Cobb, 1996).

I utilized items from the *Psychological Sense of School Membership (PSSM) Scale* (Goodenow, 1993) while listening to students' speak of their sense of belonging within a classroom context. In listening for this voice, participants may speak of how their peers in the mathematics classroom like (or dislike) them the way they are and value (or not) their opinion. The teacher, in addition, is interested (or not) in them and treats them the same (or different) from other students in the class. I also considered items on the *Math Sense of Belonging Scale*, which is specific to being a member of the mathematics community (Good, Rattan, & Dweck, 2012). Participants that have a high sense of belonging will speak of taking an active role and being included in a lot of the activities in the mathematics classroom (see Nasir & Hand, 2008). They will voice feeling comfortable, accepted, and appreciated as a member of the class. Participants with

a low sense of belonging on the other hand will speak of feeling inadequate, excluded, and/or disrespected. They will voice being situated in the background and being an unnoticed member of the mathematics classroom, not taking an active role.

Guiding voice three. Male participants, regardless of class type, will voice mathematics as a male domain, while female participants, regardless of class type, will voice mathematics as a gendered neutral domain.

Mathematics as a gendered domain can be described as the extent in which students stereotype mathematics as a subject area better suited for males, females, or females and males as equally likely (Fennema & Sherman, 1976; Forgasz et al., 2004). Research suggests that males perceive mathematics as male domain more often than females (Forgasz et al., 2004; Hyde et al., 1990; Leedy et al., 2003), and that females perceive mathematics as a more neutral domain than males (Forgasz et al., 2004). In considering this voice, I searched for dichotomist phrases and sentences (or lack of) praising one gender over another in regards to mathematics. Examining items from the *Mathematics as a Gendered Domain* instrument (Forgasz et al., 2004), these phrases and sentences, as a few examples, may include trusting one gender to provide correct answers more often than the other, perceiving one gender as more naturally gifted in mathematics than the other, or perceiving one gender as being encouraged to do well in mathematics than the other. To reiterate, if this distinction between genders are not apparent, the belief is that a participant view of mathematics is a neutral domain.

***Guiding voice four*.** Regardless of class type, female and male participants will maintain "appropriate" gender roles and characteristics within the mathematics classroom.

Gender roles and characteristics in this study are defined as the "appropriate" societal norms, which begin acting as a filter that leads females and males to conform to the expectations, behaviors, and actions expected of their *sex*, not based on their gender (Bem, 1981). In other words, males tend to navigate toward "masculine" behaviors and actions and females tend to navigate toward "feminine" behaviors and actions. This guiding voice has been and continues to be a point of contention for and against implementation of single-sex education (Bigler et al., 2014; Mael et al., 2004). Does being in a classroom with same sex peers reinforce or diminish students and teachers gender stereotypes as to how girls and boys should behave?

In considering a mathematics classroom, teachers and students tend to assign different adjective descriptions to boys and girls, placing them on opposite ends of the dichotomy rather than placing individual students along the continuum (Fennema et al., 1990; Mendick, 2005, 2006). Based on the research, I will expect this voice to remark and describe females as being non-competitive (Fennema et al., 1990); committed, conscientious, and mature (Morris, 2012; Warrington & Younger, 2000); organized (Morris, 2012; Younger et al., 1999); hardworking (Morris, 2009) and possessing better social skills (BenTsvi-Mayer et al., 1989). Furthermore, this voice will remark and describe males as competitive, logical, and independent (Fennema et al., 1990); vocal

(Warrington & Younger, 2000); disorganized (Morris, 2012; Younger et al., 1999); unconcerned (Morris, 2012); and disobedient (Cullingford, 1993; Morris, 2012).

When analyzing the participants' narratives during this step, I kept the following research question in the forefront, What voices shape the mathematics identities of the female and male students? Building from the voices gained from step two, the I-poems, I began considering the interplay of voices composing participants' mathematics identity, as well as consider participants' lead voice or dominant voice verbally and/or non-verbally communicated through their narratives (Evans, 2008). I started this process by grouping together phrases and sentences for each participant as indicated by the different colors representing the four guiding voices, in addition to any new voices. Next, I unpacked or deconstructed each participant's voices. What is this voice expressing in regards to her or his mathematics identity?

The initial voices gleaned from participants' I-poems (refer to Table 3.8) were re-conceptualized and/or maintained. One, voices were renamed as to be more representative. For instance, the Voice of Confidential Conflict was renamed to Voice of Oscillation to capture the essence of participants' confidence teetering between the two extremes of a high sense of confidence in one's mathematic abilities and a low sense of confidence in one's mathematics abilities, a voice dependent on the content and context of the classroom. Two, new voices were accounted for such as the Voice of At Ease, which captured the context of the classroom sense and participants' sense of belonging. Three, initial voices were collapsed and divided. For instance, the Voice of a Victim was partitioned into the Voice of Outsider and the Voice of Subordinate so to account for the

voices expressing being "picked on" by their peers and/or their teacher, respectively. Table 3.9 presents the voices of participants' garnered through multiple listenings of their narratives, as well as a description of each voice. Again, these voices are represented here as independent of one another.

Table 3.9

Voices Emerging from Step Three Analysis

Voices	Descriptions
Voice of Pride	Voice expresses a sense of superiority above and beyond being confident in one's mathematics abilities
Voice of Oscillation	Voice expresses contradictory statements in regards to mathematics abilities (e.g., smart, understand, quick) and being an active/passive member of the classroom
Voice of Doubt	Voice expresses a low sense of confidence in one's mathematics abilities
Voice of Effort	Voice expresses working hard and efficiently in order to receive good grades, in most instances, a grade of A
Voice of Distress	Voice expresses negative feelings experienced in the mathematics class (e.g., sad, mad, scared)
Voice of Competition	Voices expresses a desire to compare themselves to others in the classroom and/or the school
Voice of Enjoyment	Voice expresses a love for mathematics and an appreciation for the their independence in the classroom
Voice of At Ease	Voice expresses being comfortable in the classroom to take action, such as being willing to volunteer an answer, help others, and ask for help from both teacher and peers
Voice of "Good" Student	Voice expresses actions associated with being a "good" student in school (e.g., pay attention, do all my homework, always on time)
Voice of "Bad" Student	Voice expresses actions associated with being a "bad" student in school (e.g., unprepared, not completing homework)

Voice of Manipulation	Voice expresses actions used to control or influence their teacher and/or peers
Voice of Outsider	Voice expresses being “picked on” by one’s peers; feeling of not being comfortable around their peers
Voice of Subordinate	Voice expresses being a victim of the teacher’s power as an authority figure in the classroom
Voice of the Future	Voice expresses the importance of mathematics for their future role(s) and/or career
We are Different	Voice expresses a belief that females and males are different from one another in regards to mathematics and roles within the classroom
We are Similar	Voice expresses a belief that females and males are similar to one another in regards to mathematics and roles within the classroom

As expected from the multiple listenings in step three of the Listening Guide, and even though as presented as such in Table 3.9, it was difficult to consider the participant’s voices as distinct from one another. The participants’ multiple voices composing their mathematics identities were complex (e.g., Cobb et al., 2009) and in constant interplay with one another (Evans, 2008). To help consider this interplay and address the second research question, how might the interplay of multiple voices embody the dynamic mathematics identity of participants in this study, I constructed what I term voice mappings for each participant. See Figure 3.5 for an example of how I began conceptualizing a voice mapping for Hannabell, a female student in a single-sex mathematics classroom.

To illustrate how part of this voice mapping was assembled, consider the arrow from ‘help others with mathematic’ to the Voice of Oscillation, which was partly conceptualized from the following quote from Hannabel (P6/L36-39, 43).

> Because I think that they think that I know it (.) a lot because I'm not one that would ask a lot of questions. So I think that they think I would be- I would know it and I could help them...It makes me feel smarter.

For Hannabel, helping her peers, or her friends as she names them, makes her feel smart*er*. This indicates that she does not necessarily have a high sense of confidence in her mathematics abilities. It is her friends' willingness to ask Hannabel for help that may be creating a sense of confidence that she may not share as indicated by remarks such as "I'm okay at math. I'm good- pretty good at math because like I get it. But if I don't get it, then I'll figure it out I guess some. I'm kind of good at math, I guess- I would say I'm good at math" (P6/L1-3).

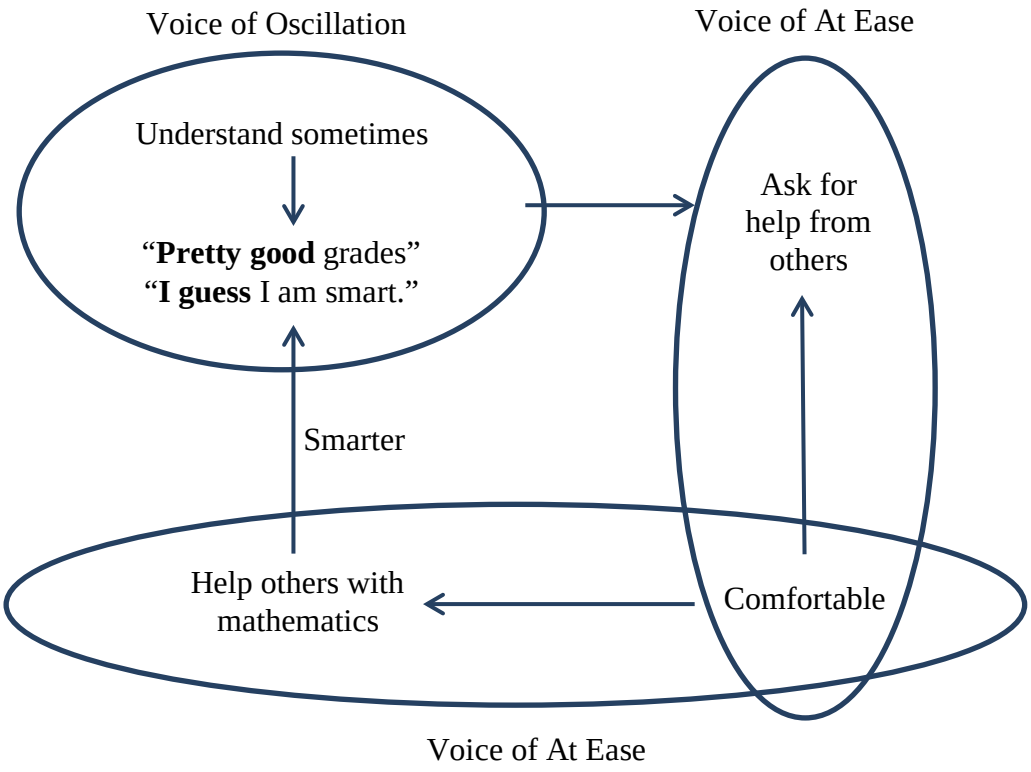


Figure 3.5 Example of a Progressing Voice Mapping

Member Checking

Through the validation interviews (Buchbinder, 2010), many of the participants' confirmed their voices, which built and maintained the trustworthiness of the study in that participants' voices were consistent between two data sources, semi-structured interviews and validation interviews (Creswell & Miller, 2000; Webster & Mertova, 2007). For example, Jennifer confirmed that both the I-poems and the word trees represented her as a mathematics student, and no additional voices arose from analyzing her comments from the member checking process. Additionally, in listening to participants' voices through analysis of the validation interviews, I questioned the voices resulting from step three; in particular, the Voice of At Ease, which was my attempt to condense the number of the voices. Therefore, I deconstructed the Voice of At Ease into the Voice of Visibility and the Voice of Invisibility (as defined in Table 3.8), and the Voice of Assisted and the Voice of Supportive, which expressed receiving mathematical help from others and providing mathematical and non-mathematical help to others, respectively.

Through this process, it also became more apparent how participants' various voices were connected (Saldaña, 2014) and in interplay with one another (Evans, 2008). Therefore, I reconstructed each voice mapping to reflect the voices that participant's confirmed and/or disconfirmed from the validation interviews. As noted by other researchers (e.g., Lareau, 2011), I struggled with maintaining my control as a researcher in portraying participant's mathematics identity and being sensitive to participant's interpretations of their voices as a mathematics student as represented in their I-poems

and word trees (Cook-Sather, 2002; Lincoln & Guba, 1985). Consider the following quote by Dottie at the end of her validation interview.

> It is the way you want to write it and it's all right with me. ... People change the way I say things sometimes. No, I said it that way. But it's okay if an adult does it because it's the way they want it. (P11/L25-28)

In being transparent about my analysis (Webster & Mertova, 2007), there were instances through this process in which a new voice arose from participant's validation interviews and other instances in which a voice was refuted by participant's; and hence, altering the interplay of their voices and their subsequent voice mapping. For instance, the Voice of Effort was discussed within Colin's I-poem he entitled "I work hard" and again when asked if there was anything missing within the word trees, he responded, "I mean I've already made it very clear that I try hard, but I didn't see it" (P7/L40). As another example, I omitted the Voice of Distress from Trevor's voice mapping because as he expressed throughout his validation interview, he has changed since the first interview, therefore, supporting the notion that one's identity is complex (Cobb et al., 2009; Roesken et al., 2011) and ever evolving (Evans, 2008), similar to that of a kaleidoscope. "Because now instead of like last time I as kind of scared that I might get embarrassed for answering something wrong. But now, I kind of get a little bit tickled whenever I get something wrong" (Trevor/P3/L28-30). However, there were also instances in which a participant denied expressing a voice, but I retained because of the participant's language throughout the validation interview. Hannabell, for example stated, "I am okay with math, I would disagree with that. And I am kind of good, I would say I am good at math"

(P6/L12-13). Yet, on several occasions, Hannabell employed tentative language in regards to her confidence as a mathematics student. “It[I-poem] says I am good. I *guess* I would agree with that, but then again I’m just like I *guess* I would say that I’m good” (P4/L8-9). Or “...even if I am doing it right, I might also think I am doing it wrong sometimes” (P6/L26-27), which implies doubt in her mathematics ability.

Following this process, I re-constructed each participant’s voice mapping to reflect the insights gleaned from the member checking analysis. Next, for each participant’s voices, I put together a list of all quotes and I-poems from the interview and validation interview, similar to that conducted by Belenky, Clinchy, Goldberger, and Tarule (1997). The intent in conducting this step was so I could easily find representative quotes and I-poems to include within the results, particularly, in sharing the interplay of multiple voices shaping each participant’s mathematics identity. However, as I reread the quotes, I continued to refine participant’s voice mapping, or representation of their mathematics identity, which was unexpected at this point. For instance, the Voice of Effort was fighting for audibility within the direct quotes of Katrina; hence, changes to her voice mapping were altered to reflect this new voice.

Step Four

In the final step, the goal is to synthesize what has been learned about the participant’s narrated experience into a coherent essay or analysis. The synthesis is to answer the researcher’s question(s). If multiple interviews were conducted, the researcher explores the relationships among participant’s polyphonic voices looking for both similarities and differences. For example, I utilized tables (Saldaña, 2014) as a means to

look for similarities and differences within and among the participant's based on sex and class type. However, I do not attempt to synthesize participants' narrated mathematics identities by thematic patterns, but asked "What have you learned about this question through this process, and how have I come to know this?" (Gilligan et al., 2003, p. 168).

Beyond Reliability and Validity

The issues of validity and reliability so common to quantitative studies are not applicable to studies qualitative in nature, such as this one (Clandinin & Connelly, 2000; Connelly & Clandinin, 1990; Creswell & Miller, 2000; Polkinghorne, 1988; Webster & Mertova, 2007). "Like other qualitative methods, narrative relies on criteria other than validity, reliability, and generalizability. It is important not to squeeze the language of narrative criteria into a language created for other forms of research" (Connelly & Clandinin, 1990, p. 7). Polkinghorne (1988) argued that for narrative research to be valid, conclusions are well grounded and supported, and has the capability to resist challenges and alternatives presented by others. The notion of "statistical significance" within quantitative analysis also takes on a new meaning in narrative research. "A finding is significant if it is important" (Polkinghorne, 1988, p. 176). Even though Polkinghorne did not define "important," I contend that it is my responsibility to show the importance of the results in relation to single-sex education and students' emerging mathematical identities. Moreover, he contended that reliability in narrative research is supported by the trustworthiness and transparency of field notes and interview transcriptions. Using the arguments by Webster and Mertova (2007) and as described by Huberman (1995), I will discuss validity and reliability in terms of access, verisimilitude, authenticity, familiarity,

and transferability. These components are presented as distinct features, but are not mutually exclusive.

Access

Access allows the reader to know about the participants, the context (i.e., time, place, and events), and the negotiations between researcher and the research. First, to avoid homogenizing all the female participants and male participants as a group, or even more generally, mathematics students as a whole, the lived experiences and multi-voices of *each* participant were provided as part of the results of the final text. Furthermore, an image of each participant was invoked through self-identified demographic information and scores from the instrument used to select participants, as well as the use of direct quotes from the interview and/or validation interviews about what they liked and disliked about their mathematics class. Field notes from classroom observations are also embedded within my discussion to support, and at times refute, participant's voices. My hope is that readers are able to identify with each participant as a former student, parent, and/or adult. Second, to structure the narrative inquiry and to provide the reader with an image of the classroom settings, I provided classroom images along with other descriptions such as the posters hanging around the room, as well as describe the mathematical structure of the classrooms. Additionally, I situated the classroom within contexts such as the school and the community. Third, readers need to be aware of the various negotiations (Clandinin & Connelly, 2000) that I continuously encountered throughout the research process, the continuous back of forth of reevaluating and maintaining my role as a researcher. This includes, but is not limited to, negotiating

relationships with participants, negotiating the purpose of the research study, negotiating my place within the field, negotiating the writing of the final text, and negotiating personal shifts and changes in my beliefs of mathematical identities. Such negotiations were written about and maintained in my researcher journal and as part of my analytic memos in my typed field notes, and are included in various sections throughout this text.

Access also implies allowing others retrieval of the data, as well as knowing the data sources I utilized and a detailed schedule of data collection. Interview protocols, along with a sample analysis of a participant's interview through each of the four steps of the Listening Guide, are provided within the text and as part of the appendices. I provided voice mappings and tables (Saldaña, 2014) as to make my analysis more transparent. For example, I utilized a table to display how participants' voices that compromise their dynamic mathematics identity may differ based on whether they are in a single-sex or coeducational classroom. This table streamlined the practice employed in the Listening Guide – underlining voices in various colors. Additionally, quotes provided within the final text were tagged (Weber & Mertova, 2007) to identify participant, page number, and line(s) of which the quote was drawn. For example, a quote tagged as (Barbara/P7/L22-26) will refer to the interview of the participant with the pseudonym Barbara, page seven, and lines 22-26. An addition of VI, (Barbara/P7/L22-26/VI) indicates that the direct quote was from participants' validation interview. Field notes are tagged as (10.21.14_6) to designate the data of my observation, followed by the observation number. Therefore, this example refers to the sixth observation conducted on October, 21, 2014. This practice allows others access to track supporting data to its direct source.

Verisimilitude

Verisimilitude, or trustworthiness, is the second characteristic. To begin, having prior research experience in collecting data has taught me some of the skills and methods I needed for this study. As a researcher, I have had experience with conducting classroom observations and interviews with participants ranging from three to sixty-five years of age. I have refined my note-taking skills during my fieldwork and have learned how to listen and engage participants in conversation during interviews. Additionally, trustworthiness was accomplished by presenting results that are plausible and likely to be confirmed through similar cases and contexts (Clandinin & Connelly, 1990; Polkinghorne, 1988; Webster & Mertova, 2007). In showing the results as plausible, readers are assured that alternative explanations are not feasible or that the findings have not been altered as to provide a happy ending (Clandinin & Connelly, 1990) or aligned with a researcher's intended purpose of the study. Member checking, or the process of asking participants to confirm or disconfirm the voices of their lived experiences through I-poems and word trees, was another means that I as a researcher utilized to build and maintain the trustworthiness of my findings (Webster & Mertova, 2007).

Authenticity

Authenticity is achieved by presenting enough information that the final text is read and perceived by readers as a serious and honest account. One way I ensured authenticity was to ask participants to read through and comment on their I-poems and word trees that emerged from my data analysis. As stated above, this technique is known as member checking.

Familiarity

Familiarity is defined by Amsterdan and Bruner (2000) as "when our ways of conceiving of things become routine, they disappear form consciousness and we cease to know that we are thinking in a certain way or why we are doing so," (p. 1). Through the use of narrative inquiry, familiarity can be noted through the stories told by the participants, particularly the expected voices found within male and female participants' narration of their dynamic mathematics identity regardless of the class type. For instance, as a former teacher and present student, I was not surprised to hear participants speak often of grades (i.e., A, B, C, D, or F) through their self-confidence in mathematics voice. As I am familiar with how students' self-confidence in an academic subject area is positively correlated with academic performance (Tavani & Losh, 2003). However, in noting that which is familiar, a researcher is able to discover that which is unfamiliar, those voices that differ from other participants and from what may or may not be found within the literature. Uncovering the unfamiliar is to "rescue the taken-for-granted and bring it back into mind" (Amsterdam & Bruner, 2000, p. 1), to consider what may or may not make a single-sex mathematics classroom a unique setting, which are highlighted and discussed in Chapters 4 and 5.

Transferability

Transferability, equivalent to external validity within quantitative analyses (Lincoln & Guba, 1985), refers to the amount and specificity of information provided by a researcher as to allow another to reconstruct the study and apply the results to another setting; implying that results are not universal and generalizable to middle grade students'

emerging mathematical identity at large. It is the responsibility of the reader to make the proper comparisons of the research setting to a setting in which they are familiar. To aid in the transfer of this research study, readers may access my data sources and analyses. I provided detailed descriptions of the context and the participants, and I was transparent in my intentions and possible biases. The goal is for other researchers to replicate this study so to either strengthen or challenge my results.

Ethical Issues

Narrative inquiry research is fraught with making decisions or choices throughout the entire process, decisions that are laden with ethical issues or tensions between moral and research obligations (Clandinin & Connelly, 2000; Josselson, 2007). Josselson (2007) discussed adopting an ethical attitude as, "a stance that involves thinking through these matters and deciding how best to honor and protect those who participate in one's studies while still maintaining standards for responsible scholarship" (p. 538). I have a responsibility to protect the privacy and dignity of my participants. As noted by Webster and Mertova (2007) this includes, but is not limited to, informed consent, honesty and truth, and confidentiality. I would even argue that I have a responsibility to myself to maintain my ethical dispositions as a human being and as a researcher. I have had to live emotionally and intellectually with the decisions that I have made throughout this research study from conception to the writing of the final text to even my conversations with the two teachers with whom I worked alongside.

Prior to contacting possible participants and collecting data, the research study was approved by the university's Institutional Review Board (IRB). The role of the IRB

is to protect the rights and welfare of participants. Research cannot be conducted without the approval of the IRB, and within narrative inquiry research, completing the appropriate IRB forms may pose an ethical issue because the research process is relational and reflexive (Clandinin & Connelly, 2000; Josselson, 2007). The intent and purpose of the research may change and the results not anticipated. Understanding is emergent and negotiated and cannot be explicitly described at the onset of the research study; therefore, Josselson (2007) advised using statements that are more general.

Such ethical concerns was also considered in informing the participants of the purpose of the researcher study, how data was collected, what their role entailed, and how the data will be disseminated. It is not likely that the researcher will be able to be anticipate and explicitly delineate all aspects of the research study within an informed consent form. However, as a researcher I was forthcoming and honest with the participants and their parents throughout the entire research process; and as suggested by Josselson (2007), the more public the final text, the more the researcher should seek participant's consent at each stage. For example, prior to the each interview and validation interview, I described the purpose of this part of the research study, what they should expect, as well as how I intend to use the information. It is possible that the participants and their parents signed the informed consent form without intently reading it (Josselson, 2007).

As a researcher, I was also concerned with maintaining participant's confidentiality and anonymity (Clandinin & Connelly, 2000; Josselson, 2007; Saldaña, 2014). Steps were taken such as using pseudonyms in saving files and within the final

text, maintaining electronic files on a password protected computer, and storing consent forms and other forms of written documentation in a locked filing cabinet. This information is made apparent within the IRB application and in the student and parent informed consent forms. Yet, it is possible that participant's anonymity may be compromised, as well as the location of the school. The participants and other students in the classroom and school may tell others about the research study and what information I collected (Clandinin & Connelly, 2000). I may be seen by visitors to the school who further probe into my presence within the school and in a particular mathematics classroom (Clandinin & Connelly, 2000). It is also possible that within writing the final text – in describing the participants and using direct and indirect quotes – the participant's identity may be revealed. Ethically, I must balance being true to the participants and the data and being aware of my scholarly audience and my position as a researcher (Clandinin & Connelly, 2000; Josselson, 2007). Throughout the process, there were questions that I was faced. For instance, how do I "force" students to express their feelings and concerns in the interview process without being leading in my follow-up questions? What does silence imply in the interview process? Should I break the silence or wait for the participants to speak? In conducting member checks, how should I proceed when a participant disagrees with my conclusions and portrayal of him or her? Such ethical dilemmas may have also altered my interpretation of the data and the writing of the final text. How might my observations influence how I interpret the data? How can I best represent each of my participant's dynamic mathematics identity, the interplay of their evolving voices? Therefore, I have an obligation to my participants, my audience,

and myself to adopt an ethical attitude (Josselson, 2007; Saldaña, 2014), and to make the entire research process accessible, trustworthy, authentic, familiar, and transparent to all readers.

Wakefulness

Wakefulness, as termed and defined by Clandinin and Connelly (2000), refers to ongoing reflection as a researcher. It means to be wakeful and thoughtful of all my decisions or lack thereof, and how these decisions may or may not influence the research process. For instance, the following is an analytic memo from my fourth day of observation in the all-girls class, "I do not get to see the participants much while in stations, so plan to come on days when in Station 1 or 4. I want to see them interact with Ms. Mole and other girls" (Jennifer_9.30.14_4). Therefore, I began observing on days in which at least one of the participants in the all-girls class was assigned to Station 1 or 4 for the day, the two stations in which Ms. Mole instructs the girls on a new mathematical concept.

I extend Clandinin and Connelly's notion of wakefulness to include awareness of my personal subjectivities and assumptions, from the construction of the research questions to my role as an observer within the classroom, and even my role as interpreter and disseminator of the data. How did my background and visible features of a White, female impact how I analyzed the data? How might my previous role as a mathematics teacher influence what I observed and took note of while in the classroom? How has my role as a graduate assistant influenced my analysis? What might have "blinded" me to seeing the "truth" within the narratives of participants' experiences? Many of these

questions were discussed and maintained in my research journal and field notes. For instance, “I feel so heartless when I watch this class and am wondering if it’s the “cold” nature or feel of the classroom environment. Is it just because they are boys and I am a female that I feel this way or could it be the very nature of the structure of the classroom and condescending tone of the teacher” (Colin_9.23.14_2_Analytic Memo 1).

As a female student within the discipline of mathematics, I confess that I do not feel confident in my mathematical ability, and in the past, have deemed mathematics as a subject area dominated by males. Even in considering the literature on single-sex mathematics education and gender differences within the subject area, my view is blurred because the majority of research suggest males perform better on mathematics tests (e.g., Forgasz & Hill, 2013), have less anxiety (e.g., Else-Quest et al., 2010), and report possessing higher levels of confidence in their selves (e.g., Lloyd et al., 2005) and in their ability to be successful in mathematics (e.g., Bornholt & Möller, 2003).

Additionally, as a former high school mathematics teacher, I was cognizant of how I passed judgment or commented on the teacher’s classroom management, instructional methods, or classroom procedures. Even though focusing on the teacher is irrelevant to the phenomenon being studied, it at times served as a distraction from observing the participants; yet, served me well in considering how the teachers may or may not have influenced their students’ mathematics identity. The following is a statement made in my researcher journal on September 13.

> And even though my focus has turned to student observations, I cannot help but feel the weight of the teacher on students’ mathematics identities. I feel as if

students are not allowed to form identities in the classrooms I am observing because of the need or desire for the teacher to control everything. Maybe this outweighs societies "grip" on the mathematical beliefs and perspectives of students.

My role as a doctoral student and the professors I have worked under and with have also shifted how I view students and the mathematics classroom as a micro-society. In relation to this study, I am more critical and aware of the underlying and hidden aspects of mathematics education such as teachers' tendency to direct more than half of their questions toward boys (Altermatt et al., 1998; Barba & Cardinale, 1991; Younger et al., 1999), or how language and discourse structures a hierarchy of power within the mathematics classroom (Herbel-Eisenmann & Wagner, 2010; Herbel-Eisenmann, Wagner, & Cortes, 2010; Lim & Presmeg, 2011). I believe that such awareness was useful when taking note of specific instances of participants' verbal and non-verbal actions. Such instances were useful in posing observation questions in participants' interviews.

I also have not experienced a single-sex classroom as a student, but I have as a researcher on two other research studies. My role in one project was to video record an all-female, an all-male, and a coeducational mathematics classroom taught by the same teacher. My role in the other study was to observe an all-female and an all-male mathematics classroom and interview selected students about their experience within the single-sex setting. In both of these projects, I found myself relating more to the girls as an observer and former student. I felt empowered as a female mathematics student, teacher,

and teacher educator as I watched the female participants collaborate with one another, when a majority of the girls volunteered an answer to a question, or even the excitement that engulfed me as they each entered the classroom. It was as if I could put myself in their shoes. On the other, I had a difficult time relating to boys in the all-male class. Even though they all made me feel comfortable and welcomed me as an observer in their classroom, obviously, being a female influenced what I noticed. Moreover, from my previous work as a researcher, I have assumptions based on some of the results and preliminary findings that I must overcome. As an example from my research journal noted on August 29,

> Students seem unwilling to be themselves or free to talk about things other than mathematics. But in saying this, I realize I am comparing this classroom setting to my work with Mr. Christopher. I cannot let my previous experiences in a middle school single-sex classroom over shadow what I am observing now.

My biases and assumptions as a former mathematics student, a former mathematics teacher, a future mathematics educator, and a present day doctoral student and researcher no doubt influenced what I observed in the classroom, the questions I posed in the individual interviews, my construction of I-poems and word trees, and how I wrote my final research text, to name a few. Yet, through my awareness and making these known throughout the process, within my researcher journal, field notes, and reflections in analyzing the interviews, my subjectivities surfaced and strengthened my interpretations and final manuscript (Clandinin & Connelly, 2000).

Boundaries and Strengths

Throughout the study, from beginning to end, there were several boundaries. Yet within these boundaries or limitations, there was also value. First, this study was conducted with participants under the guidance and instruction of two teachers in one rural middle school in a remote area in the United States. These two teachers had different classroom structures, one employed stations, while the other used traditional classroom seating arrangements of desks. In addition, as expected, the two teachers varied in her pedagogical mathematical practices and instruction, the manner in which she communicated with her students, and in her classroom procedures, to name a few. Such differences were not controlled by the researcher because in doing so would alter participants' voices, as well as alter the natural classroom setting. However, employing two teachers within this study was embraced and accounted for within the analysis of participants' interviews and validation interviews, as it will contribute to our current understanding of the influence of the teacher (e.g., Boaler & Greeno, 2000).

Second, in conducting observations, my presence potentially altered the classroom environment and the behavior and actions of participants. As described by Connelly and Clandinin (2000), as researchers, "we are in the parade we presume to study" (p. 81). In other words, I simultaneously lived the experience with my participants. Furthermore, partaking in informal conversations with the participants, or even the teacher, unconsciously affected participants' experiences and sense of identity as meaning is shared and co-constructed. Yet, in being situated within the classroom, my intention was to build a relationship with participants so as to diminish the participant-

researcher power struggle, as well as minimize the participants' feeling of always Othered (Lahman, 2008).

Third, in conducting interviews and validation interviews, meanings were co-constructed between participant and researcher, which in return may have influenced participants' identity construction (Hollingsworth & Dybdahl, 2007). Meanings were also dependent on the types of questions posed during the interviews and validation interviews, as well as the specific I-poems and word trees selected for interpretation during the validation interviews. In addition, the participants in the study were able to provide narratives about their experiences and thoughts in their mathematics classroom that they could remember and wished to discuss. As noted by Greene and Hill (2005), there are "limits of a what a focus on experience can tell us about the other" (p. 6). Interviews are not "true" or accurate depictions of reality, but an artifact of language (Polkinghorne, 1988; Tsai, 2006) and dependent upon social situations (Gergen & Gergen, 1988). It is an imagined reproduction composed of distortions, lies, self-delusions and/or wishful thinking (Huberman, 1995; Polkinghorne, 1988; van Putten, Stols,& Howie, 2014). But in conducting interviews, the stories shared indicated a noteworthy and significant experience worthy of being discussed. In addition, the member checking process indicated a critical event, an event that revealed a change in participants understanding or worldview (Webster & Mertova, 2007). In the interview process, the stories told by participants "molds them [experiences] into a meaningfulness that is greater than the meaningfulness they originally hold" (Polkinghorne, 1988, p. 31). These noteworthy stories allowed me to gain information unconscious to participants and

allowed me to discover taken-for-granted assumptions or voices (Bell, 2002). Another value to conducting interviews was the potential to overcome the effect of unconscious bias when responding to survey items (Polkinghorne, 1988).

Fourth, the extensive amount of time to analyze the data limited the number of participants to a small sample size (Bell, 2002). Yet as stated by Byrne and colleagues (2009), the amount of time in using the Listening Guide to analyze the interview data is worth it. Fifth, the analysis of the data and the retelling of participant's stories were my own interpretation (Bell, 2002; Connelly & Clandinin, 2000; Josselson, 2007; Polkinghorne, 1998; Webster & Mertova, 2007), and do not reflect an exact mirror of how participants viewed her or himself or their respective experiences (Josselson, 2007). It is an interpretation based on personal biases, subjectivities, and experiences, in addition to my knowledge of relevant literature (Webster & Mertova, 2007). It is an ethical issue as the participant's stories and voices changed ownership to my jurisdiction, and became more powerful as the oral word became a written text (Connelly & Clandinin, 2000; Josselson, 2007).

CHAPTER 4

FINDINGS

Introduction

In this chapter, key learnings from the data analysis are discussed in regards to the research questions of this study. The first question to be addressed is the voices that are shaping the mathematics identity of the female and male participants in this study. The multiple voices are defined and organized under the four guiding voices, self-confidence in mathematics, sense of belonging, mathematics as a gendered domain, and stereotypical gender roles. In addition, new voices, those not accounted for in the four guiding voices, will be presented. To answer this research question, the voices will be presented as distinct and independent of one another. The second question to be addressed is how the interplay of participants' multiple voices embodies their mathematics identity. To answer this question, each participant's mathematics identity will be shared and privileged; therefore, providing each participant with a living expression in this study (Cook-Sather, 2002; Gilligan, 1982). The third question to be addressed is the similarities and differences among participants' voices between and among sex and class type. The fourth question to be addressed is how the classroom type may be shaping the female and male participants' dynamic mathematics identity in this study. Beyond classroom type, other external factors shaping participants' dynamic mathematics identity will be discussed, which additionally highlight subtle nuances in participants' voices.

The Voices

Here I address the research question, what voices shape the mathematics identities of the female and male students? The first guiding voice was self-confidence in mathematics, defined as "one's perceptions of their ability to do well in mathematics and to learn mathematics quickly" (Else-Quest et al., 2010, p. 117). Also, considered within this guiding voice was self-confidence as expressed through their actions or lack thereof (Hardy, 2007) and self-confidence as expressed through participants' attributions for successes and/or failures in mathematics. Within this guiding voice of self-confidence in mathematics, participants communicated eight varying voices. Table 4.1 displays the eight living voices (use of expres*es* rather than expres*ed*), along with a definition, and an example statement from one of the participants.

Table 4.1

Voices Expressing Self-Confidence in Mathematics

Voice	Definition	Example
Voice of Pride	Voice expresses a sense of superiority above and beyond being confident in one's mathematics abilities	I know a little bit more than her [the teacher] in math.
Voice of Oscillation	Voice expresses contradictory statements in regards to mathematics abilities	I'm good- pretty good at math because I'm like I get it. But if I don't get it, then I'll figure it out, I guess.
Voice of Doubt	Voice expresses a low sense of confidence in one's mathematics abilities	If you're guessing, you're not having confidence in yourself like me.

Voice of Effort	Voice expresses working hard and efficiently in order to be successful in mathematics	Because I am willing to put forth the effort to make good grades.
Voice of Visibility	Voice expresses taking an active role in the classroom, typically due to one's mathematical understanding	I raise my hand when I know the answer.
Voice of Invisibility	Voice expresses taking a passive role in the classroom, typically due to one's lack of mathematical understanding	I wouldn't want to work a problem out on the whiteboard. I wouldn't want to.
Voice of Assist	Voice expresses giving mathematical help to others	I feel like I'm helping her and not hurting her in math.
Voice of Inquiry	Voice expresses receiving mathematical help from others	I'll ask the teacher for help and ask her what should I do first.

The second guiding voice was sense of belonging in the mathematics community and/or classroom. This guiding voice was defined as the "extent in which students feel personally accepted, respected, included, and supported by others in the school social environment" (Goodenow, 1993, p. 80). Within this guiding voice, participants communicated six varying voices. Table 4.2 displays the six living voices along with a definition, and an example statement from one of the participants.

Table 4.2

Voices Expressing Sense of Belonging in the Mathematics Community and/or Classroom

Voice	Definition	Example
Voice of Outsider	Voice expresses being "picked on" by one's peers; feelings of being "the other" (Davies & Hunt, 1994)	Like nobody liked me. No body sat with me.

Voice of Subordinate	Voice expresses being a victim of the teacher's power as an authority figure in the classroom	I normally raise my hand because I don't like just randomly called on
Voice of Visibility	Voice expresses taking an active role in the classroom, typically due to being comfortable in one's classroom	It seems like a safe environment to like raise your hand
Voice of Invisibility	Voice expresses taking a passive role in the classroom, typically due to not being comfortable in one's classroom	I don't like saying things in front of the class. That's scary. People just stare at you and give you looks.
Voice of Inquiry	Voice expresses being comfortable with receiving mathematical help from others	She makes me feel comfortable to where I can go to her and just ask her for help.
Voice of Assist	Voice expresses giving non-mathematical help to others	I'll flip her book open for her and I'll help when she's busy.

In examining the third guiding voice, mathematics as a gendered domain, participants' expressions and narratives were condensed to We are Different and We are Similar. We are Different is defined as a *belief* that females and males are different from one another in regards to mathematics and gendered roles within the classroom. We are Similar is defined as a *belief* that females and males are similar to one another in regards to mathematics and gendered roles within the classroom. After analysis of the participants' interviews and validation interviews, these were not viewed as living voices shaping participants' becoming and evolving mathematics identity (Evans, 2013), but as beliefs, or external factors, influencing what the participants' see within the mathematics

classroom, and therefore shaping the participants' dynamic mathematics identity in this study accordingly. This will be discussed later in this chapter.

The fourth guiding voice was participants' views of stereotypical gender roles and characteristics defined as "appropriate" societal and/or classroom norms. These voices are commonly found from the scholarly work on gender differences. Within this guiding voice, participants communicated five varying voices. Table 4.3 displays the five living voices along with a definition, and an example statement from one of the participants.

Table 4.3

Voices Expressing Stereotypical Gender Roles and Characteristics

Voice	Definition	Example
Voice of "Good" Student	Voice expresses actions associated with being a "good" student in school	Most people will sit there and like talk and whisper while she's trying to teach. But I, I don't. I just sit there and pay attention.
Voice of "Bad" Student	Voice expresses oppositional actions associated with being a "good" student in school	But I normally don't have pencils with me most time.
Voice of Competition	Voices expresses a desire to compare themselves to and compete with others in the classroom and/or school	I didn't get that at all. And then everybody else like got it in a snap.
Voice of Enjoyment	Voice expresses a love for mathematics and an appreciation for the their independence in the classroom	I like math. I just like numbers. It's fun.
Voice of the Future	Voice expresses the importance of mathematics for their future role(s) and/or career	Because I want my math work to perfect and go to Clemson.

In addition to the voices gleaned within the four a priori guiding voices, one new voice (Evans, 2008) was articulated by participants, the Voice of Manipulation. This voice expresses actions used to control or influence their teacher and/or peers. For example, “I'll pretend to raise my hand just so she thinks I know the answer and call on someone else who doesn't.”

Interplay of Participant’s Voices

To address the research question, how might the interplay of multiple voices represent female and male’s dynamic mathematics identity, the voices are not presented as distinct and independent from one another as above, but as an interplay of voices, vying for audibility (Evans, 2008), and moving in and out of one another while simultaneously shaping each participant’s mathematics identity, similar to that viewed at the opening end of a kaleidoscope. Therefore, the voices are “interdependent because each exists not merely for itself but precisely for the other, and each hears itself and its echo in the response of the other, now colored with the other’s intentions, emotions, and predilections” (Roth, 2009, p. 260). In addition, the validation interviews illustrate how participant’s rejected some voices and accepted other voices; therefore, changing who they are being perceived as mathematics students (Evans, 2008).

Each participant’s interplay of voices composing their narrated mathematics identity is presented below for several reasons. One, none of the participant’s mathematics identity was the same, supporting the notion that one’s mathematics identity is complex (Cobb et al., 2009). Two, as stated at the end of Chapter 2, presenting each participant’s mathematics identity is counter to the majority of research that examine

females and males as two distinct, yet homogeneous groups. Participants are unique individuals and therefore, are privileged as individual mathematics students here. Each participant's interplay of voices, and ensuing mathematics identity, are presented in the order in which I observed participants in the school day, male participants in the all-boys class, female participants in the all-girls class, and female and male participants in the coeducational classes. My interpretations of each participant's mathematics identity is represented through my narratives, my words and my language, but with direct quotes from the interviews and validation interviews and/or participant's I-poems (Bakhtin, 1981; 1986), as well as field notes from my observations. The direct quotes and field notes were included based on how clearly the voices of the participants were captured and enacted within the classroom, respectively. Readers are encouraged to listen, rather than read, to participants' multiple voices and join the relationship formed between each participant and myself (Gilligan et al., 2003).

Additionally, I illustrate my interpretation of each participant's interplay of voices composing their mathematics identity through a voice mapping. Voice mappings are used to provide readers with access (Webster & Mertova, 2007) to how I made sense of the manner in which participant's multiple voices were in interplay with one another (see Figure 4.1 for a hypothetical voice mapping).

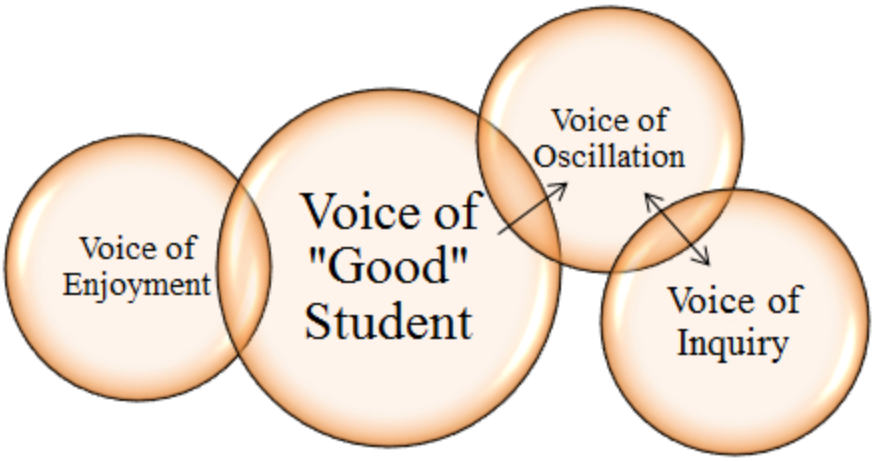


Figure 4.1 Hypothetical Voice Mapping

The voices are represented by overlapping translucent circles to indicate how one's mathematics identity is not static, but dynamic and constantly in flux. This is a further indication that from my analysis voices co-exist with another (Evans, 2008) rather than contrapuntal to one another (Gilligan et al., 2003). In addition, arrows are embedded within the voice mappings to indicate the relationship between voices. By way of example, the arrow (→) between Voice of "Good" Student and Voice of Oscillation in Figure 4.1 would be represented by a statement such as I pay attention in class and do my homework, so I make pretty good grades. A double arrow (↔), as between the Voice of Oscillation and the Voice of Inquiry, would represent a cyclic relationship between two voices such as I will ask for help from the teacher when I am unsure of the what to do, which will help me learn more. Additionally, there are some overlapping circles without arrows because the voices seem to be living in accordance with one another. For example, it is not evident that one voice, the Voice of "Good" Student, is impacting another voice, the Voice of Enjoyment and vice-versa (see Figure 4.1). The size of the

circles also had significance. The largest circle identified the lead voice of the participant's mathematics identity, the voice in which participants' most pervasively identity (Evans, 2008). In most instances, this was indicated by how the voices interplayed with one another, the voice that seemed to be in direct relationship with other voices. This is indicated in voice mappings by the overlapping circles and placement and direction of arrows. But on other instances, participant's lead voice was identified by the emphasis placed on the adjectives expressed when asked to describe themselves as a mathematics student. The differing font size was not significant, but based on practicality.

As each participant's narrated mathematics identity is presented, I include a quote that epitomizes my subjective interpretation of the participants' mathematics identity, a quote that preoccupied my mind either as a researcher, a former student, and/or a former mathematics teacher. The participants are then represented with self-identified demographics and information about things they liked and disliked about their mathematics class, which was gathered from their interviews. A voice mapping representative of participant's interplay of voices, or their mathematics identity, are provided next, supported by direct quotes, field notes, and statements that describe or explain the voices, and how the voices are in relationship with one another. To conclude each narrative, I briefly reflect on my personal subjectivities documented in step one of the Listening Guide, as well as my understanding of participants' mathematics identity, as a way to close my relationship with each participant formed through my observations, my interviews, and my analyses.

Colin "That's what I mostly care about, just getting an A" (P3/L16/VI).

Colin self-identified as a White, male student, who rated himself as good at mathematics. He is one of 23 students in the all-boys class and was chosen for this study because of his high score on the neutral domain subscale (4.69) on the *Mathematics as a Gendered Domain* instrument. Colin described his mathematics class as hard, enjoying getting stuff done fast because of his good teacher, but disliking going a little bit too fast because it confused him; hence, what he disliked is based on a self-deficit influence, but what he liked was identified as an external influence. He described his teacher, Mrs. Ely, as hardworking, yet sometimes a little mean, and his peers as both cool and smart. Colin himself was described by another participant as, "funny and he looks like a nine year old. And he has glasses. ... He's my best friend" (Matthew/P10/L25-27).

Colin's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of Effort, the Voice of Invisibility, the Voice of Competition, and the Voice of Inquiry (see Figure 4.2).

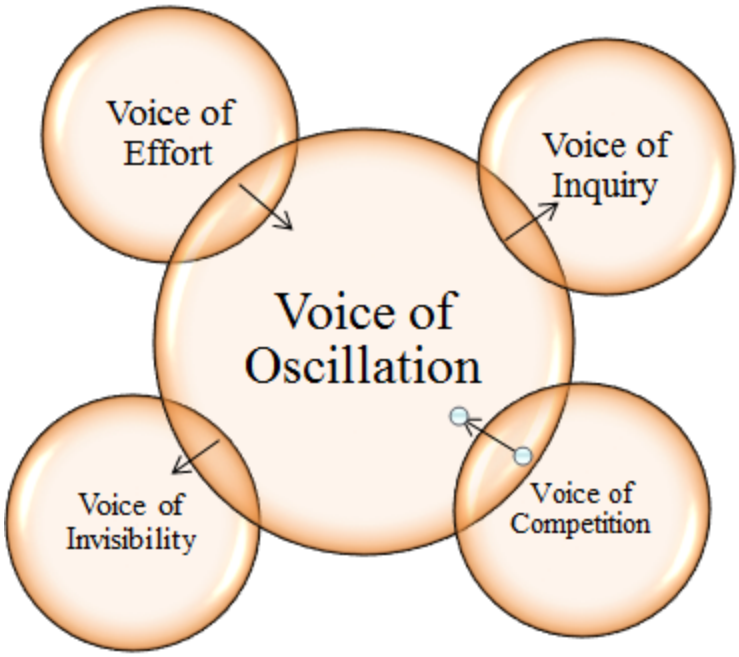


Figure 4.2 Colin's Voice Mapping

Colin's lead voice, the Voice of Oscillation, was expressed throughout his narrative, which is indicated by the overlapping circles and arrows in his voice mapping. Colin's Voice of Oscillation expressed contradictory statements in regards to his self-confidence in mathematics. Because he was enrolled in an advanced mathematics class, this voice was articulated at a class level and an individual level, as he considered the class "pretty hard. I mean it's not too hard" (P1/L29-30), and in moving fast through the content, he experienced moments of confusion and feeling stupid. Yet, he countered this with describing himself as smart and confident, which is equated with getting an A in this class, and that as the content in the class has become more difficult, he stated he was "okay with a B. I used to hate B's, but now I'm okay with a B in her class" (P2/L40/VI).

Colin confirmed in his validation interview that there were moments when he felt good as a math student and moments where he was unsure of himself as a math student.

I would contend that Colin's Voice of Oscillation was also observable in his mathematics class. The following is an example from my sixth day of observation (10.10.14) entitled "Stumped," in which Colin's gestures (as indicated by italics) during a test may be an indication of confusion.

> After about 18 minutes, C walks to the back of the room and asks Mrs. Ely a question about one of the problems on the FF test. As he sits back down, he appears stumped. *Sitting forward in his desk with one leg propped under him to lift him up. He sits with his hand in his hair and rubbing his eyes and the top if his right ear.* After about 22 minutes, C places his answer key in his notebook...

Colin also conveyed a Voice of Effort, which he recognized as influencing his self-confidence in mathematics (Voice of Oscillation). "If I don't work hard, then I'm not going to be smart" (P4/L7/VI). This voice was represented in an I-poem entitled "I work hard," and was selected by Colin as the I-poem most representative of him as a math student.

I am hard working.
    I will always try.
    I always do
    I try
    I will do that
    I always want
I am better.
    I tried harder

A Voice of Competition was communicated by Colin as a way to compare himself to others in his mathematics class and grade level, which in return shaped his Voice of Oscillation in contrasting ways. In some instances, Colin's Voice of Competition improved his self-confidence in mathematics. "We spent time on something that we started last year and I understood it. So, I like knew what I was doing. And then I felt smart because I felt I was one of the best in the class at doing that" (P3/L26-28). Conversely, this voice at times diminished his self-confidence in mathematics. "I didn't get that at all. And then everybody else got it in a snap" (P3/L37). This voice was represented in a one-word word tree entitled "compete," and was selected by Colin as the word tree that represented him the most as a math student. "If you are the smartest one in an advanced class that means you are the smartest boy in the grade at math. I think that's why I put a 10 for compete" (P6/L39-41/VI). This voice corroborated with my observations. "Bell rings. C asks M, "What did you get on your agenda?" M does not answer. But M's partner says he got a 97. C says that he got a 99. C asks him again. M replies with 93" (10.10.14_6).

Colin's Voice of Oscillation was not only being shaped by the Voice of Effort and the Voice of Competition, but this voice was shaping his Voice of Inquiry and Voice of Invisibility, which the latter two voices were typically related to his lack of self-confidence in his mathematics abilities. Colin's Voice of Inquiry was most audible when Colin spoke of asking for help from Mrs. Ely because something was hard, and asking for help would only help him do better. Additionally, the Voice of Invisibility was communicated by Colin to indicate how uncomfortable he was speaking in front of a lot

of people, especially when responding to a mathematical question or problem. “Like if it was a question that our teacher asked us and anybody could raise their hand, I don’t think I would raise my hand because I don’t want to just shout a random answer and get it completely wrong” (P7/L12-14).

In general, I was not surprised by Colin’s voices composing his mathematics identity because, with the exception of the Voice of Invisibility, I in a sense observed each of his voices. I would argue that Colin was an active member of the classroom, raising his hand to answer questions, explaining how he solved a problem, and talking with his peers about an assignment; therefore, exhibiting the Voice of Visibility rather than the Voice of Invisibility. Colin thus positioned himself as a peripheral member of the mathematics classroom. As exemplified in Colin’s voice mapping (see Figure 4.2), the majority of his audible voices were articulated within his wavering sense of confidence in his mathematical abilities, which is apparent not only by the voices themselves, but by the relationship between the interplay of his voices.

Justice “I mean it don’t really matter. We’re just in there to learn” (P8/L31-32).

Justice self-identified as a White, male student, who is excellent at mathematics. He was selected as a participant because of his enrollment in the all-boys mathematics class and for his high score on the male domain subscale (3.69) on the *Mathematics as a Gendered Domain* instrument. Justice liked the beginning activity at the start of each class period because it covered many types of math, but disliked the textbook because it was boring. He described Mrs. Ely as being nice because of how she made the math easier to understand. His classmates were described as smart because this was an

advanced mathematics class. Justice seemed indifferent to many questions during the interview. Similar to the above quote, he stated on many occasions that things such as class type and seating positions in the classroom did not matter because it was just math class, which he confirmed during the validation interview.

Justice's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of Effort, the Voice of Competition, and the Voice of the Future (see Figure 4.3).

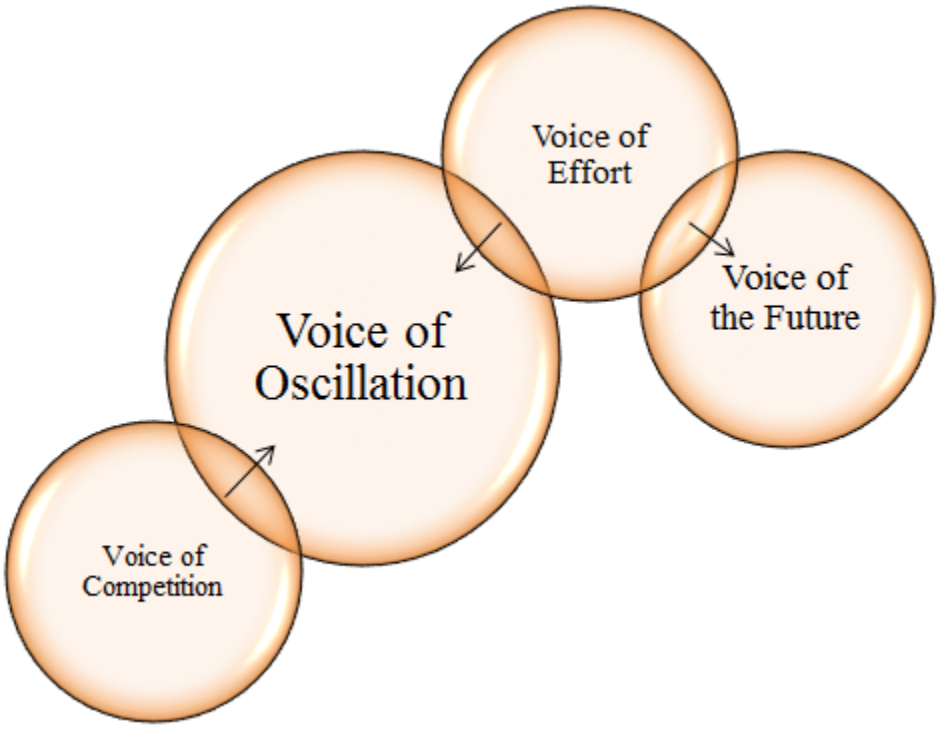


Figure 4.3 Justice's Voice Mapping

Justice's lead voice was the Voice of Oscillation, and through selecting the I-poem entitled "Test" to be most like him as a math student, Justice too believed this voice to be the most audible. Justice's Voice of Oscillation was indicative in his use of the hedge word "pretty," which implied a level of uncertainty or doubt (Rowland, 1995) in

his mathematical abilities. For instance, “I’m pretty smart at math. I’ve always been pretty smart. I’ve always made pretty good grades” (P5/L45). Justice’s uncertainty may also be suggested in his use of the word “most” in explaining why understanding was selected as an adjective to describe himself as a math student. “Like most of the time I understand math a lot. Most of the time I can explain it. (P6/L7 & L11) Because most of the time, I get things pretty easy” (P12/L20). I considered the use of hedge words to be significant in the Voice of Oscillation because it was not audible in Justice’s other voices composing his mathematics identity. In addition, Justice situated himself as an average math student, or in the middle of his classmates, which exemplified his Voice of Competition. “I’m not like the best, but I’m not the worst” (P4/L43/VI).

A Voice of Effort was expressed by Justice as a means to make good grades, which directly impacted his Voice of Oscillation as indicated by the arrow in his voice mapping and represented by the following quote. “Because to make good grades you have to put forth effort. And I want to make good grades, so I try to put in as much effort as I can” (P5/L8-9/VI). Justice articulated how he was willing to do what was necessary in order make the grade and was best exemplified in his I-poem entitled “extra work.”

I am willing
  I will be able
  I will put forth the effort
  I learn it better
  I am willing to put forth the effort
  I will go home
  I will get on the computer
I am willing
  I do the homework
  I spend a lot of time

This voice was also in direct relationship with his Voice of the Future, which implied that Justice recognized the importance of mathematics for his future. “Because I am willing to do extra work to get good grades. I want to do better in school, so I can get a good job someday. Because you could end up with a really good job and make a lot of money” (P1/L5 & L7/VI).

Justice, in my opinion, was a reserved individual in the classroom and during the interview process; therefore, as a researcher, I was interested in understanding how Justice voiced his mathematics identity. It appeared as though Justice was intentionally hiding or choosing to be silent, possibly not providing a space for his voices to be audible. At first, I likened this to possessing a non-opinionated attitude. As illustrated in Justice’s voice mapping (see Figure 4.3), his mathematics identity was missing voices in regards to his sense of belonging in his classroom. The most audible voices were those that uttered a fluctuating self-confidence in his mathematics abilities. Yet, Justice also expressed two voices that positioned him as conforming to behaviors and actions expected of his sex.

Matthew “I am top dog” (P11/L34).

Matthew self-identified as an Asian, male student excellent at mathematics. He was enrolled in the all-boys mathematics class taught by Mrs. Ely. Matthew was chosen to participate in this study because of his high score on the female domain (4.13) on the *Mathematics as a Gendered Domain* instrument. Matthew described the class as boring and had a negative disposition not only to the class in general, but to his peers and his teacher. For example, when asked what he disliked the most about his class, his response

was Mrs. Ely because “she tries to teach and the way she talks to people when she- like she even tells you to be quiet when someone like coughs or sneezes” (P2/L14-15). In his validation interview, he claimed feeling as if he could not be himself as a mathematics student in this classroom; therefore, I claim suffocating the audibility of his voices, which will be delineated below.

Matthew’s mathematics identity was expressed as an interplay of the Voice of Pride, the Voice of Visibility, the Voice of Competition, the Voice of Manipulation, the Voice of Outsider, the Voice of Subordinate, and the Voice of a “Good” Student (see Figure 4.4).

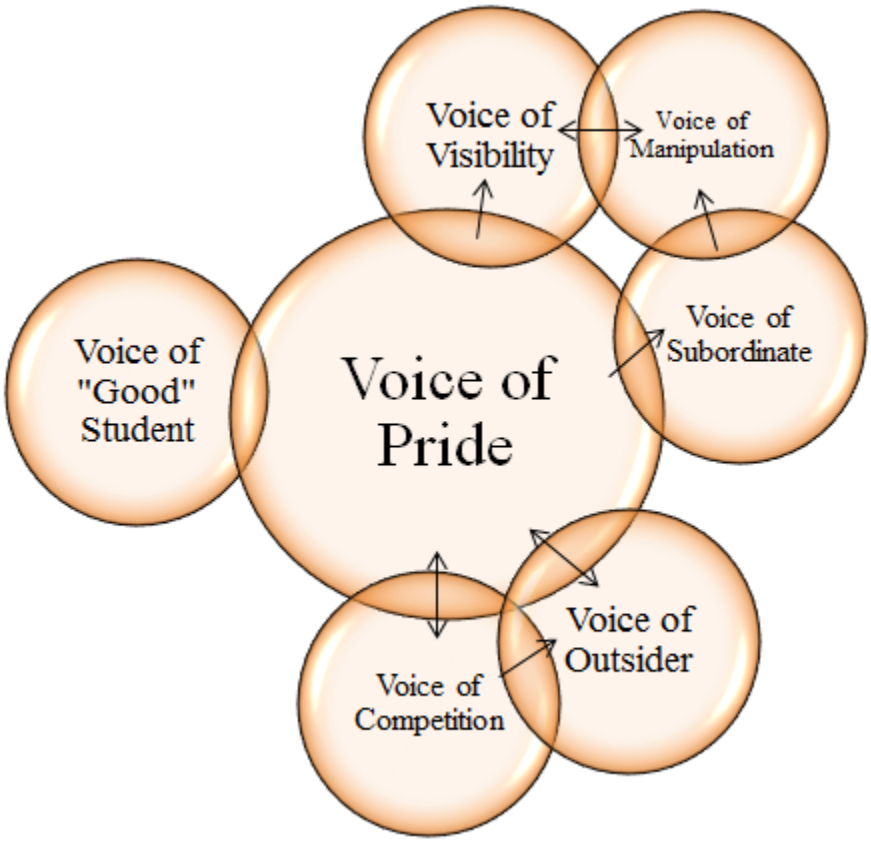


Figure 4.4 Matthew’s Voice Mapping

Matthew's lead voice was the Voice of Pride because this voice not only influenced how he viewed himself as a mathematics student, but also affected how he acted and reacted to his peers and teacher in the mathematics class. Matthew consistently expressed in both his interview and validation interview how he was the smartest in the class, if not the smartest mathematics student in the entire school.

> I feel too smart in that class. Because I know in other classes, I wouldn't be the smartest one in the school, but I know I'm like one of the smartest in this school at math. They make me feel, they make me feel so smart because they're not. Because like it makes me so frustrated how much they're off. (P3, L13-16)

He communicated how it did not take him long to learn new concepts, which in his opinion is detrimental to Lindell Middle School.

> Well the work is pretty easy. Because it's not that hard to learn a lesson, like learn one of those lessons in the math book. Like it doesn't take a whole week like Lindell makes it. Lindell's not that smart. That's why I'm going to [another school] next year because Lindell is not the smartest school. [Lindell] in not really smart. (P3/L1-3/VI) I probably could [teach myself] if I had a math book, but it would be better if a teacher taught me. (P3/L11-12/VI)

Matthew even claimed that he was smarter than many of his mathematics teachers, in this case, Mrs. Ely. "But I feel like I know a little bit more than her in math. Because she gets all her answers off the math book and she even reads the stuff wrong" (P4/L2 L6/VI). Within my observations, I witnessed Matthew challenging Mrs. Ely at times. The following is one instance of several taken from my ninth observation (10.14.14).

> He also questions the answer on #4, if the area of a base doubles, what will happen to the volume. He states that if you double the base, you double both the width and the length because they shift over. Ms. Ely informs him that it is the area that doubles and not the base. Yeah, but to get the volume you have that times something else time something else. Ms. Ely brings out a rectangular prism to explain, but it was no help. So she gets 2 Kleenex boxes to show what happens when you double the area. Yeah, but you make this longer too. Wouldn't the volume be four times as much? I walked over to M and showed him where his thinking was going astray. M states that he always won last year when he argued. Ms. Ely tells him to keep trying because he will probably win sometimes.

Within his validation interview, Matthew made several statements regretting how he came across in his I-poems and word trees that were representative of this voice. "Well I was trying to tell the truth, but the truth is mean sometimes. I was just trying to tell facts about the classroom and I put in on paper. And on paper it makes me look like a jerk" (P10/L23-24/VI). In addition, when asked during his validation interview if there was something that represented him as a mathematics student that was not included, he responded that he is reliable because he always completes his homework assignment. Therefore, I add the Voice of "Good" Student, but this was the only instance in which this voice was audible, and explicitly audible by request of the participant.

Matthew also communicated a Voice of Competition, in which he noted how much he enjoyed competing with other students in the class because it made him feel smarter; thus, influencing his Voice of Pride. But that in competing so much, he tended to

lose friends; thus giving a bringing life to the Voice of Outsider, which at times Matthew positioned himself as the "other" rather than allowing himself to be positioned as the "other" by his peers. He stated that his classmates are "jealous of me because I even hear them. I always go the harder way on the questions and they're like where do you get these numbers Matthew. Gosh" (P4/L24-26). His classmates typically refused to compare grades with him because they "don't want to see how stupid they are" (P7/L16/VI). In addition, guarded against making mistakes in front of his peers because it showed a sign of weakness in his mathematics ability; thus, he maintained his position as an "other." Matthew stated, "I would work a problem out on the whiteboard. Cause I usually know the answer. (P12, L33) But if I'm not sure of the answer, I wouldn't because I don't want people to see that I make mistakes too" (P13/L9-10).

In Matthew's perception of himself as a mathematics student (Voice of Pride), He felt as if he was "picked" on by his teacher and the following she-poem, Matthew entitled "the truth," is illustrative of this voice, the Voice of Subordinate.

She tries to teach
She talks
She makes me feel bad
She didn't go over
She says nope

She always go
She asks me
She thinks I'm cheating
She is asking me

She thinks I know
She calls on someone else
She never calls on

Matthew also articulated being an active member of the classroom (Voice of Visibility), which is in direct interplay with his Voice of Pride. “I raise my hand just to prove how smart I am” (P4/L15). Matthew claimed that on a scale between 1-10, he raised his hand “like a 7 or a 6” (P7/L3/VI). I witnessed this voice active within his mathematics classroom during my first observation (9.9.14).

> For question 1, Mrs. Ely calls on a boy, yet his answer was incorrect. M raises his hand to respond, but Mrs. Ely did not call on him. For question 3, on finding supplementary angle to 75, M raises his hand to respond, but again not called. For question 4, 7.3 cm = _____m, M raises his hand. Ms. Ely calls on him. Seventy-three thousandths. For question 5, M raises his hand again, but not called.

Matthew also articulated a hidden voice, which was discussed in his validation interview, the Voice of Manipulation, which was the word tree selected by Matthew to represent him most as a mathematics student. This voice appeared to be a way to compensate for the Voice of Subordinate, which required him to be a vocal member of the classroom (Voice of Visibility). For example, “I'll pretend to raise my hand just so she thinks I know the answer and call on someone else who doesn't” (P10/L36-37). He also expressed manipulating his actions in the classroom so he would be moved to another seat, as well as writing a bunch of random things on his homework and classroom starter problems to give the illusion of completing his work really good.

Matthew’s expressed mathematics identity fascinated me as a researcher because many of his voices were not expected such as the Voice of Subordinate or the Voice of Manipulation. I thoroughly enjoyed observing him in the mathematics classroom because

he had such a visible presence, displayed an eagerness for learning, and challenged his teacher. As Matthew's voices suggest, he had a high sense of self-confidence in his abilities as a mathematics student, which was also exhibited in his active involvement within the classroom. Yet, it appeared as though Matthew did not have a high sense of belonging within his mathematics class because he positioned himself as the "other" in relation to his peers and perceived himself to be dominated by the power structure inherit within the institution's classroom setting and/or teacher's actions. Therefore, additional Voices were audible, such as Voice of Manipulation, to allow Matthew a way to manage his present classroom situation as he continually develops his mathematics identity and is continually becoming a mathematics student.

Hannabell "I think it makes me feel good that they think I am smart" (P5/L43).

Hannabell self-identified as a White, female student excellent at mathematics. She was chosen to participate in this study because she was enrolled in the all-girls mathematics class and for her high score of 3.94 on the female domain subscale on the *Mathematics as a Gendered Domain* instrument. The class, specifically the stations, was described by Hannabell as fun, yet boring. The class was not considered to be a normal math class where students were required to sit and listen to a teacher, then complete a worksheet. Yet, it was considered boring because it was simply math. Ms. Mole was described as funny, really nice, and strict, while her classmates were described as nice helpers.

Hannabell's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of Assist, the Voice of Inquiry, and Voice of Enjoyment (see Figure 4.5).

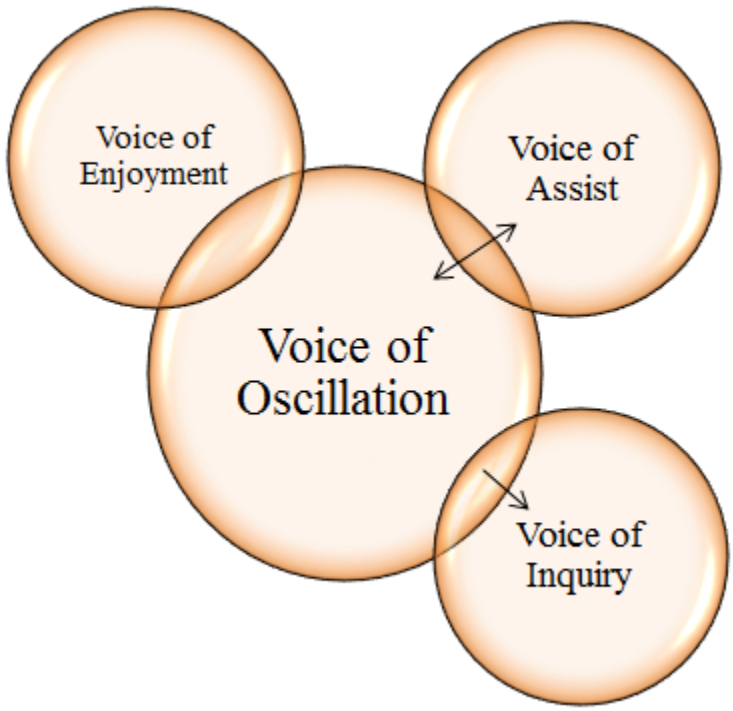


Figure 4.5 Hannabell's Voice Mapping

Hannabell's lead voice was the Voice of Oscillation because of its relationship with at least two other voices composing her mathematics identity. Similar to other participants, Hannabell's Voice of Oscillation was revealed in her use of a variety of hedge words including "guess," "kind of," and "usually" (Rowland, 1995). Here is included one of Hannah's I-poems entitled "I am good at math."

I guess I am good
    I am okay at math
I am good
I am pretty good
    I get it
    I don't get it
    I will figure it out
I am kind of good
I would say I am good
    I am the one
    I get it
    I will know
I usually feel good
I am usually proud

Yet Hannabell did not specify what she was pretty good at doing, other than math in general. There was little to no mention of being pretty good because of grades or understanding specific content or answering questions posed by Ms. Mole. In addition, Hannabell had a tendency to doubt her ability in mathematics.

> Well sometimes if I don't get it. I start doing it and then even if I'm doing it right, I might also think I am doing it wrong sometimes. It just depends on if I really know it for sure or if I'm not really sure about it. (P6/L28-30/VI).

This uncertainty in her self-confidence in mathematics influenced the shaping of both Hannabell's Voice of Inquiry and Voice of Assist. Take the following quote as representative of her Voice of Inquiry.

> If you were good, even though you're good, you might still need help. So you still need to get help for it. You always need to ask and make sure, if you are not sure on it. So I am good at math, but you also need help even if you are good at it. (P5/L15-17/VI).

The Voice of Assist was in a cyclic interplay with the Voice of Oscillation. Hannabell discussed how she enjoyed helping her friends in math, and in many instances, her friends, or the other girls in the class, asked her for help because "I think that they think that I know it a lot because I'm not one that would ask a lot of questions" (P6/L36-37). In providing mathematical support to her friends, Hannabell discussed how this made her feel good about herself, as well as feeling smarter; therefore, affecting her Voice of Oscillation. There were many instances in my field notes in which I documented Hannabell helping her peers. This is a short excerpt from my field notes on October 10, 2014 entitled "Helper or Helpee." "H compares her answers to the girl on her left. She explains to the girl to move the decimal two spots and she makes a motion with her hand to illustrate."

One other voice expressed by Hannabell was the Voice of Enjoyment that indicated an appreciation for her independence in a "funner" classroom. "You're by yourself most of the time, so you can do your own stuff. But you get to do extra things except just sit there and stuff" (P2/L39-40). She enjoyed the freedom provided within her mathematics classroom such as working in one of the computer stations and having the freedom to complete the assignments at home if she could not concentrate while in class. This expressed voice in a sense negates the Voice of Inquiry as one expresses independence and the other expresses reliance; yet the Voice of Enjoyment is dependent on the classroom structure and the Voice of Inquiry is based on her perceived mathematical abilities.

Based on my observations, I contend that Hannabell may be over-confident in her portrayal of her confidence in her mathematical abilities. Throughout my field notes, I noted Hannabell's uncertainty in completing assignments and appearance of exhibiting anxiety when grading work in class. For instance, "H looks as her partner counts the number she missed – 7. "How?" H grabs her homework from this girl, lays it next to the one she just graded, and double checks that the girl graded her work correctly" (9.26.14_3). On the other hand, as Hannabell's voices imply, she felt comfortable receiving and giving help in her mathematics classroom; therefore, possessing a high sense of belonging. This was further indicated through Hannabell's use of "friends" to describe her peers in the all-girls class. Hannabell's sense of belonging appeared to be influenced by her relationship with her classmates and the structure of the class in stations rather than a personal or professional relationship with her teacher. This was further supported in the Voice of Enjoyment, communicated as appreciating the independence established within the stations. A voice I would consider a voice of resistance in that Hannabell did not express a conventional female role, but one typically perceived traditional to males. However, it is uncertain whether this voice is fighting for audibility or being silenced by the Voice of Inquiry.

Jennifer "I guess because my parents always tell me that I'm smart" (P3/L41/VI).

Jennifer self-identified as a White, female student, who rated herself average at mathematics. She was one of 17 female students enrolled in Ms. Mole's all-girls mathematics class. She was selected to participate in this study because of her score on the male domain subscale (3.19) on the instrument *Mathematics as a Gendered Domain.*

In general, Jennifer was positive about her experience in the classroom. She liked that it was an all-girls class, and when asked what she disliked most about the class, she responded with, “I don’t think I really dislike anything about it” (P2/L3). Interestingly, when asked to describe her teacher, she began with Ms. Mole played music for them while working independently, to continue with how Ms. Mole was helpful. Her classmates too were described as being very helpful.

Jennifer’s mathematics identity was expressed as an interplay of the Voice of Doubt, the Voice of Visibility, the Voice of Inquiry, the Voice of Assist, and the Voice of a “Good” Student (see Figure 4.6).

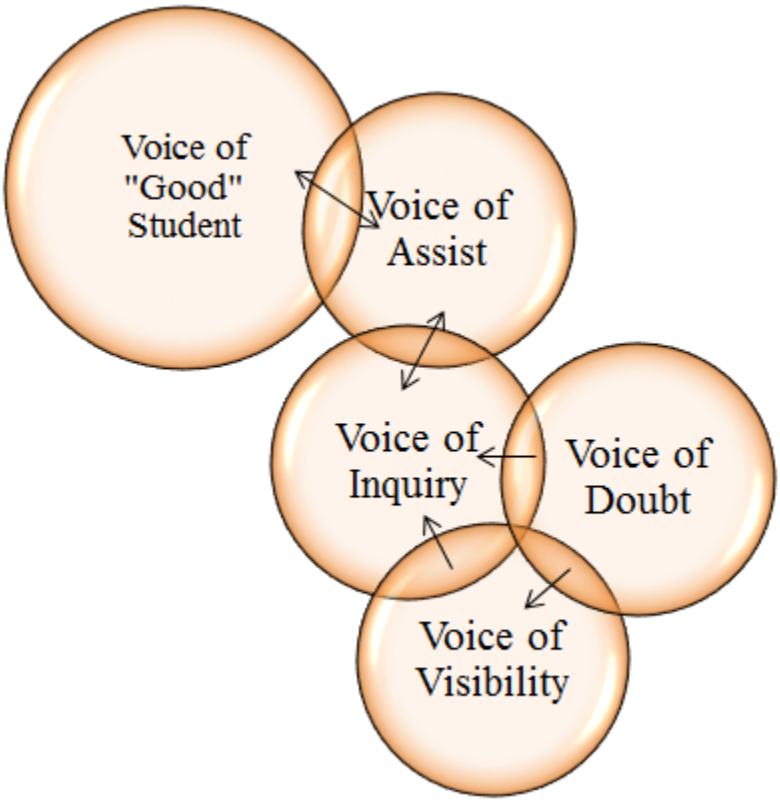


Figure 4.6 Jennifer’s Voice Mapping

Jennifer's lead voice, the Voice of "Good" Student, was due to her emphasis placed on adjectives that described her as a student in general, such as being trustworthy, honest, and helpful, rather than a mathematics student. Take the following explanation as an example of being trustworthy.

> If the teacher is like needing me to like carry something to the library or carry something to the office, they can trust me not to like wander off down to other classrooms and like peak into other classrooms. (P5, L31-33) I think Ms. Mole needed me to take something to the office one time. And I went straight to the office and then straight back to the classroom. (P5, L37-38)

It was only after forced to choose a fourth adjective that Jennifer stated, "I guess I would say smart" (P4/L47). Jennifer too confirmed this voice as one that represented her best as a mathematics student; selected the I-poem entitled "Honest math student."

The Voice of "Good" Student was also in a cyclic relationship with the Voice of Assist, particularly in how Jennifer provided non-mathematical support to Ms. Mole. But in addition, the Voice of Assist was audible in Jennifer's statements in providing mathematical help to others in her class. "I would help Barbie and help other students that need help with anything they needed" (P5/L26-27). I also observed this voice exhibited in my observations of Jennifer in her mathematics class. The following is an example from my twelfth day of observation (10.27.14).

> While J is working, the girl sitting next to her taps her arm and asks about how to do the problem that Ms. Mole just explained. J says to take the $40 and multiply by .67, then you get your answer. Did that help? Yeah.

Additionally, the Voice of Assist was in a cyclic relationship with the Voice of Inquiry. “I guess because I know that if I help somebody and I need help, then they’ll help me back. And I know that if even Ms. Mole is teaching or something, I know that after she’s done, she will come help anybody that needs it” (P5/L32-34). This statement also exemplifies how she received help from not only her peers, but Ms. Mole as well. This combination of “Help/Helper” from one of the word trees was chosen by Jennifer to represent her well as a mathematics student. In many instances too, Jennifer’s Voice of Inquiry was dependent on her Voice of Doubt. She had a tendency to seek confirmation from Ms. Mole rather than being reliant on her own mathematical abilities. “She raises her hand to ask Ms. Mole if she rounded to the nearest cent correctly. Yes because cent means to the nearest hundredths. “That’s what I thought”” (10.13.14_9). Jennifer confirmed this assumption in her interview (P4/L19).

Expanding upon Jennifer’s Voice of Doubt, her statements were typically negatively stated, regardless of her making good grades. The following I-poem, composed of I-statements from her interview and validation interview, is representative of this voice.

I get frustrated
I get confused
    I want to make sure
I get frustrated and confused
    I am not real comfortable
    I can’t find
    I can’t think
    I am having a mental breakdown
I will get frustrated

Surprisingly, Jennifer's Voice of Doubt did not hinder her from being an active member of the classroom, asking and answering questions, and being willing to work out problems on the whiteboard. But additionally, her Voice of Visibility was also a way to seek mathematical assistance from Ms. Mole or her peers (Voice of Inquiry). This relationship among the three voices is represented in Jennifer's voice mapping (see Figure 4.6) and within the following quote. "I would be willing to go up to the whiteboard and work out a problem (P6/L46). Because I know that if I get the problem wrong, that Ms. Mole will like talk through it and make me understand it more" (P7, L3).

Jennifer was the participant I believe likened me the most as a former mathematics student; her demeanor in the classroom and how she spoke of herself and her beliefs during the interview and validation interview. It seemed as if there was a desire to please others before doing things for herself, and would argue that this was expressed in her voices such as the Voice of "Good" Student, and even as exemplified in statements about pleasing her parents. She articulated and was observed taking an active role in the mathematics classroom, for instance, asking and answering questions of Ms. Mole and of her classmates. I sensed that Jennifer was at ease and very comfortable in her mathematics classroom. And as illustrated in Jennifer's voice mapping (see Figure 4.6), the most audible voices implied her exhibiting a high sense of belonging. Yet, she stated a low sense of confidence in her mathematical abilities. Through Jennifer, I questioned how my experience in mathematics might have been different if I had been afforded the option of enrolling in an all-girl class.

Savannah "I know I have a lot of potential and I should use it" (P2/L37/VI).

Savannah self-identified as a White, female student excellent at mathematics. She was enrolled in the all-girls mathematics class taught by Ms. Mole and was selected to participate in this study because of her high score on the neutral domain subscale (4.88) on the *Mathematics as a Gendered Domain* instrument. In this class, Savannah enjoyed Ms. Mole, more specifically how she was funny and made jokes, yet disliked having to do the same thing every day. She had reservations about her classmates. "Some people I get along with and then there's others that are just, they're not serious" (P3/L43-44). Throughout my observations, I witnessed Savannah form a close relationship with another female in the class, Aaliyah. This was supported by Savannah, who confirmed that they were not in the same social circle, but "I have gotten close to her over math. I probably wouldn't have even been her friend. I wouldn't have known her, so math has really brought us close" (P7/L8-10/VI). This relationship has influenced how Savannah expressed herself as a mathematics student and will become more apparent below.

Savannah's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of Visibility, the Voice of Inquiry, the Voice of Assist, the Voice of Effort, and the Voice of "Good" Student (see Figure 4.7).

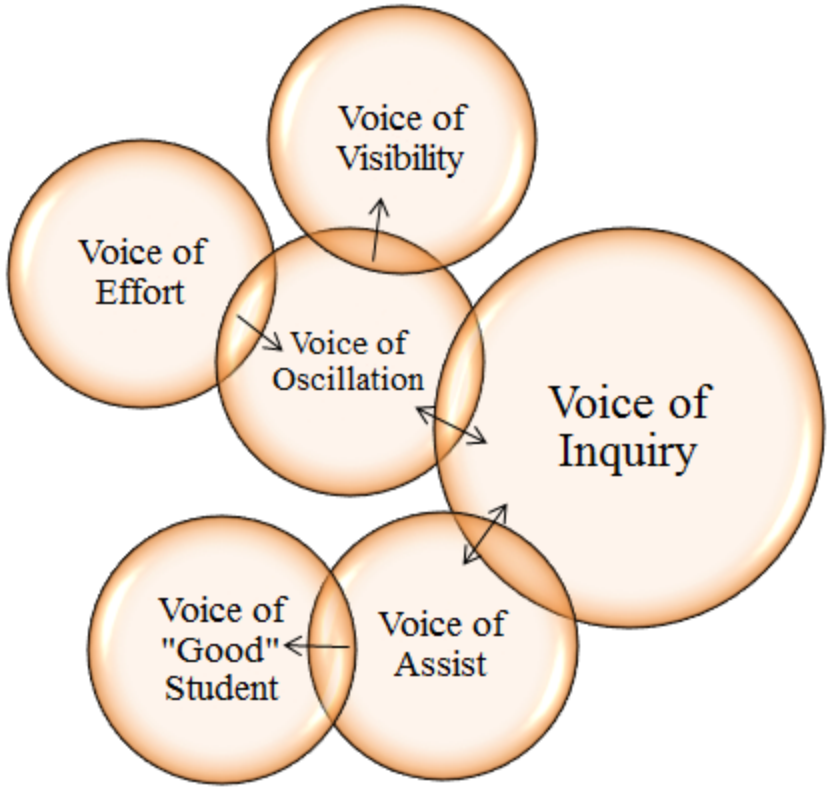


Figure 4.7 Savannah's Voice Mapping

The Voice of Inquiry was Savannah's lead voice, and as noted above, this voice was forming and shaping her mathematics identity because of another female student in her class, Aaliyah, whom she spoke of often. Savannah remarked on several occasions how if Aaliyah were not a member of her math class, particularly in the same station, she would struggle at mathematics. Savannah referred to Aaliyah as a guide, a reference, an individual she could rely, and as noted in the following quote, an individual she depended on more than Ms. Mole. "I feel like it's something that helps me more because I have somebody there that like understands and like is going through like the same problem. Not necessarily a teacher who doesn't see it from my, from my perspective" (P3/L1-3).

Not only did Savannah receive help at mathematics, but she also provided help to others, Aaliyah in particular (Voice of Assist). “Like if I don't know something then I'll ask her and she knows it. And if she doesn't know something, I'm pretty good at helping her” (P2/L40-41). I too witnessed this cyclic relationship during my tenth observation (10.21.14).

> On one of the problems, S turns to ask “the girl” about it. S raises her hand and I overhear enough to conclude asking Ms. Mole about percent of error problem, which was not reviewed earlier. S discusses with Ms. Mole for a few seconds before “the girl” contributes what she did in solving the problem. S erases her problem and her and “the girl” continue to discuss a few of the problems.

Yet beyond providing mathematical aid to Aaliyah, Savannah commented on providing non-mathematical support, support that would be deemed appropriate for a student (Voice of “Good” Student). “And I’ll get her out paper. And I’ll flip her book open for her and I’ll help when she’s busy. And like when she’s still packing up, I’ll get her computer ready for her” (P6/L36-38). Yet Savannah too expressed exhibiting traits of a “good” student. She described herself as being a serious and a focused mathematics student, who always completed her work even when she was absent. As an example, she selected serious as an adjective to describe her as a mathematics student because “there’s a time and there’s a place where you can goof off. ... And I’m really serious about it [math] and I don’t really goof around” (P6/L19-20).

Savannah’s Voice of Oscillation may be summarized by the following statement. “Well some days, I feel really good about it. Like I’ll go in there and I’ll do really good.

And then other days, I don't feel as confident and I don't really do good" (P2/L15-17/VI). As this quote suggests, Savannah at times exhibited a high or positive self-confidence in mathematics, but at other times, exhibited a low or negative self-confidence in mathematics. She expressed how class and math in general were easy for her, and wished she were in a higher class so that she could be challenged. Additionally, she stated that she typically made A's and B's in this class and worked at a fast pace. Yet, Savannah also experienced moments of confusion, more specifically in regards to certain content areas such as geometry concepts. In her confusion, Savannah sought out assistance, which in return helped her mathematically. This accounts for the double arrow between the Voice of Oscillation and the Voice of Inquiry in her voice mapping (Figure 4.7). As an example from Savannah's validation interview, "And I do get confused and I don't know what to do, but as soon as she comes over there and she helps me set it up, I get it right there" (P5/L44-46/VI).

But Savannah acknowledged that she had to put forth effort to be a successful mathematics student; thus, her Voice of Effort was a direct influence in shaping her Voice of Oscillation, and was selected by Savannah to be the one that best represented her as a math student (I-poem entitled "I can do better than what I put in."). Furthermore, Savannah blamed her success or lack of success in mathematics on her own efforts and not on an external motivation factor such as rewards. "I do feel like I deserve what I get because what I put into it is what I get out of it. And if I don't study, it's my own fault. I can't argue with that" (P2/L24-25/VI). The last voice composing Savannah's mathematics identity is her Voice of Visibility, which was expressed as a "bad habit" that

she “can’t really stop.” And being an active member of the class are at times due to her Voice of Oscillation, particularly her lack of knowing if an answer is right or wrong. “And like things I don’t think I know, I’ll *tell* [not ask] her that way she can help me” (P2/L39/VI).

As indicated from Savannah’s narrated mathematics identity, she had a high sense of belonging within the classroom environment, which was typically articulated through a sense of comfort with her peers and her teacher. I would argue that in many instances, Savannah’s expressed and observed actions in the classroom, particularly the Voice of “Good” Student and the Voice of Assist, was similar to the role of a “motherly” figure such as opening another’s book to the correct page, getting another’s computer ready, or distributing calculators to her classmates. As a researcher, I was surprised that Savannah did not voice a higher level of self-confidence in her mathematical abilities because I would have considered her a confident mathematics student. Placing myself in her shoes as a student, I was excited to see a friendship with another girl develop around the mathematics in the classroom and I question whether such a relationship would have developed in a coeducational mathematics setting. Yet, it appeared as if this friendship did not transcend the classroom itself or beyond the mathematical content. And it is possible that Savannah was becoming dependent on this individual because “I always have her there” (P7/L1/VI), which may be influencing how she perceives herself as a mathematics student, particularly in regards to her self-confidence.

Cameron "I don't like to talk about how much better I am" (P3/L13/VI).

Cameron self-identified as having an ethnicity other than the ones listed on the survey. In addition, he identified as a male student good at mathematics. He was in Ms. Mole's coeducational mathematics class, one of 15 males in a class of 28 students. Cameron was chosen to participate in this study because of his high score on the male domain subscale (4.00) on the *Mathematics as a Gendered Domain* instrument. Cameron expressed how much he enjoyed the structure of the classroom, the stations, because it was unlike a regular type of class. In other words, he liked that his mathematics class was not structured in rows of desks in which he had to listen to the teacher provide instructions and introduce new mathematics concepts on a daily basis. And similar to Jennifer, he did not dislike anything about the class and noted how Ms. Mole "plays weird music" (P3/L23). He described his peers as being either goofy or calm, but did not discern based on gender.

Cameron's mathematics identity was expressed as an interplay of the Voice of Pride, the Voice of Enjoyment, the Voice of Effort, and the Voice of the Future (see Figure 4.8).

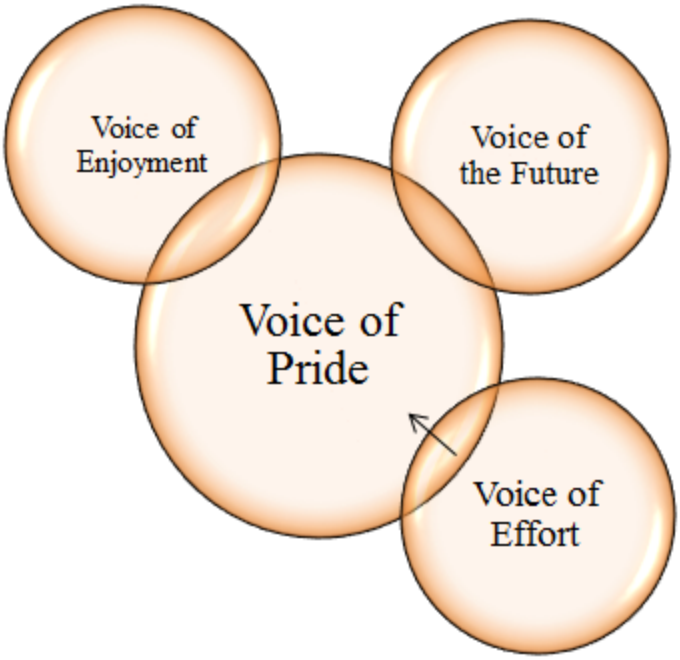


Figure 4.8 Cameron's Voice Mapping

Cameron's lead voice was the Voice of Pride, and picking the I-poem entitled "Good Grades" to be most like him as a math student, Cameron also believed this voice to be the most audible.

I am confident
I get A's
I know
I got the right answer
I think I know most the answers

I am the type to do well
I believe I can
I am better

Even though Cameron acknowledged that the class was getting harder, he claimed that he was still confident in himself as a math student simply because "I just think I can do it" (P1/L47/VI). Yet, this voice was not considered a voice expressing self-confidence in

mathematics, but rather a sense of superiority above and beyond being confident in one's mathematics abilities. There were several occasions in my analytical notes in which I questioned Cameron's confidence in his self. For instance, "I am beginning to get a sense that C lacks confidence in his math ability and maybe beyond that, he may struggle with the math concepts in general" (9.30.14_4, Analytic Memo #2). I also documented instances in which Cameron asked for help (Voice of Assisted), which was never mentioned by Cameron. The following field note from my ninth observation is one example of his need of assistance as he turned to ask *me* for help.

> While Ms. Mole is busy helping others, C looks to me and ask if they are allowed to ask me questions. He needs help on percent of change of problems. He asks me about turning his answer to a percent. However, he was only subtracting the difference and not dividing by the original, which I explained. I also asked him what to do to change the decimal to a percent. Move 2 places. Soon after, he asks me if the original is the bigger number. No, and told him to state whether it was an increase or a decrease. (10.21.14)

In addition, it may be argued that one exhibiting a Voice of Pride would contribute their success to ability, but Cameron contended that he had to push himself and work hard to ensure he got the right answers in mathematics (Voice of Effort). He also gave a lot of effort "because that's really the only subject I like to work hard at" (P13/L39). This quote was also suggestive of Cameron's Voice of Enjoyment. He expressed liking mathematics because he likes numbers and challenging math problems, and considered math to be fun. He also enjoyed the independence provided by rotating

from station to station. In addition, Cameron expressed a Voice of the Future by commented on how important mathematics was for his goals of playing football at Clemson and eventually in opening up a training business.

My initial reaction to Cameron's narrated mathematics identity following his interview was astonishment. I believed he was over-confident in his abilities as a mathematics student, not so much because he made good grades or had an understanding, but simply because he was a male. As a female researcher, I felt Cameron was not always forthcoming with me because he was afraid of offending me as a female, as indicated in his response to why he believed math was harder for girls, "I'm not trying to be mean" (P9/L1). Also, two of Cameron's four voices are those deemed "masculine" by traditional views of "appropriate" sex-based expectations and behaviors. Additionally, Cameron did not express voices indicating whether he felt he belonged as a member in his mathematics class, and from my observations, I believe Cameron was struggling with "appropriately" behaving as a student and behaving as a "cool" adolescent. This was most prevalent in his behaviors and disrespectful demeanor when his teacher was absent.

Dottie "I'm like a calculator that don't need buttons" (P7/L29-30).

Dottie self-identified as a White, female student who is average at mathematics. She was one of 13 girls enrolled in Ms. Mole's coeducational mathematics class of 28 students. Dottie was selected as a participant because of her score of 3.12 on the male domain subscale on the *Mathematics as a Gendered Domain* instrument. The class was described as awesome because Ms. Mole was always there to help. She also spoke about Ms. Mole on a personal level. For example, "Ms. Mole had kids and then she always

wanted to be a teacher. So chose math because she knows students have struggled in math sometimes" (P3/L40-41). Dottie described her peers as being silly because they had a tendency to play around instead of focus on learning math. When expressing what she disliked about the class, she identified the lack of a personal action, forgetting her work every now and then.

Dottie's mathematics identity was expressed as an interplay of the Voice of Doubt, the Voice of Effort, the Voice of Inquiry, the Voice of "Good" Student, and the Voice of Assist (see Figure 4.9).

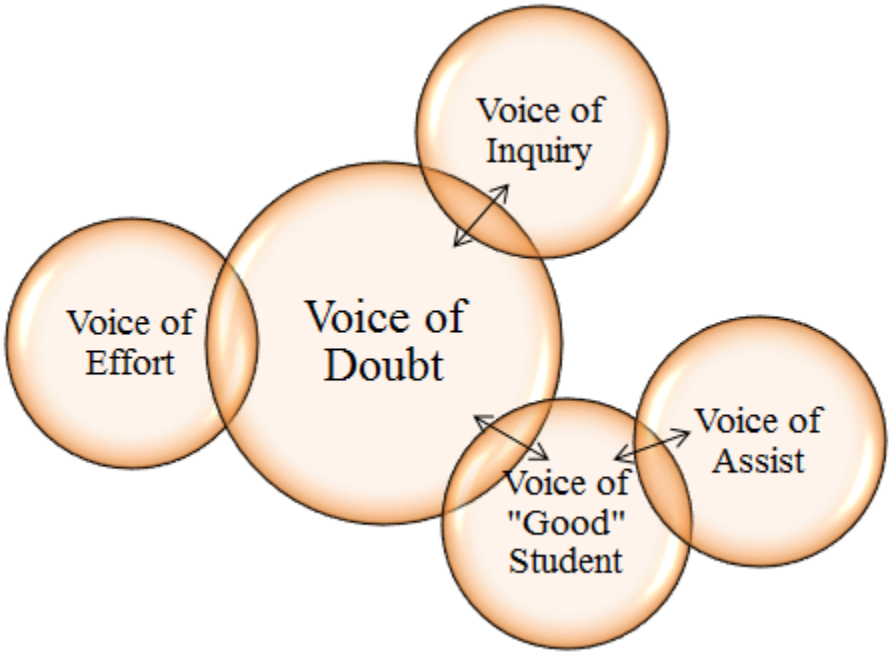


Figure 4.9 Dottie's Voice Mapping

Dottie's lead voice was the Voice of Doubt. Even though Dottie claimed in a few instances that she good in mathematics, as implied in the statement, "I'm like a calculator that don't need any buttons" (P7/L27), the majority of Dottie's statements regarding her self-confidence in mathematics was negative. She expressed how she had a tendency to

make mistakes and forget what she was doing. She expressed emotions of fear because "I never know if I'm right or wrong" (P3/L28-29/VI) and was surprised when making an A or a B on tests. Below is one I-poem representative of this voice, and entitled by Dottie as "hurry and others."

I am clumsy.
I won't know
I forget each step
I made a mistake
I don't go back
I don't fix it
I leave it
I am silly
I don't know
I forget all completely
I forget on purpose
I am in a hurry.
I won't care
I don't know
I work
I pick

In the above I-poem, a sense of carelessness and/or lack of effort seem to be fighting for audibility; for instance, "I won't care" and "I don't fix it." Yet, there are other instances in which Dottie acknowledged that she always tried to get the correct answer and strived to make high grades in her mathematics class because her grandmother bribed her with money and a phone. It appeared as if Dottie's Voice of Effort was acknowledged, yet not enacted. Consider the following quote in which Dottie removed herself; in other words, omission of her I-voice. "You always have to put in effort even if you don't have it because if you want to be the best in your grade, you

always have to be the A/B student that most people expect you to be or want you to be" (P7/L15-17/VI).

The latter part of the statement speaks to a Voice of "Good" Student in that "you" have to do things that others, probably adults, expect. Dottie spoke of always being focused while in the class, always on time, always completing her assignments, always staying quiet, always being helpful to a teacher, and always being present. When questioned about her use of always in her validation interview, Dottie confirmed that the use of always was appropriate. Due to these qualities, Dottie commented on how Ms. Mole would ask her to help other students with their mathematics work or help Ms. Mole complete tasks such as grading papers. Therefore, Dottie's Voice of Assist is not necessarily in direct interplay with her perception of her mathematics abilities (Voice of Doubt), but because she was asked and it is expected (Voice of "Good" Student). This is exemplified in the following quote.

> Because Ms. Mole would either call on me to help someone and help her at the same time. She calls me to help her because either she's in between doing her work with her horseshoe table or she's having trouble grading all the papers. And that's how you can get along with a teacher and help be a teacher's pet. And that describe me because I like being teacher's pets because they will usually pick you and do stuff for her while the others are still learning.

In my observations of Dottie, I witnessed several occasions in which Ms. Mole asked for Dottie's help. I noted how Ms. Mole asked her to go to the office and find the location of a 6th grade student who left his book on a bus (9.23.14_2). Ms. Mole asked for her

textbook log-in information so that she can show things to the class (9.26.14_3). Lastly, she asked Dottie to grade late assignments (9.26.14_3).

In addition to helping Ms. Mole, Dottie also spoke of seeking mathematical assistance from Ms. Mole (Voice of Inquiry). This voice is in a cyclic relationship with her Voice of Doubt because the "more she helps, the more I get to learn" (P4/L11-12) and "get my grades up even more" (P3/L46). This voice appears to have become a crutch for Dottie. She stated on several occasions how she would wait to seek aid from Ms. Mole rather than attempting to solve a problem on her own. For instance, "I'll ask the teacher for help and ask her what I should do *first.* And then I'll know what to do later on in the problem" (P8/L1-2). In her validation interview, Dottie selected the word tree characteristic of this voice to be the one most like her as a mathematics student.

Dottie's expressed mathematics identity, particularly in listening to her voices and the interplay of her voices, was difficult to make sense of, comparable to other participants. A few of the living words and their respective multiple meanings straddling Dottie and myself were in my opinion foreign and only began taking shape as our conversations unfolded (Bakhtin, 1981). Take for instance Dottie's use of the word silly in describing herself as a mathematics student. Taking out of context, this word for me means to be funny in an endearing way. But considering the use of the word within the context of our conversations, "silly and just forget all completely on purpose sometimes" (P5/L33), I had to assimilate and transform the word prior to my response and in my further interpretations of the living word in my analysis. As stated by Bakhtin, "to

understand another's utterance means to orient oneself with respect to it, to replace it in an appropriate context" (as cited in Roth, 2009, p. 195).

In taking an examination of her voice mapping (see Figure 4.9), it appears as though Dottie in general had a low sense of self-confidence in her abilities in mathematics and had a tendency to rely on the teacher for help prior to struggling through a problem on her own. These voices, particularly the Voice of Doubt and the Voice of Inquiry, were surprising voices based on my observations because she typically can into class and immediately began working on her assignment. I rarely viewed her asking questions of Ms. Mole or from a peer. In addition, it seemed as if Dottie's sense of belonging is due to her relationship with Ms. Mole rather than with her peers, a relationship based on doing what was asked and expected of her as a "good" student.

Emmeline "People. People. People. Cause people are mean" (P6/L27/VI).

Emmeline self-identified as a Mixed, female student, who is excellent at mathematics. She was one of 11 girls enrolled in Mrs. Ely's coeducational class of 21 students. She was chosen to participate in this study because of her high score of 4.44 on the female domain on the instrument, *Mathematics as a Gendered Domain.* Emmeline had mixed feelings about the classroom and noted it was only okay. When asked what she liked the most of the class, she identified her teacher because she is super nice; yet, agreed during the validation interviews that she liked Mrs. Ely as an individual, but disliked her actions as a teacher such as calling people out in class. When asked what she disliked the most about the class, she responded, "the people who's in it" (P1/L45).

Emmeline's mathematics identity was expressed as an interplay of the Voice of Oscillation with the Voice of Doubt fighting for audibility, the Voice of "Good" Student, the Voice of Invisibility, the Voice of Subordinate, and the Voice of Outsider (see Figure 4.10).

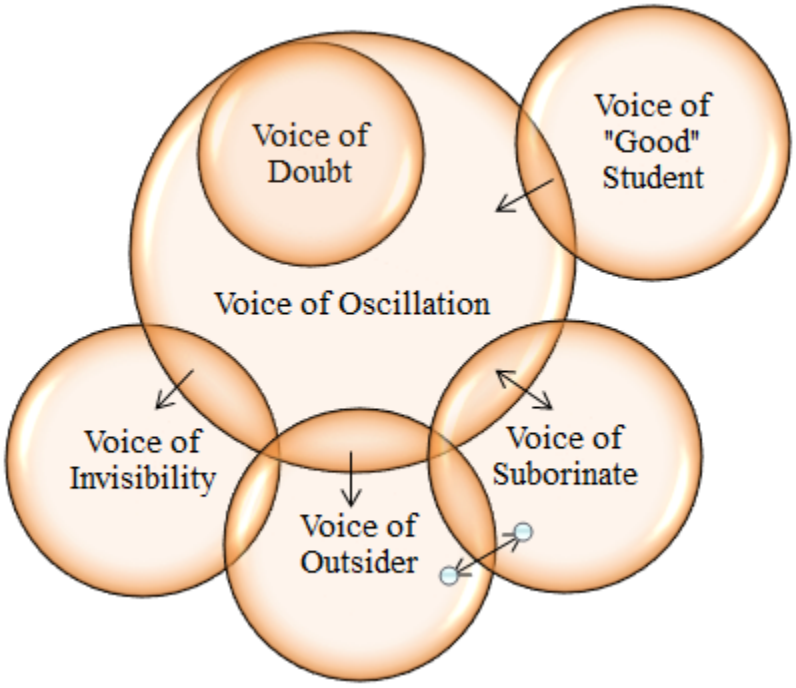


Figure 4.10 Emmeline's Voice Mapping

The Voice of Oscillation, which was Emmeline's lead voice, was in direct interplay with each voice composing her mathematics identity. Several of her statements regarding her self-confidence in her ability as a mathematics student were contradictory. "When I just do math, most of the time I get it. But half of the time, I don't" (P2/L39). As another example, "I'm quick at learning it [math]. But sometimes I'm not" (P8/L1). In addition, Emmeline used hedged words such as "I guess," "I think," and "pretty good" in describing herself within this voice, which suggested a sense of uncertainty (Rowland,

1995). She too questioned her ability when taking tests because "I don't have a real good history with math tests" (P5/L23). I too noted how a test grade was influencing this voice in my second day of observations (9.26.14). "She is then called to come get her quiz. "I don't want to see mine," and E lays it face down on her desk and keeps it covered with her notebook." Emmeline also confirmed that this voice was her lead voice by selecting both the I-poem and the word tree representative of this voice as most like her as a mathematics student.

But as illustrated in Emmeline's voice mapping (see Figure 4.10), a Voice of Doubt is fighting for audibility within her mathematics identity. This voice was more prevalent in her validation interview in which she stated not having confidence in herself, as well as experiencing negative emotions. "I erased so hard, I ripped my math paper...Because I can't do it and I get so confused. And as soon as I figure it out all of a sudden, it just makes me mad at myself" (P2/L40-41/VI). Emmeline's Voice of Oscillation/Doubt was at times contributed to her Voice of "Good" Student, particularly in that she pays attention in order to make good grades and that she obediently does what was asked of her by Mrs. Ely.

Due to her lack of confidence as a mathematics student, Emmeline was hesitant about being an active member of this class; therefore, her Voice of Oscillation/Doubt was directly shaping her Voice of Invisibility. She expressed a lack of desire for wanting to work a problem out on the whiteboard or say things in front of the class because she spoke of typically getting answers wrong. She guarded herself from feelings of embarrassment, frustration, and anger. This voice was also apparent in my observations

of Emmeline in her mathematics class. “Ms. Ely reviews the answers to the FF problems. E at no time raises her hand to respond” (10.3.14_5). This latter sentence was repeated in variation in many of my field notes. This particular quote came from my field notes entitled “Where is Emmeline?”

These two voices, Voice of Oscillation/Doubt and Voice of Invisibility, were in direct relationship with Emmeline’s expressed Voice of Outsider. As stated by Emmeline,

> When I get the question wrong, it makes me feel embarrassed. And then- cause one day after school, people kept on making fun of me because I kept on getting answers wrong. (P3, L20-21) Like when we were – it was time to leave and I went outside and people were making fun of me because I couldn’t get them right. So I don’t like answering questions (P3, L25-26).

Therefore, Emmeline’s embarrassment and ridicule followed her outside of the mathematics classroom. In addition, she expressed how she was positioned as an outsider in the classroom, literally. “Like nobody liked me. No body sat with me. People just don’t ever talk to me” (P4/L8 & L12). As noted in one of my observations, “E sits and listens to the conversation of the three girls next to her. At times, she smiles or releases a small laugh” (10.21.14_10). Thus, she was not a part of this group, nor was she invited to join the conversation.

Emmeline’s Voice of Subordinate was in a cyclic relationship with her Voice of Oscillation/Doubt and Voice of Outsider. I want to begin with field notes from my ninth observation (10.14.14). I adapted my field notes here to be as a conversation. It begins

with Mrs. Ely calling on individuals to answer questions from their homework assignment on dividing integers. T stands for Mrs. Ely and E for Emmeline.

T: Question six. Emmeline.

E: I didn't do that one.

T: Do it now, then. I don't like it when you don't do it and I make you do it in front of everybody. Well, not really. It just takes up a lot of time.

E: -12

T: -12? I don't think so.

E: Oh, -7. I was looking at the 12.

Emmeline voiced how she disliked being called out in class. She feared making a mistake because

> [i]f I get it wrong, I'm going to like be very embarrassed because she would be calling me out. Emmeline, you know this is not right. And I, half the time when she does that, I have to go back up and do it. And I keep on getting it wrong. And it just makes me get really frustrated at math. (P6/L22-25)

I would assert that Emmeline's mathematics identity was composed of negatively expressed voices, both in her impending low self-confidence in her mathematical abilities and in her sense of not being accepted and respected in her mathematics classroom by her peers and her teacher. Her Voice of "Good" Student appeared to be the only positive perception influencing Emmeline's view of herself as a mathematics student and was not a voice easy to hear within her interview and validation interview. This voice may illustrate Emmeline's attempt to live up to the expectations that others have established as

necessary within the game of school. During my observations, I felt sorrow and much concern for Emmeline. She sat alone, rarely spoke out, and seemed to guard herself against interactions with her teacher. My feelings toward Emmeline only escalated after the interview and validation interview, in which she spoke openly about her experiences in her mathematics class and in her beliefs about mathematics.

JJ "Because math is my favorite subject" (P1/L28).

JJ self-identified as a White, male student, who is excellent at mathematics. He was one of 10 boys enrolled in Mrs. Ely's coeducational class. He was selected to be in this study because of his high score of 4.75 on the female domain subscale on the *Mathematics as a Gendered Domain* instrument. He described the class as awesome because it was "easier than other subjects" (P1/L36). Much of JJ's responses were based on his immediate experience. For example, he expressed that the best thing about the class was playing on the computers, which as noted in my observations was not a common occurrence in this class. As another example, Mrs. Ely was described as being nice because she had math games, which they are allowed to play on rare days in which they complete their homework assignment early. He described his peers as "[s]ome's nice because they help me some problems I don't get. And some's mean because they call me names in their classroom" (P3/L33-34).

JJ's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of "Bad" Student, the Voice of Enjoyment, the Voice of Visibility, the Voice of Outsider, and the Voice of Assist (see Figure 4.11).

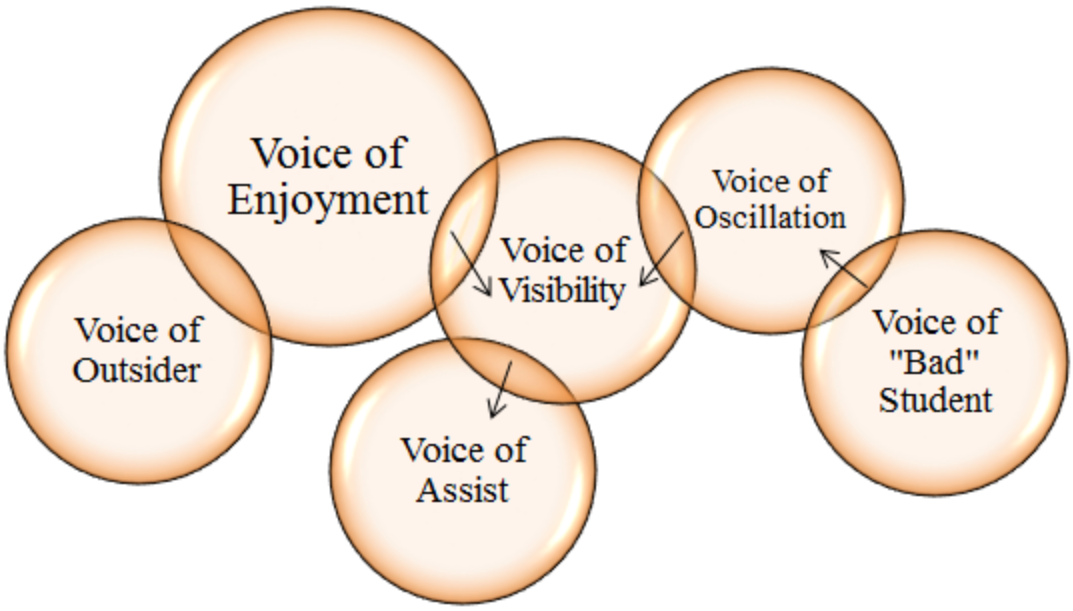


Figure 4.11 JJ's Voice Mapping

The Voice of Enjoyment was JJ's lead voice because regardless of JJ's expressed feelings of sad, mad, and sometimes happy while in his mathematics class, he always spoke of liking/loving computers, math homework, math as a subject area, and answering questions. This voice too was selected by JJ to be the word tree that represented him the best as a math student. Because JJ loved to answer questions, he was an active member of the class and he commented on how he liked to raise his hand a lot (Voice of Visibility). My observations in his classroom supported this voice. The following is one example from my fifth observation in which Ms. Ely is reviewing the five problems on the class starter (10.3.14).

> For question 2, on evaluating $6.3 + 7^2 \times 3.1$, J raises his hand after several other people have answered. Prior to question 4, J raises his hand. And for questions 5, about the percent of people who prefer to drink coke, J raises his hand and Ms.

Ely asks him to answer. 90. “Sorry, want to try again?” No. How did you get 90?

J raises his hand again as other’s begun giving their answers.

JJ also expressed how his Voice of Visibility was his way of helping his peers (Voice of Assist). When asked why he liked to volunteer, he responded with “Because I like helping people” (P4/L1/VI). This voice was also audible within his titling the following I-poem as “helping people.”

I love answering questions
I would try
I would volunteer
I can pick

JJ also expressed a Voice of “Bad” Student, in which he described doing things that may be considered by some as unbecoming of a student. He admitted that on occasion he forgot to complete his homework, was not always prepared for class because he did not have pencils or his textbook, was late to class, and was inattentive. These practices influenced his Voice of Oscillation. This voice was a mere whisper in JJ’s mathematics identity, meaning that he did not speak a lot in regards to his confidence in his mathematics ability. But when asked whether he agreed, disagreed, or was neutral about the statement, I am the type to do well in math, JJ responded with medium, suggesting he is (and is not) the type to do well in math. Another voice that was barely audible was JJ’s Voice of Outsider. Other than stating that some of his peers were mean because they called him names, he preferred to work alone. “Does who I choose to work with have to be in this classroom? (P6/L47) I wouldn’t want to work with anybody in the classroom because none of them are basically my friend” (P7/L4 & L8).

It was my sense throughout the interview and validation interview that JJ seemed hesitant to disclose too much information about his experience in the classroom and his thoughts and emotions regarding his self as a mathematic student. Admittedly, I found it difficult to uncover JJ's multiple voices and how these voices interplayed with one another in shaping his mathematics identity. JJ uttered the sentence "I don't know" sixteen times during his interview and eight times during his validation interview. Many of his responses were short phrases and I felt as if I was pulling answers out of him. This may be illustrated in JJ's voice mapping (see Figure 4.11), where it appears that his voices are in linear interplay with one another rather than in a relationship with his lead voice.

Within his narration, JJ expressed uncertainty in his mathematical abilities, yet was a visible member of the classroom not because he necessarily knew the answers or was comfortable in the classroom, but because this was his way of helping others. In my observations, I would have contended JJ was vocal as a way to gain attention from the teacher and to overcome his view of himself as a "bad" student. I was also surprised that JJ did not speak unfavorably of his teacher because from my point of view in the classroom, he was often disciplined for his misbehavior such as being off-task; therefore, not playing the role of a "good" student by his teacher's standards at least. Additionally, it is difficult to claim that JJ positioned himself as a member of this classroom or not because of his limited audible voices in regards to his sense of belonging. Again, from my view as an observer, I would argue that JJ was "picked on" by his peers, but he did not speak of this when describing his peers.

Katrina "I raise my hand because I don't like being a victim" (P4/L35).

Katrina self-identified as a White, female student who is good at mathematics. She was enrolled in Mrs. Ely's coeducational class, and was chosen to participate in this study because of her high score on the neutral domain subscale (4.75) on the *Mathematics as a Gendered Domain* instrument. The class in general was described as being pretty simple and non-chaotic. Katrina liked that she "gets to learn new stuff every day about math" (P1/L43), but disliked having too much homework. Similar to other participants, she described her teacher as being nice because she was "not like the regular old boring math teacher in the book all the time. So, she's not normal" (P2/L22-23). She identified her classmates as being smart. But additionally, she expressed how she did not talk too many of her classmates; therefore, they were identified as only being okay.

Katrina's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of Competition, the Voice of Inquiry, the Voice of Invisibility, the Voice of Outsider, the Voice of Subordinate, the Voice of Effort, and the Voice of "Good" Student (see Figure 4.12).

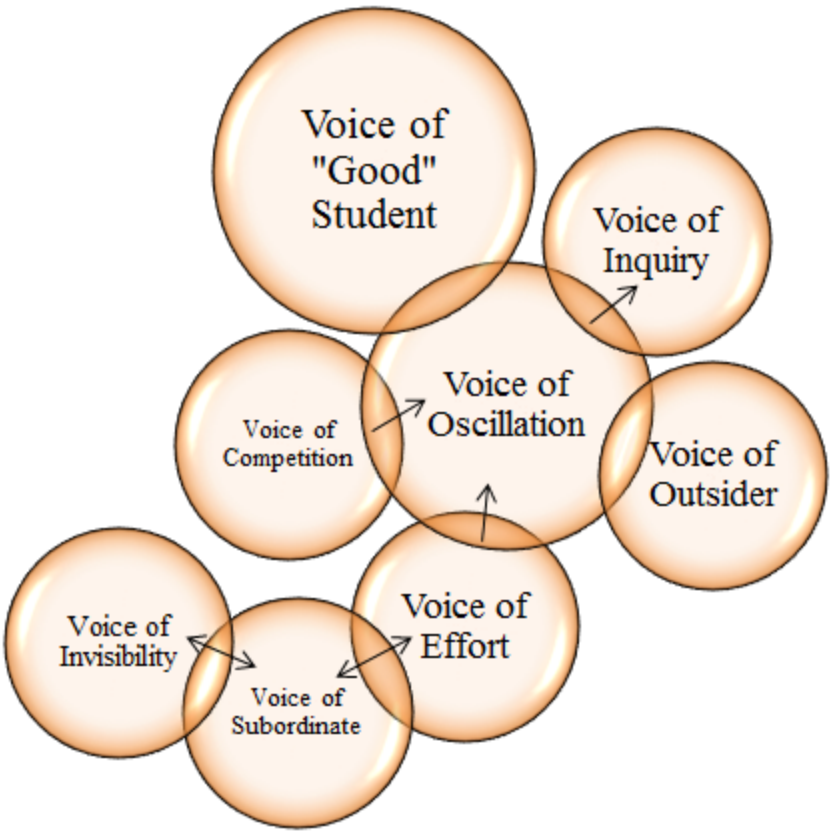


Figure 4.12 Katrina's Voice Mapping

Katrina's lead voice was the Voice of "Good" Student because it appeared to be a way to cope with her other voices composing her mathematics identity. As can be seen in her voice mapping, her Voice of "Good" Student in not in direct relationship with any voice, but living in agreement with one another Katrina spoke of rarely talking to others in her class; therefore, she was not misbehaving any classroom rules or getting caught up in any drama. "I just sit there and pay attention" (P4/L15). Other instances of this voice included always completing her homework, never cheating because "you are giving your teacher somebody else's grade" (P5/L35), and telling her neighbor friend she had to

complete her homework before going outside to play. Another example of this voice is illustrated in the following quote.

> One night I didn't have homework and I got bored. So I took a piece of paper and I started doing order of operations. And I gave it to Mrs. Ely and she said that she would check it. And I only got like two wrong. And if like I'm bored in class, I'll start doing math problems. I just put random numbers down and like put random signs. (P10-11/L46-L10)

Similar to this voice, the Voice of Outsider was another voice expressed by Katrina not to have a direct influence on shaping any of the other voices. She spoke of being an outsider in the classroom, but this extended beyond the mathematics classroom to her social status as an individual within this middle school. This influence is discussed below when considering how participants' class type was shaping their mathematics identity.

Katrina's Voice of Oscillation was also an audible voice composing her mathematics identity. In this voice, her statements contradicted one another; composed of antonyms. Class was pretty simple, but hard sometimes. She considered herself a fast learner; yet, it would take her a four or five days, or even four or five problems, to understand a concept. She, like other participants, used hedge words such as "pretty" and "guess" when describing herself as a mathematics student. During the validation interview, she stated that she was having a more difficult time with the mathematics content and on the verge of receiving a C in the class; yet Katrina still claimed, "I guess I feel like in math I'm pretty smart because I learn fast and understand a lot more" (P5/L15).

Due to Katrina's mathematical concerns expressed in her Voice of Oscillation, she spoke of asking for help from her teacher (Voice of Inquiry). "And I had to actually go to her during enrichment yesterday to figure a problem out because I didn't know how to do that one" (P6/L1-2/VI). But Katrina articulated how Mrs. Ely made her feel comfortable in coming to her and asking for help, which in return made her feel better about herself as a mathematics students. Katrina stated, "She makes me feel good at math. And she helps me like if I don't understand something. She makes me feel comfortable to where I can go to her and just ask her for help" (P2, L31/32). But through my observations, I would argue that seeking assistance was typically a private manner. For instance, "K *walks up to Ms. Ely at the front of the room* and asks questions about a problem or two on her quiz. Ms. Ely runs through the integer rules with K and several other issues" (9.26.14_3). This voice, the Voice of Inquiry, as portrayed in a word tree entitled "She makes me feel," was selected by Katrina as representing her most as a mathematics student. Additionally, the Voice of Competition was another voice that impacted her Voice of Oscillation, both positively and negatively. "Well it depends on which ones were talking about because some of them make me feel like smart and there are other ones that make me feel like whoa" (P8/L36-37).

Katrina also communicated the Voice of Effort. Yet this voice was not about giving effort, but her lack of effort in the mathematic class and being successful as a mathematics student. "I'm now switching from a C to a B. It makes me feel like I'm not trying hard enough I guess. Because I can try a lot harder than I am right now" (P7/L34-35). Her lack of effort is also exhibited in not completing her homework assignments, and

as I observed from my vantage point in the classroom the need to hide this fact from the Mrs. Ely. “As Ms. Ely moves on to review homework problems, K did not complete her assignment because her paper was empty. She leans her book up on the desk” (10.28.14_12). Katrina hid this fact out of fear (Voice of Subordinate). “Like sometimes when we had homework and I forget to do a problem, I’m afraid that she may call on me to do that exact problem that I didn’t do” (P4/L3-4/VI). She also described how she felt like a victim when Mrs. Ely called students out to answer a question a loud or write their solutions on the board. She typically shied away from talking out in class, and tended to mumble when talking out loud because she got nervous and feared answering incorrectly (Voice of Invisibility). The following I–poem captured Katrina’s Voice of Subordinate and Voice of Invisibility.

I don’t like talking out
I raise my hand
I don’t like being a victim
I raise my hand
I don’t like just randomly
I get nervous
I talk out loud

I don’t like raising
I don’t like answering
I’m not going to volunteer
I’m scared
I might get it wrong
I’m not too fond

In both the interview and validation interview, I felt as if Katrina was not being truthful. For example, in her interview, Katrina identified only speaking with two other females in her coeducational mathematics class, Emmeline and Nyra; yet, in her response

to the next question in the interview, she spoke of texting Tania for help with her homework. As another example, in the validation interview, Katrina stated, "And ever since that [one] day I didn't do my homework and I got silent lunch, every day" (P4/L4-5/VI). From my observations, there were several instances in which Katrina did not have her homework, so I was hesitant to believe that Katrina was telling me the truth. However, Katrina's narrative was maintained as "truth" in how she perceived herself or in how she wished others to view her as a mathematics student (e.g., Clandinin & Connelly, 2000).

Therefore, Katrina's mathematics identity was expressed as oscillating between possessing a high and a low self-confidence as a doer of mathematics, as well as a marginal member of the classroom, which from my observations, I was generally not astounded by Katrina's voices. The one exception was her lead voice, the Voice of "Good" Student because this voice was narrated as living inside and outside of the classroom setting and what appeared to be conforming to the expectations of adults, expectations expected of females when playing the game of school.

Trevor "I always raise my hand and try to get the answer even if it's wrong or right" (P2/L46-47/VI).

Trevor self-identified as a White, male student, who is good at mathematics. He was enrolled in Mrs. Ely's coeducational mathematics class. He was selected to participant in this study because of his high score on the gendered neutral domain subscale (4.56) on the *Mathematics as a Gendered Domain* instrument. Trevor described the class as a safe environment and very good because "we learn new things" (P1/L32).

He enjoyed the beginning activity at the start of each class period, but did not enjoy taking tests. Trevor described Mrs. Ely, as well as his peers, as nice, which equated to being helpful to those who need help.

Trevor's mathematics identity was expressed as an interplay of the Voice of Oscillation, the Voice of Visibility, the Voice of Competition, and the Voice of Inquiry (see Figure 4.13).

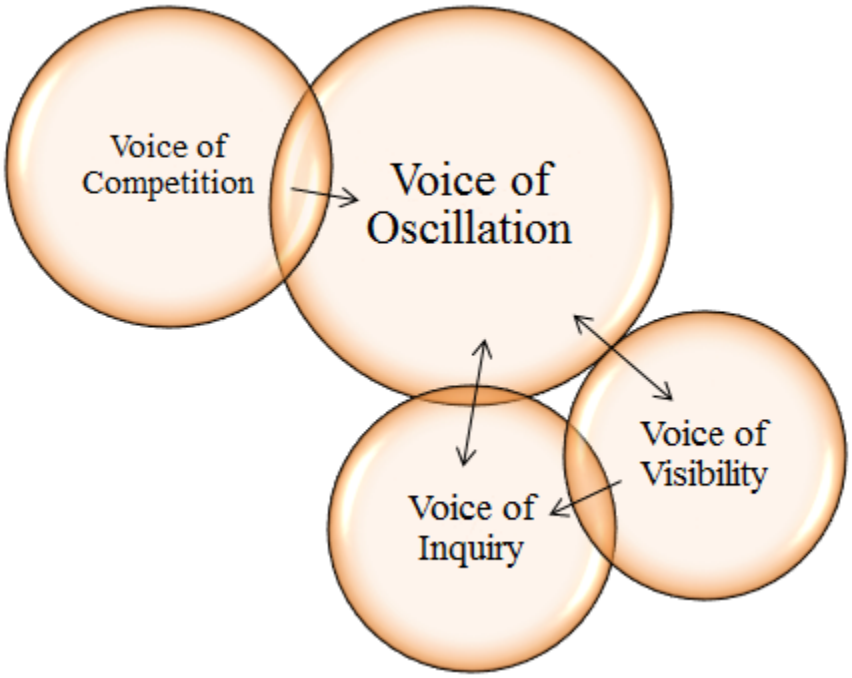


Figure 4.13 Trevor's Voice Mapping

Trevor's lead voice, the Voice of Oscillation, was in direct interplay with each voice becoming his mathematics identity. When describing himself as a mathematics student, his adjectives opposed one another and were always related to his mathematics abilities and letter grades. Trevor too contended that his Voice of Oscillation was

representative of him as a math student. Here I have included the I-poem entitled "sometimes" to illustrate this voice.

I am good
I am great
I am smart
I am super
I am usually getting good grades

I get A's
I get B's sometimes

I am a little not good
I am bad
I wouldn't be not so great
I don't get it
I would make
I get messed up
I don't think
I start writing it down
I mess up
I get bad grades

In experiencing moments in the class when Trevor was good and other times when he was not so good, he commented on asking Mrs. Ely for help about half of the time because "she helps me understand like the parts I don't get" (P2/L10). In addition, his Voice of Inquiry was sought by being an active member of the classroom (Voice of Visibility). As an example, "I like to volunteer on stuff. Like whenever she asks a question or anything, I always raise my hand and try to get the answer even if it's wrong or right (P2/L46-47) But if it's wrong, then you know you can like fix that whenever she tells you the right answers" (P3/L3-4). Note though that in seeking out assistance, the goal is to receive the right answer rather than an understanding of the mathematical

concept at hand. The Voice of Visibility was also an audible voice with my field notes. During my first observation (9.9.14), I wrote

> Ms. Ely next asks the class to turn to page 206 in their text. The lesson is on adding integers. For one of the problems, T raises his hand, but Ms. Ely calls on a girl. As she is having a difficult time with articulating, T raises his hand again. As a class, they review the answers in the guided practice section of the text. The answer to question 3 was incorrect and T jumps at the chance to raise his hand. Once called on, he answers 0. Ms. Ely then asks him to explain. Because -8 + (-4) is -12 and then add 12 to that and you get 0.

Trevor also exposed a Voice of Competition, which as expressed in his statements; he positioned himself in a negative light. For instance, “Like there’s a lot of smart kids in my class and there’s like a few of us that don’t get it right aw- every other time” (P5/L24-25). I too observed Trevor competing with his peers. Just take the following statement to a few of his classmates in reference to a quiz on adding and subtracting integers, “I will do better than all of you on this” (9.26.14_3). The next day, he received his grade on this quiz, a 50, which in returned was shaping his Voice of Oscillation. In his interview, Trevor commented that he felt kind of dumb after seeing his grade because “Because like everybody else got like good grades and I didn't think about what I was doing on it. I just thought I got it right” (P6/L43-44).

During my time in Trevor’s classroom, he and I sat next to one another in eight of my 10 observations. This afforded me the opportunity to observe Trevor’s verbal and nonverbal communication more than other participants in this study. We conversed often

over the course of my observations, so I question whether I was overstepping my role as a peripheral observer and how our conversations may have affected how he articulated his voices, which I liken to the butterfly effect. But regardless of any affect I may have had, as indicated in Trevor's voice mapping (see Figure 4.13) his mathematics identity was overwhelmingly expressed in regards to his self-confidence in mathematics. Throughout the interview, Trevor could not move beyond describing himself as smart and not so smart, as good and bad at mathematics. Even when urged to consider other adjectives, Trevor used similar terms to describe himself. It seemed as if his Voice of Oscillation was overshadowing other voices composing his mathematics identity. In addition, it is difficult to discern if Trevor perceived himself as being a member of the classroom because of his limited audible voices in regards to his sense of belonging. The one exception was the Voice of Visibility, which I would argue changed over the course of my observations, from a vocal member willing to volunteer answers to a more silent member less willing to volunteer answers. In my opinion, it was as if he was losing confidence in his self as a mathematics student as visible through his actions in the classroom; yet, Trevor's "truth" as portrayed in his validation interview contradicted my observations.

Similarities and Differences

Here I present results for the following research question. How might participants' voices be similar and different between and across sex and class type? I begin with discussing the general beliefs of We are Similar and We are Different, and the reason for considering these beliefs to address this research question. Next, through

displaying results in tables, I comment on the similarities and differences between and among participants' voices by sex, class type, and sex-class type interaction. I conclude with deconstructing the participants' expressed beliefs, We are Similar and We are Different.

As stated earlier, the participants' expressions and narratives representative of their beliefs in mathematics as a gendered domain were reduced to We are Similar and We are Different. These are identified as beliefs rather than voices composing one's mathematics identity because in general, participants' statements seemed removed from their immediate experience in the mathematics classroom (micro-level), as well as whom they are as mathematics students within broader institutional and societal contexts (macro-level). This was indicated by participants' use of "they" rather than "we" are "I" in their responses to questions eliciting these two beliefs, particularly in regards to their own sex. For example, Katrina claimed,

> Well, I think they [girls] are [good at math] because they're somebody, I think it was one of the teachers last year. But said that it's been proven that more girls go to college than boys. So I figured well you have to get through math class to go to college. So I figured you know more girls would be better at math than boys. (P10/l7-10)

In addition, the beliefs of We are Similar and We are Different were not in interplay with other voices composing participants' mathematics identity. This was apparent when listening to participants' various voices in step three of the analysis. Statements referring to the guiding voices of mathematics as a male domain and stereotypical gender roles in

the mathematics class were rarely underlined with two or more colors representing two or more voices. Even though We are Similar and We are Different are not identified as voices in this study, these two beliefs remained a part of the analysis here because of the ongoing debate of whether single-sex education reinforces or diminishes students' views of what is appropriate for men and women or boys and girls (Mael et al., 2004).

In examining the similarities and differences in participants' voices, there were fewer differences than similarities uncovered in this study; therefore, results highlight these differences and readers are encouraged to view the provided tables for similarities in voices. Results based on participants' sex are displayed in Table 4.4.

Table 4.4

Similarities and Differences between Participant's Voices by Sex

Voices	Girl (n = 6)	Boy (n = 6)
Voice of Pride	--	2
Voice of Oscillation	4	4
Voice of Doubt	3	--
Voice of Effort	3	3
Voice of Visibility	2	3
Voice of Invisibility	2	1
Voice of Assist	4	1
Voice of Inquiry	5	2
Voice of "Good" Student	5	1
Voice of "Bad" Student	--	1
Voice of Outsider	2	2
Voice of Subordinate	2	1
Voice of Competition	1	4

Voices	Girl (n = 6)	Boy (n = 6)
Voice of Enjoyment	1	2
Voice of the Future	--	2
Voice of Manipulation	--	1
We are Similar	2	2
We are Different	4	4

The female participants in this study expressed the Voice of Assist, the Voice of Inquiry, and the Voice of "Good" Student more frequently from the male participants in this study. These voices communicated providing and receiving mathematical and/or non-mathematical help to and from others, as well as exhibiting actions associated with being a "good" student in school. On the other hand, four of the male participants, and only one of the female participants in this study, expressed a Voice of Competition; therefore, the male participants claimed to more often compete mathematically with their peers than female participants. Additionally, two male participants articulated a voice concerning the benefit of mathematics in attaining a future goal of playing sports at the post-secondary level (Voice of the Future). When investigating the participants' voices specific to their self-confidence in their mathematical abilities, a few of the female and male participants articulated voices on opposite ends of a spectrum, Voice of Doubt and Voice of Pride respectively. More specifically, three female participants and none of the male participants expressed a Voice of Doubt while two male participants and none of the female participants expressed a Voice of Pride.

When exploring similarities and differences between participants' voices based on class type (i.e., single-sex or coeducation), the results in this study suggested no

differences in participants' voices, but differences in their beliefs of We are Similar and We are Different (see Table 4.5). The six participants enrolled in the coeducational mathematics classrooms held the belief of We are Different; therefore, holding the viewpoint that females and males are different from one another in regards to mathematics as a gendered domain. The results in regards to the six participants enrolled in the single-sex mathematics classrooms were varied. Four participants held the belief We are Similar, while two held the belief We are Different.

Table 4.5

Similarities and Differences between Participant's Voices by Class Type

Voices	Single-Sex (n = 6)	Coeducational (n = 6)
Voice of Pride	1	1
Voice of Oscillation	4	4
Voice of Doubt	1	2
Voice of Effort	3	3
Voice of Visibility	3	2
Voice of Invisibility	1	2
Voice of Assist	3	2
Voice of Inquiry	4	3
Voice of "Good" Student	3	2
Voice of "Bad" Student	--	1
Voice of Outsider	1	3
Voice of Subordinate	1	2
Voice of Competition	3	2
Voice of Enjoyment	1	2
Voice of the Future	1	1

Voices	Single-Sex (*n* = 6)	Coeducational (*n* = 6)
Voice of Manipulation	1	--
We are Similar	4	--
We are Different	2	6

The differences concluded in participant's voices based on the sex-class type interaction (i.e., single-sex girls, coeducational girls, single-sex boys, and coeducational boys) were between female participants in a single-sex class and female participants in a coeducational class, and between male participants in a single-sex class and male participants in a coeducational class (see Table 4.6). One, there were audible voices expressed by female participants in the coeducational mathematics classes that were not audible or were silenced within the voices of female participants in the single-sex mathematics classes. These include the Voice of Invisibility, the Voice of Outsider, and the Voice of Subordinate, voices that are likely having a negative influence on these females' mathematical identities. Two, the three male participants in the single-sex mathematics class expressed a Voice of Competition while only one male participant in the coeducational mathematics class articulated this voice.

Table 4.6

Similarities and Differences among Participant's Voices by Sex-Class Type Interaction

Voices	SSG (*n* = 3)	CEG (*n* = 3)	SSB (*n* = 3)	CEB (*n* = 3)
Voice of Pride	--	--	1	1
Voice of Oscillation	2	2	2	2
Voice of Doubt	1	2	--	--
Voice of Effort	1	2	2	1
Voice of Visibility	2	--	1	2

Voices	SSG (n = 3)	CEG (n = 3)	SSB (n = 3)	CEB (n = 3)
Voice of Invisibility	--	2	1	--
Voice of Assist	3	1	--	1
Voice of Inquiry	3	2	1	1
Voice of "Good" Student	2	3	1	--
Voice of "Bad" Student	--	--	--	1
Voice of Outsider	--	2	1	1
Voice of Subordinate	--	2	1	--
Voice of Competition	--	1	3	1
Voice of Enjoyment	1	--	--	2
Voice of the Future	--	--	1	1
Voice of Manipulation	--	--	1	--
We are Similar	2	--	2	--
We are Different	1	3	1	3

Note. SSG = Single-sex girls. CEG = Coeducational girls. SSB = Single-sex boys. CEB = Coeducational Boys.

Participants' expressed beliefs, We are Similar and We are Different, were deconstructed as a way to look for patterns (Saldaña, 2014) and gain a better understanding of the third guiding voice (see Chapter 3) regarding issues of gender at a macro- (mathematics as a gendered domain) and a micro-level (roles in the mathematics classroom). For the four participants with the belief We are Similar, they stated that girls and boys are good at mathematics and that any differences that may exist are due to the amount of effort put forth. But there was no indication that one sex puts forth more effort than another does. And with the exception of one of these four participants, there was no indication that one sex acted differently or took on different roles in the mathematics

classroom. Take the following quote as an example, “I think about they would be the same. Like they would both be smart” (Colin/P9/L41-42). “I think both have to study and keep up with their grades and stuff. That’s really about it. I mean you don’t have to do much to be smart. You just have to study and pay attention in class” (Colin/P1/L27-28).

The majority of participants (n = 8) in this study voiced the belief We are Different with seven of the eight participants declaring that girls are smarter than boys in mathematics. There was only one participant that stated boys were smarter than girls. When asked if he agreed, disagreed, or neutral with the statement, boys are naturally better at mathematics than girls, Cameron agreed (P12/41). He followed by stating, “Because guys they just like hard problems. And they like to work hard at math” (P12/L44-45).

At times, the notion that girls were smarter than boys was clear. “Because girls are smarter than boys” (JJ/P9/L1). At other times, the belief that girls were smarter than boys was based participant’s language. They would claim that girls were good at math, but only *some* boys were good at math. Consider the following condensed conversation from an interview between Hannabell and myself.

I: So do you think girls are good at math? Why or why not?

H: I think they are because...

I: Do you think boys are good at math? Why or why not?

H: Yeah, some of them. But sometimes, some guys aren't.

There were several reasons provided for why participants believed girls to be smarter than boys, which were stated within the terms of what is deemed “appropriate” for how

each sex is to behave. Girls are quiet and pay attention. They push themselves and complete their assignments more than boys do. Girls retain information and are more independent. They also care a lot more and are patient. Boys on the other hand, are loud, ask a lot of questions, and blurt out answers. They tend to play around too much. Boys are lazy and have a difficult time concentrating in class. They simply do not care. To provide one example, Emmeline stated,

> But I just think they [girls] listen more because I think they have patience I guess. And I guess they can sit still and actually listen. Boys cannot because I've actually looked and they just sit there and do nothing or doing something they're not supposed to be doing. (P7/L36-39)

To support his position, Matthew claimed that girls and boys are treated differently by their parents and their teachers (P4/L19-31).

> M: Well girls are kind of pushed more to be smarter than boys. And boys always like to cut up and be like a class clown or something, that doesn't really pay attention. While girls are pushed more to succeed in classrooms.
>
> I: Who pushes them?
>
> M: Probably their parents more. And the teacher just has more...what's the word I'm looking for.
>
> I: So do you think boys and girls are treated differently in a math class?
>
> M: Yeah. Because boys always get, well they always get all rowdy in the classroom and always talk, and never finish their work. That's because

> they want to be the class clown and stuff. While girls, they have no desire to be a class clown or mess up in school.

Therefore, participants in this study are typically reinforcing the gendered stereotype that girls and boys act differently at least in the mathematics classroom.

Is Class Type Making a Difference?

The results in addressing the question, how, if any, might the type of mathematics classroom (i.e., coeducational and single-sex) be shaping the female and male participants' dynamic mathematics identity in this study, contribute to our limited understanding of single-sex education within the United States (e.g., Pahlke, Hyde, et al., 2014). Beyond the influence of the classroom type, other external factors shaping participants' voices, and thus their dynamic mathematics identity, will be discussed and include: (1) the instructional structure of the class and role of the teacher, (2) the institutional emphasis on letter grades and being tracked into an advanced class, (3) family members, (4) social status, and (5) the belief of mathematics as a male domain. These are the influences that alter and manipulate the turning mechanism of a kaleidoscope, which subsequently influence what one views when peering through the opening hole to the reflection of one's "true" mathematics identity at the opposite end of the opening hole.

Class Type

In listening to participant's narratives, more specifically, but not exclusively their response to the interview questions regarding what they imagine it would be like to be in a math class with both boys and girls/only boys/only girls and to explain which type of

class they would prefer, eight of the 12 participants expressed that class type was having either a positive or negative influence on their mathematics identity. Three of the participants, Katrina, Cameron, and Trevor, communicated how being enrolled in a coeducational mathematics class was positively shaping their mathematics identity, either directly or indirectly. Yet Katrina was the only one of the three participants that could support her statements based on her prior experience in a single-sex mathematics class. While Trevor, on the other hand, relied on the prior experiences of his peers in a single-sex class. In general, each of the three participants voiced how the environment in a coeducational mathematics class was more conducive to learning because of the omission of distractions such as talking among female or male peers. For instance, Katrina stated, "If I was still in an all-girls class, I think I would be more focused on what they're doing than what Mrs. Ely is doing" (P9/L25-26/VI). Trevor, in addition, added how he felt safe in his coeducational mathematics class to raise his hand (Voice of Visibility). "If I was like in an all-boys room, all the boys would like laugh and stuff if you messed up. That wouldn't happen in this class" (P4/L30 & L34).

Conversely, two female participants, Dottie and Emmeline, conveyed how the coeducational classroom may be negatively shaping their mathematics identity. The two girls' voices are represented well within Emmeline's I-poem from her interview entitled by Emmeline as "What Could Happen."

I think it would be different
I would make more friends
I wouldn't get as teased
I could possibly learn better
I could possibly concentrate
I would pick an all-girls class
I feel comfortable around them [girls]
I just feel better

In the I-poem, it is evident that at least for Emmeline, she can only hypothesize what her experience would or could be in an all-girls mathematics class because she has never been in a class with only girls. Therefore, she voiced a perception that a single-sex mathematics class would be better. It was never uncovered whether Dottie had been previously enrolled in an all-girls class, but many of her comments compared her experiences in her mathematics class to other coeducational classes such as her social studies class.

All three of the female participants in the single-sex mathematics class, Hannabell, Jennifer, and Savannah, articulated how the class type was having an influence on shaping their identities. Hannabell and Jennifer expressed how they felt more comfortable in this environment to ask others for help (Voice of Inquiry) and would not be embarrassed to share answers in front of the class (Voice of Visibility). Furthermore, it was noted by Hannabell and Savannah how there was less distractions without boys in the class because "they are always asking questions" (Hannabell/P8/L30), or "[t]hey'll blurt out and they'll be like playing or they'll fight" (Savannah/P1/L22/VI), which for Savannah, hindered her from completing her work.

For the remaining four participants, each male, class type did not appear to have any influence on shaping their mathematics identity. Yet, with the exception of Justice, who was indifferent about the class type in relation to mathematics, the remaining three male participants did vocalize their preference for class type and their reasons. JJ was enrolled in Mrs. Ely's coeducational class and preferred a single-sex class because boys in general are not smart, which would afford him an opportunity to answer more questions out loud. Conversely, both Colin and Matthew were enrolled in a single-sex class yet preferred a coeducational class, both in relation to the Voice of Competition, but for different reasons. For Colin, it was so "you could see like the majority of who's smarter, like guys or girls" (P9/L6). For Matthew, his preference was in hopes that "maybe there's even smarter people in there to compete with" (P14/L17), which is not surprising since he has voiced mathematics as a female domain.

Class Instructional Structure and Role of the Teacher

In consideration of other external influences, the instructional structure of the class and the role of the teacher appeared to be shaping the participants' mathematics identity. Ms. Mole utilized stations on a daily basis, where a few students received instruction from Ms. Mole at the front of the classroom, known as the safe zone (Jennifer), while the majority of the class worked in stations on various assignments. In general, this classroom structure was not viewed as a normal class, sitting in rows of desks, listening to the teacher, and then completing a worksheet. But as expressed by Cameron and Hannabell, they enjoyed the structure of the classroom because it provided a sense of independence (Voice of Enjoyment). "Like you're by yourself most of the

time, so you can do your own stuff. But you get to do extra things except just sit there and stuff. So it's a lot funner" (Hannabell/P2/L39-40). Additionally, no participant in Ms. Mole's class expressed the Voice of Invisibility, taking on a passive role in the classroom due to not feeling comfortable in the environment or due to one's lack of mathematical understanding. Moreover, the stations in this class, as compared to the structure of rows of desks, seemed to promote a learning environment conducive to asking for help from (Voice of Inquiry) and providing help to one's peers (Voice of Assist). For example, Savannah stated, "If we were not in the same station, then I guess I would just have to find someone else that I could help and they could help me" (P5/L29-30). This is in stark contrast to the participants in Mrs. Ely's class, in which they voiced receiving help from the teacher and having little opportunity to provide support to one another.

Mrs. Ely's room was structured in rows of desks, positioned to face the front of the room. As described in Chapter 3, Mrs. Ely's instruction would be considered more traditional in nature; for instance, following the IRE method (initiate-response-evaluate) of questioning (NCTM, 2014). The participants in this class, as compared to those in Ms. Mole's class, expressed the Voice of Outsider and the Voice of Subordinate. It is not evident that these two voices are directly due to the influence of the classroom instructional practices employed by Mrs. Ely, but it is not unreasonable. Take for instance, the Voice of Subordinate, in which three of the participants in her class expressed being called out by Mrs. Ely in front of the class. It is a public display. "Because she says it out loud. I have asked for help once and she yelled it out and I was like nope, that's the last time. I'm not doing that anymore" (Emmeline/P7/L44-45/VI).

Additionally, five of the 12 participants, all enrolled in Mrs. Ely's class, expressed a desire to compare themselves to and compete with others in the classroom, the Voice of Competition. Again, it is not certain that this is due to the classroom instructional structure within Mrs. Ely's class, but it is not unwarranted.

Institutional Policies

The institutional emphasis placed on letter grades and the practice of tracking was shaping at least half of the participants' interplay of voices, more specifically their voices involving their self-confidence in mathematics. Six of the participants, two in a single-sex class and four in a coeducational class, described themselves as smart or good at mathematics because of receiving high letter grades and not necessarily because of gaining an understanding of the mathematical content. For instance, Colin selected the adjective smart because "I got an A in her class. And it seems like it would be pretty hard to get an A in her class...how you're like going through stuff really fast" (P5/L18-20). This notion of being smart or good at mathematics because of high letter grades was also for a few of these participants based on past experiences. "I've always been pretty smart. I've always made pretty good grades" (Justice/P5/L45). Additionally, a few participants claimed that making good grades was dependent on the amount of effort put forth to being mathematically correct; in other words, to meeting the demands of a static body of knowledge. For instance, Cameron stated, "I watch over my work [because my ultimate goal is] to have all the right answers" (P2/L3 & L7).

Lastly, the all-boys class was the only class labeled as an advanced mathematics class, and both Colin and Justice made the assumption that they had to be smart since

they were tracked into this advanced mathematics class, which shaped, and I would argue shap*ing*, their Voice of Oscillation. “It makes me feel more confident that I am with advanced students” (Justice/P6/L44-45/VI). Colin commented, “It feels awesome to be in that class. Because to know you’re one of the best in the grade, it feels good” (P6/L14-15).

Family Members

In the interview protocol, participants were asked the following question. What are some things your parents tell you about learning and doing math? However, answers to this question were omitted here because it was a forced response. The data presented here was not forced, but occurred during the participants’ narratives; therefore, shaping participants’ mathematics identity. Family members, typically a parent(s), were discussed by five of the 12 participants, and for a variety of reasons such as encouragement to try or not to try (Voice of Effort) and providing help (Voice of Inquiry). As an example of the former, Savannah testified that one reason she did not put forth a lot of effort was due to differential treatment from her mom.

> I guess it’s just cause I don’t really get- like my mom will be like oh, good job to me. But when my older sister does something good because she always gets like C’s and D’s, she rewards her a lot more than she does me when I try a lot harder. So I guess I feel like I don’t really have to try. (P4/L23-26/VI)

For Jennifer, her parents shaped or are shap*ing* her Voice of Doubt. When asked to respond to the statement I am smart in her I-poem entitled “honest math student,” she

replied, “I think it suits me. I guess because my parents always tell me that I’m smart and stuff like that” (P3/L41/VI).

Dottie did not speak of her parent(s), but of her grandmother’s influence on shaping her mathematics identity, more specifically her Voice of Inquiry and Voice of Effort. I have constructed a variation of an I-poem to reflect how Dottie spoke of her grandmother in her interview and validation interview.

I was growing up
I needed help
my grandma
would help me
show me tricks
I still use those tricks
My grandmother’s been very helpful.
I have been held back
been striving me
helping me focus
put effort in my work
get my 8th grade work
for me to start learning that

Also, reflected in this I-poem is the shaping of her mathematics identity due to a prior, yet present experience of being held back a grade level, and her grandmother’s encouragement and guidance in overcoming this experience.

Social Status

As expected, participants are socially positioned within the broader school culture such as being categorized as wimp, slut, popular, or nerd (Eder, 1995). Such labels are brought with participants into the mathematics classroom and in this study, negatively shaping the mathematics identities, specifically the Voice of Outsider, of three

participants in this study, Emmeline, JJ, and Katrina. In listening to Katrina's Voice of Outsider for example, there was little indication that she felt like an "other" in the mathematics classroom because of a lack of mathematical understanding or being embarrassed if answering a problem incorrectly. Her feeling of an "other" hinged on the number of friends she had, or did not have, in the mathematics classroom, as well as what happened throughout the school day prior to this class, which the latter is reflected in the quote below.

> It all depends on if like I'm in the mood or something. Like sometimes I'm like okay, I can do this. And then there's some days that I'm just like, oh, no, no I'm good. Because like before I come to her class, you know, I have six more periods in front of that. So it all depends on what happens in those classes. So it depends if this class has put me in a good mood or a bad mood. So, and then just some days, I feel like man, I don't feel like doing nothing. (P8/L25-29)

JJ expressed this influence of social status by stating that people in his class called him names and for Emmeline, she commented that girls in the class hated and picked on her because of non-mathematical reasons such as being jealous, which ultimately impacted her as a mathematics student. "I would be sitting there the whole time thinking what's she going to do to me. I wouldn't be learning anything. If she [Mrs. Ely] called on me, I would be like what" (P7/L4 & L6).

This finding did not necessarily imply that one's social standing within the school did not positively shape the mathematics identity of participants. It was just not apparent in the participants' narratives in this study. However, it does appear that having a friend

in the classroom accounted for a more positive experience in the classroom. For example, Matthew voiced that the only thing he liked about this mathematics class was that his friend Colin was in it. This was reciprocated by Colin, “I mean I don't really care who I'm beside. But sometimes I- it's like nice to be beside a friend. Cause me and Matthew are best friends and sometimes it's nice to be beside a friend” (P7/L1-2). This was further supported by Savannah’s relationship with Aaliyah, who were not the same social circle, but formed a friendship in their mathematics class; and Trevor, who referred to receiving help in class from his friend Aaron. “My friend Aaron, he like showed me like you do like times or division on it” (P2/L45-46).

Mathematics as a Male Domain

The belief that mathematics is more suitable for boys than for girls was a direct societal influence on one male participant’s mathematics identity. This was first indicated indirectly in Cameron’s interview through both his answers and his gestures. For instance, in our conversation about how he imagined his experience with math to be different if he was a girl, he replied “I'm not trying to ((*hand covering mouth; as if trying to cover his true thoughts and feelings*)) be mean” (P9/L1). As a female researcher, Cameron’s verbal and non-verbal communication implied to me that he was uncomfortable in answering my questions regarding gender differences in mathematics, and possibly attempting to keep a voice hidden (Sorsoli & Tolman, 2008). But through the member checking process, Cameron confirmed that his belief that males are naturally better than girls at math was shaping his Voice of Pride. I have included the conversation from the validation interview below (P3/L3-18).

I: Do you think that you are good at math simply because you're a boy and not a girl?

C: I stay humble about that.

I: No, I would like to know.

C: I let people say about that.

I: So you don't think that?

C: Well I don't really like to talk about how better I am. I am better because I work hard at it. I noticed some girls don't.

I: But do you think you're a little bit better in math because you are a boy?

C: Yeah. I pay attention. Boys pay attention.

Summary

This chapter presented the results for each research question across participants' narratives and voices, as well as individual narratives and voices. As these results suggests, participants' expressed mathematics identities are complex (Cobb et al., 2009) and as assumed, no participant's mathematics identity is the same. This is illustrated through examining each participant's voice mapping, a visual representation of the interplay of voices. Yet in considering participants' voices as distinct entities, it appears as though they are more similar than different. But participants in this study must make sense of their multiple voices, their mathematics identity, within the broader context of society and the classroom setting, external influences shaping how they perceive and narrate themselves as mathematics students.

CHAPTER 5

INSIGHTS FROM ANALYSIS

Introduction

The purpose of this exploratory study was to gain an understanding of female and male adolescent students' dynamic mathematics identity, as composed of an interplay of voices, enrolled in either a single-sex mathematics classroom or a coeducational mathematics classroom within the same public middle school. In this chapter, I situate the findings from each research question in the scholarly research presented in Chapter 1 and Chapter 2. To conclude the chapter, I discuss ontological questions that this study has uncovered and challenged me as a researcher. Additionally, I consider implications of this study, as well as how this study may generate both short-term and long-term future research endeavors.

Key Learnings

The Living Voices

The purpose of the first sub-question was to uncover the various voices expressed by participants in this study when narrating their perceptions of themselves as mathematics students, their experience in their mathematics classroom, and their beliefs around mathematics. These voices were based on the scholarly work published on single-sex education and gender differences, in general and specific to mathematics, in international settings consisting of grades kindergarten to twelfth published in peer-reviewed journals from 1985 to 2014. Generally speaking, the voices expressed by participants in this study coincided with this research (see Chapter 2) and their respective

guiding voices (see Chapter 3), with the only exception being the Voice of Manipulation that was articulated by a sole male participant. In what follows, the voices are discussed within each of the guiding voices, with the exception of Guiding Voice Three, mathematics as a gendered domain, which through the analysis was considered more of a belief than as a voice composing participants' expressed mathematics identity. The insights from this belief will be discussed in a subsequent section.

Guiding Voice One, self-confidence in mathematics, included voices uttering personal perceptions of participants' abilities to succeed (or not) in mathematics (e.g., Voice of Oscillation & Voice of Effort), which typically influenced voices expressing active or passive performative actions (e.g., Voice of Visibility). But additionally, two voices were articulated by participants that were initially not considered within Guiding Voice One, the Voice of Assist and the Voice of Inquiry; voices expressing giving and receiving help to and from others based on one's perceived mathematical abilities. These voices are supported by literature that suggests adolescents consider the benefits and threats associated with help-seeking behavior, which included but are not necessarily limited to perceived competence and achievement goals (Ryan, Gheen, & Midgley, 1998; Ryan & Pintrich, 1997), teacher's instructional strategies, and classroom environment (Ryan et al., 1998; Turner et al., 2002). And as noted by Ryan and colleagues (1998), boys are more likely to avoid seeking help from teachers and classmates than girls do, which they argued contradicts theories and ideas of others that suggest girls lose their voice during adolescents. Furthermore, a Voice of Ability, as opposed to the Voice of Effort, was not articulated by participants in this study, which has historically been

voiced more by male participants (e.g., Gilbert, 1996). Yet this does not imply that the participants not expressing a Voice of Effort in this study attribute their successes in mathematics to their abilities. Lastly, unlike scholarly work that examined adolescents' self-confidence in mathematics as either low or high, the Voice of Oscillation in this study accounted for participants' uncertainty in their mathematical abilities as they are becoming mathematics students and developing their mathematics identity.

Guiding Voice Two, sense of belonging as a member of the mathematics classroom and/or community, included voices communicating being "picked on" by their peers and/or teacher (e.g., Voice of Outsider), being comfortable (or not) as an active or passive member of the classroom (e.g., Voice of Invisibility), and being comfortable with asking or giving help to and from others (e.g., Voice of Inquiry). The latter voices differ from the Voice of Assist and Voice of Inquiry considered within one's self-confidence in mathematics because here it is based on how comfortable they are within the classroom rather than their perceived mathematical abilities. These two voices are supported within Guiding Voice Two by literature that claimed that seeking help is based on adolescents' relationship with their teacher and the possibility of being ostracized by their peers (Newman & Schwager, 1993; Ryan & Pintrich, 1997). Overall, participants expressed voices encompassing being accepted (or not), of positive and/or negative affective factors, and a desire to fade or not, similar to constructs in the *Math Sense of Belonging Scale* developed by Good et al. (2012), which was utilized in this study to uncover participants' voices within their narratives.

Guiding Voice Four, stereotypical gender roles and characteristics, comprised voices defined as "normal" ways of being and acting in the classroom based on one's sex, which position girls and boys as being different from one another. Generally, girls tend to voice possessing "feminine" behaviors and actions such as being non-competitive (Fennema et al., 1990) and boys tend to voice possessing "masculine" behaviors and actions such as being vocal (Warrington & Younger, 2000). Each of the voices articulated here are well grounded in the literature. For example, the Voice of the Future is supported through the scholarly work of Else-Quest et al. (2010), as well as Muzzatti and Agnoli (2007), which suggested that boys perceive mathematics as more useful and valuable than girls do, and further supported in this study in which this voice was only communicated by two male participants. The voices of "Good" Student and "Bad" Student were expressed as playing the game of school, behaviors and actions expected of them as students such as completing their homework assignments or raising their hand before speaking. The only new voice to arise from this study was the Voice of Manipulation, which is not well documented in our current literature base, but could also be viewed as a form of playing the game of school.

We are more Similar than Different

In answering the second sub-question, the similarities and differences among participants' voices, results indicated an existence of differences in voices based on participants' sex, class type (i.e., single-sex versus coeducational), and sex-class type interaction (i.e., single-sex girls, coeducational girls, single-sex boys, and coeducational boys). The results based on the sex of the participants' in this study coincide with the

literature that examined differences between female and male students. In general, the female participants in this study expressed the Voice of Assist, the Voice of Inquiry, and the Voice of "Good" Student, voices that invoke an image of these participants' mathematics identity in terms of an ethic of care (Gilligan, 1982). These voices are analogous to the literature that claims girls conform to the demands of school more often than boys (Maccoby & Jacklin, 1974; Morris, 2012; Younger et al., 1999). Gilligan (1982) would argue that these voices expressed here by female participants, position them as subordinate to their male counterparts, while Belenky and colleagues (1997) would argue these female participants are acting in blind obedience to authorities. Morris (2012), on the other hand, would contend that these voices are a form of resistance, specifically a conscientious resistance, in which females "appropriate" school-oriented behaviors are "aimed at achieving recognition and independence in a male-dominated society" (p. 129). Unfortunately, evidence from this study is unclear as to support either case.

The male participants in this study expressed a Voice of Competition more often than the female participants; therefore, the males spoke of comparing themselves to and competing with others in the classroom and/or school. This finding coincides with teacher's perceptions of boys as competitive and girls as non-competitive in a mathematics classroom (Fennema et al., 1990), which Niederle and Vesterlund (2008) argued may be explained by boys' overconfidence in their abilities. The last difference in participants' voices based on their sex was the number of females who expressed a low self-confidence in their mathematical abilities (Voice of Doubt) as compared to the

number of males who expressed a high self-confidence in their mathematical abilities (Voice of Pride). Previous scholarly work too has suggested that boys report possessing higher self-confidence in their mathematical abilities from girls (e.g., Else-Quest et al., 2010; Morris, 2012). However, this finding is not to overshadow the fact that the majority of participants, regardless of class type, expressed a Voice of Oscillation, a voice communicating both a high and a low self-confidence in their mathematical abilities. Hence, not supporting Guiding Voice One, which stated that males would voice high levels of self-confidence in mathematics and females would voice low levels of self-confidence in mathematics.

There were no differences in participants' voices based on enrollment in a single-sex or coeducational mathematics class, but there was a difference in their beliefs of mathematics as a gendered domain, coined We are Similar and We are Different. In this study, all six participants in the coeducation mathematics classrooms expressed the belief We are Different as compared to two participants in the single-sex mathematics classrooms. This finding contrasts the research conducted by Lee and colleagues (1994) and Fabes and colleagues (2013) that concluded that single-sex environments had a tendency to perpetuate gendered stereotypes such as academic dependence in an all-girls setting more than coeducational environments (Lee et al., 1994). And because studies investigating adolescents' gender stereotypes in single-sex public education settings as compared to that of adolescents' gender stereotypes in coeducational settings are scant and insufficient (see Pahlke, Hyde, et al., 2014), this finding contributes to our knowledge by illustrating the possibility that single-sex environments, at least in this

school, may be diminishing adolescents' views of stereotypical masculine and feminine characteristics and actions.

Taking a closer examination of the reasons or the statements the eight participants' (six in coeducational and two in single-sex) provided in expressing their belief We are Different, contradicted and confirmed previous scholarly work. Considering only participants' comments regarding mathematics as a gendered domain (Guiding Voice Three), seven of the participants, three male and four female, considered mathematics as a female domain, while one male participant believed mathematics to be a male domain. This finding is dissimilar to the majority of research investigating students' gendered beliefs about mathematics in that mathematics was perceived by students as being a male domain (e.g., Barkatsas et al., 2001; Leedy et al., 2003). However, the finding here is across both class types; thus, not necessarily due to enrollment in either a single-sex or coeducational setting, and contradicts Guiding Voice Three, which stated that male participants, regardless of class type, would voice mathematics as a male domain, while female participants, regardless of class type, would voice mathematics as a gendered neutral domain. In addition, the participants reasons supporting their beliefs of mathematics as a female domain is not necessarily due to what is deemed more suitable or if it is a more appropriate subject area for one gender over another, but this belief was based on girls being perceived as mathematically smarter than boys, typically because they received higher letter grades.

The eight participants' reasons for differences were framed within differences in gender roles in the mathematics classroom (Guiding Voice Four), clear dichotomous

gendered actions were articulated and aligned with characteristics "typical" of each gender as a homogeneous group, for example, girls in general were described as quiet and boys were generally described as loud. This confirmed Guiding Voice Four, which indicated that the female and male participants regardless of class type would discuss gender roles and characteristics within the mathematics classroom as deemed "appropriate" by traditional stereotypes. This suggests that simply removing the salience of gender from the classroom is not enough to diminish the taken-for-granted assumptions established within the development of human development theories (Gilligan, 1982; 2011).

Differences in participants' Voices based on sex-class type interactions were between single-sex and coeducational female participants and single-sex and coeducational male participants. In this study, two of the female participants enrolled in the coeducational class expressed voices that indicated a sense of not belonging as a member of the mathematics classroom or the school (Voice of Outsider, Voice of Subordinate, and Voice of Invisibility), while such voices in the other female participant in the coeducational class was either silenced or not audible. This finding is supported by research that claim females in general feel excluded and marginalized from the mathematics community (e.g., Solomon, 2007a, 2007b). Conversely, the girls in the single-sex class had a tendency to articulate voices of belonging to the mathematics environment, namely the Voice of Visibility and the Voice of Assist. This finding suggests that a single-sex environment may afford adolescents in an all-girls class a sense of affiliation among and comfort with same-sex peers (Brutsaert & Houtee, 2002;

Strough, Swenson, & Cheng, 2001). The only difference in voices between the male participants in the single-sex classes and male participants in the coeducational classes was the Voice of Competition, implying that single-sex environments, at least for the three male participants in this study, may be promoting an atmosphere of academic rivalry. However, other explanations for this finding may be due to the nature of the class itself being titled an advanced mathematics class or due to the emphasis placed on rote memorization rather than understanding (Turner et al., 2002).

In general, the many pronounced voices composing participants' mathematics identities are supported in the scholarly work of previous researchers. Yet there are a few instances in which the voices may be viewed as voices of resistance, a voice that contests being distorted and constrained by gender stereotypes. As noted above, one such example is the participants' beliefs of mathematics as a gendered domain, in which only one participant strongly believed that mathematics was more suitable for males than females. The Voice of Visibility, even though expressed by only two female participants enrolled in the single-sex setting, was a voice not suppressed by an environment in which boys are viewed to typically "monopolize the linguistic space" (Salomone, 2006). A particular case is the Voice of Enjoyment expressed by Hannabell in which she articulated her enjoyment of being an independent member of the classroom. This is contradictory to research that depict females as being perceived as more dependent from their male counterparts (e.g., Fennema et al., 1990). Furthermore, three of the male participants in this study expressed a Voice of Effort. And even though not considered a voice of resistance, but as a finding that dispute prior research on locus of control, in which males

tend to attribute their success to ability rather than effort (e.g., Gilbert, 1996). In considering these findings here, caution is warranted based on the small number of participants in this study, but spurs a need for further research, particularly in regards to the voices of resistance.

In considering the differences in voices expressed by the participants based on sex, class type, and sex-class type interaction, the similarities among participants' voices have been unheeded. Generally speaking, insights from this sub-question suggests that male and female adolescents' view of themselves as mathematics students, regardless of class type, are more similar than different, which raises the question of why as a research community there a tendency to pit one gender against the other, to elevate one gender as inferior to the other. This concern has been marginally addressed by researchers such as Hyde (2005), Ball, Cribbie, and Steele (2013), and Mills et al. (2009). For example, Hyde (2005) conducted a meta-analysis of approximately 2,000 studies of psychological differences between women and men and deduced that the effect size of 78% of these studies were small or close to zero. Hence, in general we are more alike than we are different, which was titled by Hyde as the gender similarities hypothesis.

Single-Sex Mathematics Classes shaping Mathematics Identities

The first research question posed was to explore how, if any, single-sex and coeducational classroom settings might be shaping participants' dynamic mathematics identity. Particular interest in this study was to understand how a single-sex mathematics classroom might be perceived by participants' as shaping their perception of themselves as mathematics students differently than participants' perceptions of themselves as

mathematics students enrolled in a coeducational mathematics classroom. To answer this question, I had to rely more on participants' perceptions as "truth" because I as a researcher cannot make definite claims that single-sex classroom are or are not shaping the participants' mathematics identity. But looking to research, Pahlke, Hyde, and Allison (2014) concluded in their meta-analysis on the effects of single-sex compared with coeducational schools from across international contexts, single-sex settings are not making much of a difference for girls or boys on any measurable outcome. Yet in considering the effects by age and grade in school, the researchers claimed that scholarly studies conducted in middle school settings showed an advantage for girls enrolled in single-sex schools and an advantage for boys enrolled in coeducational schools. But, such a claim should be interpreted with caution due to the small number of high-quality controlled studies including middle school participants. However, unlike the studies analyzed in this meta-analysis, this study was conducted in single-sex classrooms rather than single-sex schools and the "outcome" is not measurable, but a complex construct (Cobb et al., 2009) difficult to "measure" with a large number of participants; therefore, would not be considered by Pahlke and colleagues (2014) as a high-quality controlled study.

The results from this study suggested that class type, whether single-sex or coeducational, was having an influence on shaping participants' expressed mathematics identity. Broadly speaking, in this study the single-sex mathematics classes appear to be favorable to shaping the mathematics identities of female participants more so than the male participants. For the three female participants enrolled in the single-sex classroom,

they expressed feeling a sense of comfort within this setting, a feeling that afforded them the opportunity to be visible members of the classroom and possess a high sense of belonging. Additionally, there were fewer distractions due to the absence of boys in the class (Streitmatter, 2002). For two of three female participants enrolled in the coeducational classroom, they perceived the single-sex classroom to be a better option because of their negative experiences and/or low self-confidence in their mathematical abilities. For the other female participant enrolled in the coeducational class, Dottie, she spoke from experience in stating that the coeducational class was better for her because she was typically distracted by the gossip and drama exhibited in the all-girls class. However, in examining her mathematics identity (refer to Figure 4.12), she expressed a low sense of belonging in her present mathematics classroom setting and a wavering sense of confidence in her mathematical abilities. On the other hand, for four of the six male participants, the class type did not appear to make a difference in their expressed mathematics identity. For the other two male participants, they claimed that the coeducational settings was more suitable because there would be fewer distractions, which does not align with the arguments of Coleman (as cited in Streitmatter, 1999) and Streitmatter (1999), which claimed that having members of the opposite sex in the classroom was more distracting and deterred from paying attention in class.

However, it is not as simple as considering class type void of other external influences such as institutional policies, family members, social status, and teachers and classmates to name a few. This is similar to the framework developed by Martin (2000) that considered adolescents' mathematical identity formation nested within

sociohistorical, community, school, and individual factors. In this study, participants, more than likely unbeknownst to them, discussed external influences shaping their mathematics identities, which was due to shifting the turning mechanism of the kaleidoscope. For these adolescents, such external factors are not questioned, but accepted as truth, as an authoritative discourse eventually assimilated into one's internal discourse (Bahktin, 1981). And in some instances, these participants may have articulated voices "mirrored in the eyes of others, the urgency is great to live up to others' expectations, in the hope of preventing others from forming a dim view" (Belenky et al., 1997, p. 48). A specific example of this is Jennifer's view of herself through the eyes of her parents. "Sometimes like if I get frustrated with it, my parents say come on, you're really smart. You can do this" (Jennifer/P6/L9-10). This is additionally supported more broadly within this study as only one new voice was articulated by only one participant, the Voice of Manipulation. This suggests that participants in this study may have been conforming to the authoritative voices of others when narrating their mathematics identity, including conforming to the static body of research presented in Chapter 2. Extending the authoritative discourse to Evans (2013) concept of an oracle, defined as a universal and necessary truth, the possibility of new voices may have been silenced out of fear; in this case, fear of communicating a voice not expected of participant. However, it is possible that participants in this study are not even aware of the possibility of formulating new voices or articulating voices of resistance.

The Complexity within Participants' Interplay of Voices

The second research question explored in this study was to gain an understanding of how participants' narrated voices embodied their beliefs and views of themselves as mathematics students, as well as to privilege the mathematics identity of each participant rather than as a homogenous group (e.g., Cook-Sather, 2002). Such groupings are common among researchers (e.g., Brown & Ronau, 2012) and even within this study, particularly in examining the similarities and differences in participants' voices. Thus, insights from this research question are not framed as definite or even suggested findings, but as lessons gleaned from listening rather than reading participants' narratives (Gilligan et al., 2003), in addition to questions I began to formulate throughout the analysis process (Chapter 3) and in writing each participant's narrated mathematics identity (Chapter 4). These questions may not have a simple response.

Insight. My initial formulation and understanding of participants' mathematics identity was as a "perfect" interplay of voices, which I once viewed as situated within at least four interlocking circles or four guiding voices, indicated by the dark center in Figure 4.14.

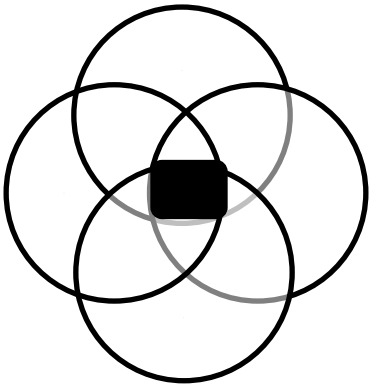


Figure 4.14 "Perfect" Interplay of Voices

Yet, through my analysis and construction of participants' voice mappings, the interplay of voices evolved into three different interplay configurations. The first configuration was similar to the "Perfect" interplay of voices in that the lead voice was the center voice with participants' other audible voices in direct and indirect relationship with the lead voice. This is evidenced in the voice mappings of Colin (see Figure 4.2), Matthew (see Figure 4.4), Hannabell (see Figure 4.5), Cameron (see Figure 4.8), Emmeline (see Figure 4.10), and Trevor (see Figure 4.13), and displayed hypothetically in Figure 4.15.

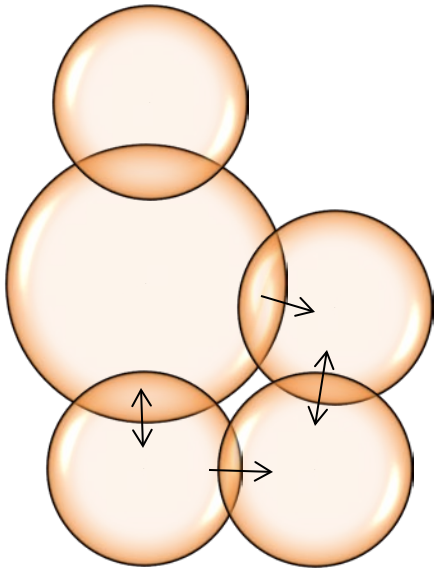


Figure 4.15 Hypothetical Example of Interplay of Voices around Lead Voice

The second was a linear configuration as evidenced by Justice (see Figure 4.3), Jennifer (see Figure 4.6), and JJ (see Figure 4.11). The voices in this interplay were not in a direct relationship with their lead voice, but rather similar to a chain reaction in which one voice is typically in a relationship with another voice, which is typically in a relationship with another voice, and so forth. See Figure 4.16 for a hypothetical example of this interplay.

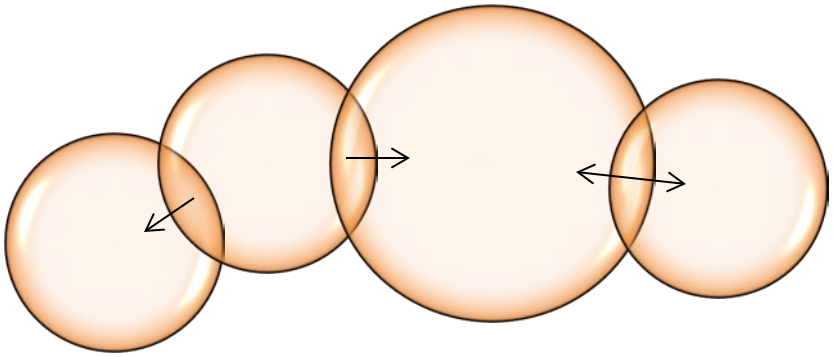


Figure 4.16 Hypothetical Example of a Linear Interplay of Voices

The third pattern is likened to an intersection of multiple pathways, or in this study, multiple pathways of voices extending in various directions from the lead voice. Thus, not all voices are in direct relationship with participants' lead voice (see Figure 4.17). This pattern was evidenced in the voice mappings of Savannah (see Figure 4.7), Dottie (see Figure 4.9), and Katrina (see Figure 4.12).

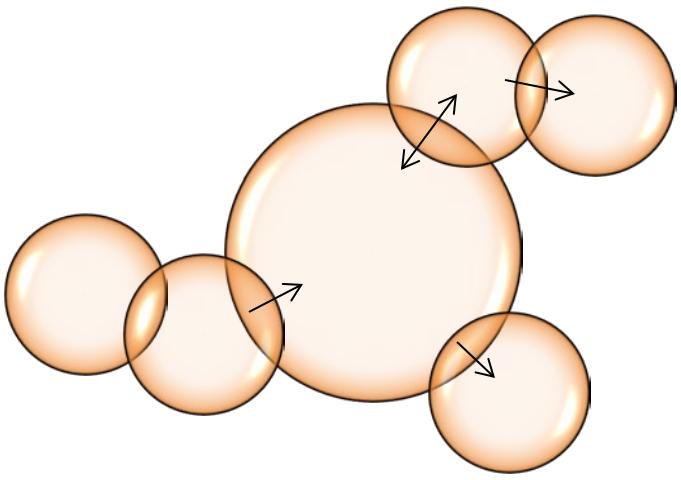


Figure 4.17 Hypothetical Example of a Multiple Pathway Interplay of Voices

Other than disrupting my initial understanding of one's mathematics identity and re-emphasizing the notion that identity is complex, what might these different configurations mean in regards to adolescents' interplay of multiple voices embodying their mathematics identity, specifically their lead voice. Might a linear configuration imply a "disjointed" mathematics identity in which adolescents' are struggling to express their mathematics identity or fighting against authoritative discourses?

Practicality. As asserted by scholars, experience is not something that can be observed (Clandinin & Connelly, 2000; Polkinghorne, 1988; Webster & Mertova, 2007), which I conjectured to extend to adolescents' mathematics identity. Yet, I have grappled throughout my analytic process and synthesis with how to make such an abstract construct more tangible and less time consuming for teachers and researchers' understandings of males and females as mathematics students. Is it possible to observe students' voices? I would argue yes and no.

There were many instances in which I observed participant's "true" reflection of their voices, which I supported with field notes from my observations. Yet there were occasions in which what I observed and perceived as a voice within a participant's mathematics identity did not align with a participant's expressed voice. For example, I viewed Colin as an active member of the classroom, thus expected he would articulate the Voice of Visibility. However, Colin articulated a Voice of Invisibility because he did not like to speak in front of others. As another example, I positioned Hannabell as a student who exhibited a low sense of self-confidence in her mathematics abilities because she seemed uncertain of her work and often had a tendency to ask for help. Yet,

Hannabell expressed a Voice of Oscillation, often times stating that she was pretty good at mathematics. Do these participants consider these voices as "true" components of their mathematics identity or are they intentionally communicating voices to *position* themselves more or less favorable?

There were other moments where I did not observe expressed voices. A prime example is a few of the voices communicated by Matthew, such as the Voice of Outsider, which was only discovered through listening to Matthew during my analysis of his interview. A general example of an unobservable voice is the Voice of the Future that expresses the importance of mathematics for one's future goals and/or career. So to restate, is it possible to capture adolescents' voices and hence mathematics identities based solely on observations of discursive and non-discursive actions (e.g., Bishop, 2012). And even if it is observable as some may contend, how can one observe and explain the interplay of voices, especially since identity is a dynamic construct?

Silent or Silenced Voices. In examination of the similarities and differences of participants' voices and through construction of voice mappings, I questioned why some voices were more prevalent among participants than other voices. The Voice of Oscillation was expressed most often by eight of the 12 participants, followed by the Voice of Inquiry ($n = 7$) and the Voice of "Good" Student ($n = 6$), while the Voice of "Bad" Student and the Voice of Manipulation were each articulated by only one participant. Additionally, I questioned why some voices were not audible among participants such as a Voice of Ability as noted above or why some voices were not audible within particular participants' mathematics identity. For instance, neither

Cameron nor Justice expressed a voice indicating a sense of belonging or not. Therefore, the question then transformed into why are voices missing or silent within participants expressed mathematics identity. Are these voices intentionally suppressed or silenced by the participant, and if so, why? Are these voices silenced by the authoritative discourse of others (Bakhtin, 1981)? Or are these voices silent because participants are unaware of their existence (hidden voices)? How might the questions posed in the interview, and the selected I-poems and word trees in the validation interviews, suppress or sanction particular voices? And how do new voices gain audibility, in this study, gain audibility within their narrations of themselves as mathematics students?

Conclusion

Since the amendment to the Title IX legislation in 2006, the number of single-sex classrooms in public coeducational schools in the United States has proliferated; yet little is known about the impact of such settings on female and male adolescents. Therefore, the purpose of this exploratory study was to uncover and understand adolescent students' dynamic mathematics identity enrolled in either a single-sex mathematics classroom or a coeducational mathematics classroom within the same public middle school. Utilizing the Listening Guide to analyze participants' interviews, I gained insights to suggest that even though mathematics identity is a complex and individualistic construct, it is also a construct composed of living voices co-existing with one another in a synchronized motion. However, it is difficult to discern if being enrolled in a single-sex setting, particularly in mathematics, influences adolescents' expressed mathematics identity differently than those enrolled in a coeducational setting because adolescents must make

sense of their mathematics identity within the broader context of society. Additional insights from this study suggest that we, women and men, girls and boys, void of class type, are more similar than we are different. The significances of these general and broadly stated insights have only spurred additional questions both in regards to single-sex education and mathematics identity in general.

Implications

This study is significant for several reasons. One, it adds to our current understanding of adolescents' mathematics identities and single-sex education as there is no known study that has examined female and male adolescent students' dynamic mathematics identity within a single-sex classroom setting, particularly within a public coeducational middle school located in the United States. In studies conducted by Mendick (2005, 2006), male and female students typically positioned themselves within a gendered masculine-feminine mathematics dichotomy such as competitive/collaborative, active/passive, and naturally able/hardworking. In examining mathematics identity as composed of multiple voices, participants in this study expressed voices in resistance of this dichotomy. For example, a missing voice was the Voice of Ability; therefore, neither the male or female participants in this study attributed natural ability to one gender more than another. As another example, female participants did not always articulate a Voice of Invisibility (e.g., passive) and male participants did not always express a Voice of Visibility (e.g., active). In addition, it appears as if the students in this study enrolled in single-sex mathematics classes situate their mathematics identity within a belief of We are Similar more often than the belief of We are Different. In other words, these

participants hold a belief that females and males are equally good or successful in mathematics. Therefore, the single-sex classrooms in this study may be diminishing gendered stereotypes in relation to mathematics, as well as characteristics and roles in mathematics associated with males and females.

Furthermore, five of the six female participants in this study expressed a preference for a single-sex mathematics class than a coeducational mathematics class, three females because of their positive experience and sense of belonging within their current single-sex setting and two females because of their negative experience and sense of belonging within their current coeducational setting. Considering only the three female participants in the single-sex mathematics classroom, their sense of belonging was expressed as voices of being an active and visible member of the classroom, being comfortable with asking for help and with giving help to their peers, and as playing the role of a "good" student as defined by institutional norms. These participants also did not express voices indicating discomfort with their teacher and/or their peers. It is as if this particular single-sex classroom is instilling a sense of membership in the male-dominated "math club" (Bartholomew et al., 2011), a "club" in which women typically feel invisible and marginalized. Yet, many of the voices expressed by these three female participants conform to societal gender norms of what is expected of females, such as the Voice of Inquiry and the Voice of Assist, voices expressing the ethic of care and relationships (Gilligan, 1982). This raises the question, is conforming to these feminine norms within voices expressing a sense of belonging in single-sex settings a bad thing? Which outweighs the other, obedience to the authoritative discourse of others and societal norms

or voices that articulate a positive experience and/or sense of self within a single-sex setting? I would argue that expressing voices of self-confidence in mathematics abilities and/or expressing high sense of belonging within a classroom setting, just to name a few voices, may empower females, and other marginalized students to deconstruct gendered norms and stereotypes (refer to Parker, Bermudez, & Neustifter, 2008 for a similar argument).

Two, the notion of students' mathematics identity being composed of multiple voices in interplay with one another may present and challenge researchers to study identity differently and to continue building theoretical ideas that explain how adolescents negotiate and narrate subject-specific identities. As contended in Chapter 1, mathematics identity is an interplay of multiple voices that are going to change as individuals are becoming learners and doers of mathematics. And even though this study only captured female and male mathematics identity at a given moment of time, I argue that some of the voices expressed by participants in this study would be expressed a month, a year, or even five years later as they progress through mathematics courses. These voices become increasingly united over a period of time and potentially "solidify" participants' mathematics identity (e.g., Holland & Lave, 2001; Sfard & Prusak, 2005). The goal is identity these key voices of mathematics identity and capitalize on those expressing a positive sense of self and foster those voices expressing a negative sense of self. The use of voice mappings will serve as a useful analytical tool in examining shifts within one's mathematics identity and across many mathematics identity. The voice mappings will allow researchers to examine the relationship between and among voices

(see Figure 4.15, 4.16, and 4.17 for examples). Additionally, researchers are encouraged to consider the power of I-poems in representing and examining individual's identity as it may serve as a catalyst into their consciousness and/or depiction of self.

Three, this study diffuses the idea that females and males are different, that one gender is superior to another, or present findings that females and males are similar. Even though there were some noted differences in voices from the participants in this study, such as the Voice of "Good" Student that was more often articulated by female participants regardless of class type, these are not enough to warrant a broad, sweeping claim that the female and male participants in this study are different. By the same argument, evidence of similar voices, such as the Voice of Oscillation and the Voice of Effort, are not enough to warrant a broad, sweeping claim that female and male participants in this study are similar. I would argue that highlighting, and at times exaggerating any differences is based on the type of research questions posed and I would encourage researchers to not always pose questions that will lead to a zero sum game where there is a clear "winner" and a clear "loser."

Four, the findings may be useful for policymakers, administrators, and teachers in making sound decisions prior to implementing single-sex classes at the middle school level; as single-sex mathematics classrooms may or may not serve to combat the downward spiral and meet students' psychological and academic needs. In this study, the female participants preferred a single-sex setting and the male participants preferred a coeducational setting, but for varying reasons. For example, five of the female participants expressed being comfortable in a single-sex environment, while two male

participants preferred a coeducational environment so to mathematically compete with both girls and boys. Students' voices should be accounted for prior to making a decision that directly affects them as students as it is difficult to implement an all-female class without implementing an all-boys class. Likewise, this study should encourage teachers to listen to the voices and narratives of their students and self-reflect on how their verbal and non-verbal communication, beliefs, and values may be impacting their students' mathematics identity positively or negatively. In other words, teachers are encouraged to "see" their students (Delpit, 2006) and make changes so to silence particular voices and nurture the audibility of other voices.

Future Research

This study raises additional questions within the field of single-sex public education in mathematics classrooms. For instance, further research could address questions of why girls in single-sex classes might feel a greater sense of belonging and comfort in mathematics classrooms from girls in coeducational classes. How might the single-sex classes, at least for females, promote a sense of community (Cobb, Stephan, McClain, & Gravemeijer, 2001) and inform teachers' practices within coeducational settings? And are any impacts of this greater sense of belonging sustainable in subsequent years, particularly in a coeducational mathematics class? Additional research could also investigate why adolescent views of mathematics as a gendered domain appear to be shifting from a male domain to a female or neutral domain. There are other questions that have arisen from this study that future research may explore. How might teachers' professional and mathematics identities coincide or contrast with their students'

mathematics identities and what are possible implications? Why might boys appear indifferent to enrollment in a single-sex or coeducational mathematics class? And to conclude on a career endeavor, is the development of an interpretative framework or student profiles for understanding the interplay of voices composing one's dynamic mathematics identity warranted? This question may be begin to be addressed through a longitudinal study of how female and male participants' voice mappings change as they progress through mathematics courses in particular and more broadly through the Science, Technology, Engineering, and Mathematics (STEM) pipeline.

APPENDICES

Appendix A

IRB Approved Consent/Assent Forms

Parent Permission Form
Clemson University

The Influence of Single-Sex Education on Female and Male Adolescents' Emerging Mathematics Identity

Description of the Research and Your Child's Part in It

Dr. Megan Che, along with Amber Simpson is inviting your child to take part in a research study. Dr. Che is an Associate Professor of Mathematics Education at Clemson University. Amber Simpson is a doctoral candidate at Clemson University, conducting this study with the help of Dr. Che The purpose of this research is to gain an understanding of how being enrolled in either a single-sex mathematics class or a mixed-sex mathematics class impacts how students' think about themselves as math learners.

As a part of the study, your child is being asked to take part in an interview with Ms. Simpson. The interviews will be between 30-45 minutes and will be conducted after school in a neutral location such as the school library. The interviews will be audio recorded to ensure that Ms. Simpson captures all the information verbatim and to give her undivided attention to your child during the interview process. The interview will be conducted one time during November 2014. The purpose of the interview is to allow your child to talk about themselves as math students. Your child will also be given an opportunity to read through his or her interview and/or narrative so to clarify any misunderstandings and to either refute or confirm the information. This will be conducted after school in a neutral location such as the school library and will take approximately two hours, one hour for the interview and one hour for the narrative.

In addition, observations of your child's classroom will be conducted once or twice a week beginning at the beginning in August and ending in November. During the observations, Ms. Simpson will be situated on the perimeter of the classroom. The purpose of the observations is for Ms. Simpson to take notes on the classroom activities and your child's part in the classroom as a mathematics student.

Risks and Discomforts

We do not know of any risks or discomforts to your child in this research study.

Possible Benefits

We do not know of any way your child would benefit directly from taking part in this study. However, this research may help us to understand how males and females identify as math students in either a single-sex or a mixed-sex mathematics classroom.

Protection of Privacy and Confidentiality

All electronic information collected from the study will be stored on Ms. Simpson's password protected computer and backed up on a password protected external storage device. Any paper-based information collected from the study will be stored in a locked filing cabinet in Ms. Simpson's home office. Only Dr. Che and Ms. Simpson will have access to the data. All data will be securely stored for a period of five years, at which time they will be destroyed.

We will do everything we can to protect your child's privacy and confidentiality. We will not tell anybody outside of the research team that your child was in this study or what information we collected about your child in particular. We will use pseudonyms when presenting the information at conferences and in published articles.

Choosing to Be in the Study

You child does not have to be in this research study. You do not have to let your child be in the study. You may tell us at any time that you do not want your child to be in the study anymore. Your child will not be punished in any way if you decide not to let your child be in the study or if you stop your child from continuing in the study. Your child's grades will not be affected by any decision you make about this study.

We will also ask your child if they want to take part in this study. Your child will be able to refuse to take part or to quit being in the study at any time.

Contact Information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Megan Che at Clemson University at 864-656-2036.

If you have any questions or concerns about your child's rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-6460 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC's toll-free number, 866-297-3071.

Consent

I have read this form and have been allowed to ask any questions I might have. I give my permission for my child to be in this study.

Parent's signature: _____ Date: _____

Child's Name: _____

A copy of this form will be given to you.

Child/Minor Agreement to Be in a Research Study
Clemson University

The Influence of Single-Sex Education on Female and Male Adolescents' Emerging Mathematics Identity

You are being invited to be in a research study. Below you will find answers to some of the questions that you may have.

Who Are We?

- Dr. Che is an associate professor in mathematics education at Clemson University. She teaches classes for people who want to become teachers.
- Ms. Simpson is a student at Clemson University. She was once a math teacher and is now learning how to become a teacher at the college level.

What Is It For?

- We want to learn more about you a math student being in a class with only boys or girls or with both boys and girls.

Why You?

- You are being selected because you are currently enrolled in a school that offers single-sex and mixed-sex math classes.

What Will You Have to Do?

- If you agree to be in this study, you will be interviewed. The interview will take between 30-45 minutes and will take place after school in the school library. The interviews will be audio-recorded and you have the option to stop the audio recording at any time during the interview.
- You are also agreeing to allow Ms. Simpson to observe what you do in your math class once or twice a week for about 10 weeks.

What Are the Good Things and Bad Things that May Happen to You If You Are in the Study?

- You will get to choose a new name to be identified as in the study.
- You will get a chance to comment on your interview and/or narrative.
- Otherwise, we are unaware of any good things or bad things that may happen to you if you decide to participate in the study.

What If You Want to Stop? Will You Get in Trouble?

- Your participation in this study is voluntary. You may stop at any time. Participating in this study will not affect your grade in school.

Do You Have Any Questions?

- You can ask questions at any time. You can ask them now. You can ask later. You can talk to me or you can talk to someone else at any time during the study. Here is the telephone number to reach Megan Che, Teacher Education, 864-656-2036.

By signing below, I am saying that I have read this form and have asked any questions that I may have. All of my questions have been answered and I understand what I am being asked to do. I am willing and would like to be in this study.

_____ _____

Signature of Child/Minor Date

A copy of this form will be given to you.

School District of Pickens County

Building success beyond the classroom

June 30, 2014

Amber Simpson has permission to conduct a research study in the School District of Pickens County at Liberty Middle School. Specifically, the researcher will focus on single-gender mathematics classes. It is the understanding of the district that the purpose of the study is to determine how being enrolled in an all- female, an all-male, and a coeducational mathematics class might influence female and male students emerging math identities. As part of this study, the researcher has indicated that she plans to conduct surveys, interviews, and observations of students.

The School District of Pickens County requests that students and parents be made aware of the research study in writing and have the opportunity to opt out of the study if they so desire. Ms. Simpson should work under the supervision of the school principal or his designee.

The District wishes Ms. Simpson the best as she conducts and completes her research and would be interested in having her share her findings with us as they become available.

Sincerely,

Sharon M. Huff
Assistant Superintendent of Instructional Services
1348 Griffin Mill Road
Easley, SC 29640
864-397-1036
sharonhuff@pickens.k12.sc.us

Appendix B

Mathematics as a Gendered Domain Survey

The purpose of this survey is to find out your opinion about a number of statements related to boys' and girls' learning of mathematics. There are no correct or incorrect answers. We are only interested in your personal opinion.

The survey should take about 10-15 minutes to complete.

Please fill in the following information before answering the survey questions.

Name: _____ "Fake Name": _____

Teacher Name: _____ Class Period: _____

Math Class (circle one): All-girls All-boys Both girls and boys

Gender (circle one): Female Male Other

Have you been in an all-girls or all-boys math class before this year? (circle one) Yes No
If yes, which grade level(s)? _____

Ethnicity (circle one): American Indian or Alaska Native
Asian
Black or African American
Hispanic/Latino
White
Native Hawaiian or Other Pacific Islander
2 or more Races
Other

How good are you at math? (Circle one):
Excellent Good Average Below Average Weak

Mathematics Survey

Directions: Please circle *one* of the following responses to EACH statement:

SA if you **STRONGLY AGREE** with the statement

A if you **AGREE** with the statement

NS if you are **NOT SURE** whether you agree or disagree with the statement

D if you **DISAGREE** with the statement

SD if you **STRONGLY DISAGREE** with the statement

1. Women and men are equally likely to be good mathematics teachers.	SA	A	NS	D	SD
2. Students who get poor marks on mathematics tests are just as likely to be boys as girls.	SA	A	NS	D	SD
3. Parents think that getting high grades in mathematics is as important for their daughters as for their sons.	SA	A	NS	D	SD
4. Being good at mathematics comes as naturally to girls as to boys.	SA	A	NS	D	SD
5. Mathematics is easier for men than it is for women.	SA	A	NS	D	SD
6. Girls are more suited than boys to a career in a mathematically-related area.	SA	A	NS	D	SD
7. Girls have more natural mathematical ability than do boys.	SA	A	NS	D	SD
8. It is just as difficult for girls as it for boys to get a job in a mathematically-related profession.	SA	A	NS	D	SD
9. Boys are just as likely as girls to enjoy mathematics.	SA	A	NS	D	SD
10. Boys are more determined than girls to do well in mathematics.	SA	A	NS	D	SD

11. Girls and boys who do well in a mathematics test are just as likely to be congratulated.	SA	A	NS	D	SD
12. Boys have more use for mathematics than girls do when they leave school.	SA	A	NS	D	SD
13. Parents believe mathematics is more important for their daughters than for their sons.	SA	A	NS	D	SD
14. Explaining answers in mathematics is harder for boys than for girls.	SA	A	NS	D	SD
15. Girls and boys are just as likely to be lazy in mathematics class.	SA	A	NS	D	SD
16. Boys understand mathematics better than girls do.	SA	A	NS	D	SD
17. Girls enjoy mathematics more than boys do.	SA	A	NS	D	SD
18. Boys are distracted from their work in mathematics classes more than girls.	SA	A	NS	D	SD
19. Parents are as likely to help their daughters as their sons with mathematics.	SA	A	NS	D	SD
20. Boys, more than girls, want to do well in mathematics to please their parents.	SA	A	NS	D	SD
21. Compared to boys, girls do less work in mathematics class.	SA	A	NS	D	SD
22. More boys than girls care about doing well at mathematics.	SA	A	NS	D	SD
23. Mathematics is liked more by boys than by girls.	SA	A	NS	D	SD
24. The weakest mathematics students are more often boys than girls.	SA	A	NS	D	SD
25. Students who say mathematics is their favorite subject are equally likely to be girls or boys.	SA	A	NS	D	SD

26. It is more acceptable for a man than a woman to be good at mathematics.	SA	A	NS	D	SD
27. Career choices make the study of mathematics more important for boys than for girls.	SA	A	NS	D	SD
28. Compared to girls, boys give up more easily when they have difficulty with a mathematics problem.	SA	A	NS	D	SD
29. Boys, more than girls, like challenging mathematics problems.	SA	A	NS	D	SD
30. Men and women are equally suited to careers in the computer industry.	SA	A	NS	D	SD
31. Girls and boys are equally likely to believe that mathematics is important for their career.	SA	A	NS	D	SD
32. In a mathematics class with both boys and girls, girls tend to speak up more than boys.	SA	A	NS	D	SD
33. Men are mathematically more intelligent than women.	SA	A	NS	D	SD
34. Boys are encouraged more than girls to do well in mathematics.	SA	A	NS	D	SD
35. Boys, more than girls, say the mathematics test was too hard if they do not do well.	SA	A	NS	D	SD
36. Girls are encouraged more than boys to do well in mathematics.	SA	A	NS	D	SD
37. There are more popular boys than popular girls who are good at mathematics.	SA	A	NS	D	SD
38. Girls are just as likely to work hard in mathematics as boys.	SA	A	NS	D	SD
39. Girls are more careful than boys when doing mathematics.	SA	A	NS	D	SD
40. When they leave school, girls will have more use for mathematics than boys will.	SA	A	NS	D	SD

41. Girls, more than boys, care about doing well at mathematics.	SA	A	NS	D	SD
42. Boys are just as likely as girls to help friends with their mathematics.	SA	A	NS	D	SD
43. Girls are more likely than boys to believe they are good at mathematics.	SA	A	NS	D	SD
44. Girls are more likely than boys to say mathematics is their favorite subject.	SA	A	NS	D	SD
45. Boys and girls are equally good at using calculators in mathematics.	SA	A	NS	D	SD
46. The mathematical tasks done in class suit boys more than they suit girls.	SA	A	NS	D	SD
47. Girls are just as likely as boys to say they want to excel in mathematics.	SA	A	NS	D	SD
48. Girls are less interested in mathematics than are boys.	SA	A	NS	D	SD

Appendix C

Parent Survey Information Letter

Information about Being in a Research Study
Clemson University

The Influence of Single-Sex Education on Female and Male Adolescents' Emerging Mathematics Identity

Description of the Study and Your Part in It

Dr. Megan Che, along with Amber Simpson is inviting your child to take part in a research study. Dr. Che is an Associate Professor of Mathematics Education at Clemson University. Amber Simpson is a doctoral candidate at Clemson University, conducting this study with the help of Dr. Che The purpose of this research is to gain an understanding of how being enrolled in either a single-sex mathematics class or a mixed-sex mathematics class impacts how students' think about themselves as math learners.

Your child's part in this study is to take a survey about his or her beliefs about mathematics. The survey will take approximately 15-20 minutes to complete and will be administered by Ms. Simpson in their mathematics class. The purpose of the survey is to help Ms. Simpson select three participants from your child's class to be interviewed (see additional consent form). The results of the survey will be given to your child.

Risks and Discomforts

We do not know of any risks or discomforts to you in this research study.

Possible Benefits

We do not know of any way your child would benefit directly from taking part in this study. However, this research may help us to understand how males and females identify as math students in either a single-sex or a mixed-sex mathematics classroom.

Protection of Privacy and Confidentiality

All electronic information collected from the study will be stored on Ms. Simpson's password protected computer and backed up on a password protected external storage device. The paper-based survey study will be stored in a locked filing cabinet in Ms. Simpson's home office. An electronic copy of the survey and the results will be stored on Ms. Simpson's password protected computer and backed up on a password protected external storage device. Only Dr. Che and Ms. Simpson will have access to the data. All

data will be securely stored for a period of five years, at which time they will be destroyed.

We will do everything we can to protect your child's privacy and confidentiality. We will not tell anybody outside of the research team that your child was in this study or what information we collected about your child in particular. We will use pseudonyms when presenting the information at conferences and in published articles.

Choosing to Be in the Study

You child does not have to be in this part of the research study. You do not have to let your child take the survey. Your child will not be punished in any way if you decide not to let your child take the survey. Your child's grades will not be affected by any decision you make about this study. Please contact the researchers at 864-656-2036 if you do not want your child to take the survey.

We will also verbally ask your child if they want to take part in this portion of the study. Your child will be able to refuse to take part or to quit being in the study at any time.

Contact Information

If you have any questions or concerns about this study or if any problems arise, please contact Dr. Megan Che at Clemson University at 864-656-2036.

If you have any questions or concerns about your child's rights in this research study, please contact the Clemson University Office of Research Compliance (ORC) at 864-656-6460 or irb@clemson.edu. If you are outside of the Upstate South Carolina area, please use the ORC's toll-free number, 866-297-3071.

A copy of this form will be given to you.

Appendix D

Verbal Consent for Survey

Child/Minor Survey Verbal Consent
Clemson University

The Influence of Single-Sex Education on Female and Male Adolescents' Emerging Mathematics Identity

Hello, my name is Amber Simpson. I am a student at Clemson University and am interested in your experiences as a math student and what you think about math. The purpose of this survey is to find out your opinion about a number of statements related to boys' and girls' learning of mathematics. There are no correct or incorrect answers. We are only interested in your personal opinion and you will receive a copy of your results. There are no known risks associated with taking this survey and it should take about 10-15 minutes to complete.

Your participation in this survey is voluntary. You may stop at any time. Participating in this survey will not affect your grade in school. Also, please know that I will do everything I can to protect your privacy. Your identity or personal information will not be disclosed in any way.

Appendix E

Focus Group Informational Letter

May 1, 2014

Dear Parent(s) and/or Guardian(s),

Your child has been selected by Ms. Ely/Ms. Mole to participate in a focus group with a few of his or her peers on May 13 at 11:30 in Ms. Ely's classroom. The purpose of the focus group is to seek your child's help in rewording, omitting, and/or adding questions for interviews to be conducted with middle school students as part of my dissertation in the Fall 2014 school year. The intent of my dissertation is gain a better understanding of how one's mathematics classroom (all-girls, all-boys, or both girls and boys) influence how students view themselves as math learners.

The focus group will be audio recorded so that I may reflect back on how your child responded to the questions, as well as the suggestions that he or she may or may not make. At no point will the information gleaned from the focus group be used in a publication or in a conference presentation. Also, I will not tell anyone that your child is participating in the focus group. The audio file will be stored on my password-protected computer and will be deleted after the completion of my dissertation.

In addition, participating in the focus group is voluntary. You and/or your child should not feel as if he or she is required to participate. But if willing and allowed to participate, your child will receive a small token of appreciation such as a writing utensil or an eraser. I do ask that your child tell Ms. Ely/Ms. Mole if he or she is willing to participate or not. If you have any questions, please fill free to contact me by email, amsimps@g.clemson.edu, or by phone at 423-312-1766.

Thank you.

Amber Simpson
Clemson University
Doctoral Student, Curriculum & Instruction Mathematics

Appendix F

Interview Protocol

Pseudonym: Date/Time: Location:

Thank you for being a part of my study and meeting with me today to talk about your experiences with math. In my study, I am trying to figure out who you are as a math student. Today, I am going to ask a few questions about what you think about math and things that happen in your math class. There are no right or wrong answers. If you do not know how to answer, it's okay to say, "I don't know" or "Let me think about it for a minute." Also, feel free ask me any questions. At no point will I tell anyone what you say. When I share the results of the study, I will use your pseudonym or your fake name. Also, if you want to stop the interview or change your mind about being a part of my study, let me know and we will end the interview. However, I appreciate your willingness to share your stories and thoughts about your experiences with math. I consider you an expert.

Interview Questions:

A. Question(s) based on Observations:

Example 1 (From Jennifer's Interview): In all of my observations, I noticed how comfortable you are with answering questions asked by Ms. Mole in Station 1, as well as your willingness to ask Ms. Mole for help. You are also willing to share your mistakes. Why is this? What is it about the classroom?

Example 2 (From Trevor's Interview): As a class, you are discussing how to translate a number word into a decimal and a fraction. Mrs. Ely asks you to try one-hundred and five thousandths on the interactive board. As you walk to the front of the room, you tell Mrs. Ely that you are not that smart. She replies, yes you are. You are smarter than you think. Why do you think you made such a statement? How do you feel about Mrs. Ely's response? Why?

B. Semi-structured Interview Questions
    1. Tell me about your math class. What do you do on a typical day? What are feeling in this moment about your math class?

    2. What do you like most about your math class? Why? What do you dislike the most about your math class? Why?

3. If needed, follow-up with those in Ms. Mole's class:
   A. How do you feel about watching videos and taking quizzes on the computer?
   B. Suppose you were at Station 6. You did not know how to begin the problems, yet Ms. Mole is stationed at the front of the room. What do you do? Why? And how does this make you feel?

4. Tell me about your math teacher. What does she/he do that makes you feel good or bad at math?

5. Tell me about your classmates. How would you describe your peers? Why? Give me an example or a story. (Or give me an adjective to describe your peers? Why?)

6. Do you like math in general? Why or why not?

7. Give me at least three adjectives that describe you as a math student. Explain your reasoning for each adjective.

8. Suppose you were given a math problem that you could not solve right away. What would you do? Explain. (Follow-up for Coed only: Suppose you were allowed to work with a partner, who would you choose to work with and why?)

9. Suppose your teacher hands you a test taken the previous day, what are you feeling in the moment before receiving the test? Why? What are you feeling in the moment after receiving the test? Why?

10. If given the chance, would you be willing to work a problem out on the whiteboard or to volunteer an answer? Why or why not? (Follow-up if student has negative response. How would it make you feel if your teacher asks you to put a problem on the board even if you did not volunteer? Why?)

11. What do you think it would be like to be in a math class with both boys and girls/only boys/only girls? [dependent on participant] (Probe: Give me an example or tell me a story.) Which would you prefer? Why?

12. Do you think that your experience with math would be different if you were a boy/girl (opposite sex)? Explain why or why not? (Probe: Give me an example or tell me a story.)

13. If somebody asked you to describe a mathematician, what would that person look like? How would you describe them? What comes to mind when you think of a mathematician? (Probe: Have paper available in the event that they may prefer to draw image.) What are you basing your description (e.g, media or past experience)?

14. Do you think that girls are good at math? Why or why not? (Probe: Give me an example or tell me a story.) Do you think that boys are good at math? Why or why not? (Probe: Give me an example or tell me a story.)

15. What are some things your parents tell you about learning and doing math? (Probe: Give me an example or tell me a story.)

16. What questions do you have for me as we end our time together?

Appendix G

Member Checking Protocol

The reason we are meeting today is for you to agree and/or disagree with how I have represented you as a math student. The results are based on your interview conducted in November 2014. If at any point you do not know how to answer, it's okay to say, "I don't know" or "Let me think about it for a minute." In addition, if at any point you do not wish to continue, please feel free to tell me. Also, feel free to ask me questions at any time. Anything you say during our time together today will be confidential and will be used as part of the final result of my study. If you agree, I wish to audio-record today's conversation to preserve your words accurately.

There are two parts to today's conversation. The first part involves what is called I-Poems. These are poems that I constructed based on phrases from your interview that included "I" as the subject. For each I-poem, read thoroughly and write a title in the space provided at the top.

Questions:

1. For each I-poem:
   a. Why did you title this I-poem as _____?
   b. What phrases or parts of the I-poem do you disagree? Why? (Have them highlight as they state phrases or parts in agreement.)
   c. For each I-poem: What phrases or parts of the I-poem do you agree? Why?
2. Now I want you to put the I-poems in order from the one that represents you most as a math student to the I-poem that represents you as a math student the least. Explain your ordering. (Remember to number in top, right-hand corner)
3. Would you agree, disagree, or neutral with the following statement: These I-poems represent me as a math student. Explain.
4. What additional information do you feel should be included about you as a math student that is not represented in the I-poems? Explain.

The second part involves word trees, which branches a key word or phrase from your interview to other key words and phrases. It is similar to a family tree diagram.

Questions:

5. For each word tree: What do you think? What is your initial reaction? What are you feeling in this moment?

6. For each word tree: After reading the word tree, give it a number from 1-10 indicating how well the word tree represents you as a math student, with 1 being that the word tree does not represent me at all to 10 being that the word tree represents me well. Why did you the score the word tree with _____?
7. For each word tree: Again, highlight anything you disagree with. Why do you disagree with this statement?
8. Which word tree represents you the most? Why? Which tree represents you the least? Why? (Remember to code with M and L for most and least.)
9. Are there other word trees that resonate with you? Which ones and why?
10. Would you agree, disagree, or neutral with the following statement: These word trees represent me as a math student? Explain.
11. What additional information do you feel should be included about you as a math student that is not represented in the word trees? Explain.

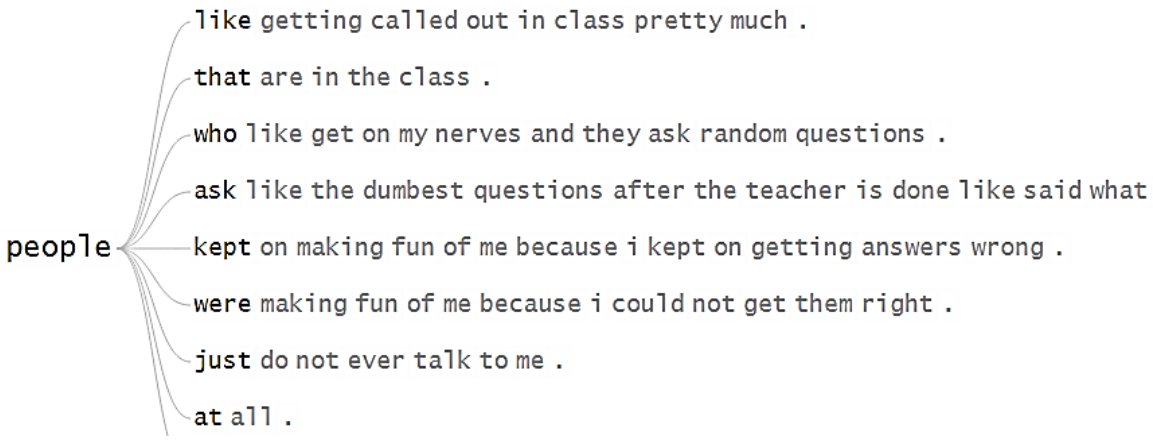
Questions about the member checking process:

12. How is being in a class of all-girls, all-boys, or both girls and boys made a difference in your I-poems and word trees?
13. What do you think about the process of reading and commenting on your I-poems? What did you like? What did you dislike? Why?
14. What do you think about the process of reading and commenting on your word trees? What did you like? What did you dislike? Why?
15. Which did you enjoy the most, the I-poems or the word trees? Why?
16. Which one do you think represented you better as a math student? Why?
17. How do you feel about having the opportunity to see the initial results of my study?
18. How do you feel about having the opportunity to change the results of my study?

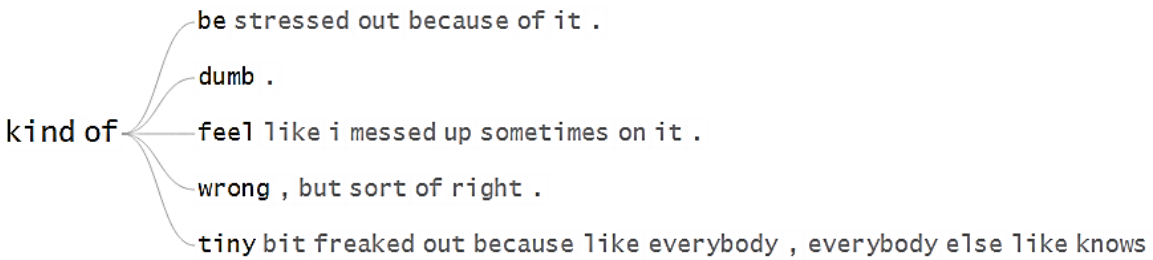
Appendix H

Examples of Word Trees

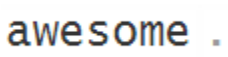
Example 1:



Example 2:



Example 3:



Appendix I

Example of Three-Column Field Notes

Entitled "I will do it better than all of you."

Descriptive Notes	Reflective Notes	Analytical Memos
As T enters the classroom, FF #23 was posted. He sat in the same location as the last observation. T has his FF notebook open on his desk prior to the start of class and begins working on the problems after the bell rings. "Hey, I need to borrow somebody's FF this weekend." Later, as Ms. Ely is standing by the door scanning over the attendance sheet, she announces to T that since he was absent yesterday he will need to get someone's FF and get with her next week about making up his quiz. "Alright." Ms. Ely sets the timer for 3 minutes and walks around the room while students finish the problems. T finishes and gets a library book from his backpack and reads. When the timer goes off, Ms. Ely immediately starts reviewing the problems. For question 1, the least common multiple of 12, 24, and 36, T raised his hand and is selected to answer. However, Ms. Ely asked what is a multiple. T replies, "Uh, 2." Ms. Ely re-asked, what is a multiple. "What times what equals a number," was T's response. Ms. Ely proceeds with asking the class if there is a better answer than that. There were a few more responses in regards to a multiple before Ms. Ely asks how many agree with Tyler that the answer is 2. Ms. Ely walks through multiples of 12, then multiples of 24, and then multiplies of 36. She circles the 72's. For question 2, extend the pattern of 1/3, 2/6, 3/9, T does not raise his hand. But after Ms. Ely displays the answer, T says "yes. That was actually the easiest one." Ms. Ely asks if someone did it differently than multiplying the numerator and the denominator. T explains how he multiplied the numerator by 3 to obtain the denominator. For	on top of things; aware of the classroom norms	which helps make it a norm and reinforce it as a norm How does such a statement impact one's identity? It's so subtle and non-intentional, but I think provides a powerful kick. There is something about sitting close because I can pick up on quotes. I need to move around the room.

the other 3 questions, Ms. Ely asks for the class to respond. Once finished, T says, "I got 2 wrong." Ms. Ely then asks the class to get out page 221-222 from yesterday. As a class, they spend some time talking about one of the problems on the bottom of page 221 that ask for the percent error. As Ms. Ely walks through the computation of 1200 ÷ 85, T helps out some. When asked if the answer should be positive or negative, T says to no one in particular, "I think it's negative." But then swayed once others said positive. In the end though, it was negative. "It is negative. Alright. I was right." The class discussion continues with problems on page 222. T raises his hand to answer question 36, but a little too late – after another asked to answer. In general, Ms. Ely called on specific people to answer and T would raise his hand anyway. Ms. Ely asks them to pass this assignment to E. She proceeds to call out names for students to come up and get their quizzes on adding integers from yesterday. She asks them to get out a colored pencil and share with those we do not have a colored pencil. After everyone gets their quizzes back, Ms. Ely asks a student to come up to the board and work out/explain problems 1 and 5. Ms. Ely thought that having a student explain from another point of view may help. Once finished, Ms. Ely puts their mind at ease because this grade is not going in the grade book and they are going to redo the ones they missed in class. T also gives one thumb up to the student. T walks to the front of the room to get the quiz from Ms. Ely. He talks of how he is going to get a 100, how he is "better than all of you all on this."	assume they are friends; this boy sits behind T competition	Where does this titter-totter affect stem? consider for interview

Ms. Ely says to raise your hand if they have a question. T sits and works on his quiz. At some point, he has Ms. Ely look over his responses. As he sits and attempts to find which ones, the boy behind offers his aid. Near the end of the period, Ms. Ely asks them to get out their agendas and write a sentence. T opens his agenda and says that he was unsure of a sentence to write. The bell rings and he says that he will write the sentence later.		my notetaking was slacking at this point

Appendix J

Jefferson Transcription Notation

Symbol	Use
[ ]	Indicates the start and end points of overlapping speech
=	Indicates the break and subsequent continuation of a single utterance
(1.2)	Indicates the time, in seconds, of a pause in speech
(.)	Indicates brief pause, usually less than .2 seconds
↓	Indicates a falling pitch or intonation
↑	Indicates a rising pitch or intonation
-	Indicates an abrupt halt or interruption in utterance
>text<	Indicates that the enclosed speech was delivered more rapidly
<text>	Indicates that the enclosed speech was delivered more slowly
°	Indicates whisper or reduced volume in speech
ALL CAPS	Indicates shout or increased volume in speech
text	Indicates the speaker is emphasizing or stressing the speech
:::	Indicates prolongation of sound
(hhh)	Audible exhalation
(.hhh)	Audible inhalation
(text)	Indicates speech which is unclear or inaudible
((*text*))	Indicates annotation of non-verbal activity
(h)	Indicates laughter within the speech

Appendix K

Sample Interview Transcript

K: Well because fantastic five tests, I try to (1.7) memorize what's on them. And when I get them, they're not the same thing. So I realize now that don't try to memorize, just practice with different numbers. But like, use the same problem with different numbers. So that's what I've been doing. *((sitting back in chair with hands in front pockets of sweatshirt))*

I: Has it been helpful?

K: Yeah↑. And I think you're right, we did take a test yesterday.

I: Did you?

K: Yeah.

I: I got this mental thing going on. ((*K laughs*))

K: And it was a fantastic five test too. ((*laughs*))

I: You all take a lot of those. So if given the chance, would you be willing to work a problem out on the whiteboard? Why or why not?

K: (3.3) That depends.

I: Why? *((takes hands out of sweatshirt, places on table))*

K: If I'm- it, it, it all depends on if like I'm in the mood or something. Like sometimes I'm like okay, I can do this. And then there's some days that I'm just like, oh, no, no I'm good. Because like before I come to her class, you know, I have six more periods in front of that. So it all depends on what happens in those classes. So it depends if this class has put me in a good mood or a bad mood. So, and then just some days, I feel like ma::::n, I don't feel like doing nothing. So it just all pretends, blah, what's the word I'm look for?

I: Depends.

K: Yeah, depends (h) on my mood.

I: Okay. So let's suppose, how would you feel if Mrs. Ely asked you to put a problem on the board even if you did not volunteer to go up there?

K: I would still (1.8) do it because I know she wants me to. And it would (1.6) she's probably doing it because if I got it right, you know, she would be proud of me. <And then, she> would want me to do it because she knows I'm smart and she would° want the right answer.

I: What do you think it would be like to actually be in a math girls with only girls?

K: *((leans up in chair))* I know it's fun because last year I was in one. So it was alright, but there was just so much drama. So that's the only <u>bad</u> thing about being in a girl class is when you're in that same class, you got to worry about oh my god. Who's dating who? Or oh my gosh, were not friends no more. Don't talk to her and stuff like that. So it's just stressful. So I'd rather be in a boy-girl class.

I: So what about mathematically?

K: (4.6) I still wouldn't want to be in a girls class.

I: So if you had your choice this year you would pick to be in a

K: Boy-girl class.

I: Okay. So let's imagine that you're actually a boy. Do you think that your experience with math would be different?

K: (3.6) No.

I: So why not?

K: *((leans back in chair, places hands in front of sweatshirt))* Because I mean I would still have <the same like the characteristics> and stuff. and I would still you know have my (7.1) what's the word?

I: I don't know this one. ((*both laugh*)) Is this a quiz?

K: No, like emotions and stuff. I would still have that.

I: If someone asked you to describe a mathematician, how would you describe them?

K: (3.7) I don't know what a mathematician is.

I: So that's someone that does math and not necessarily a math teacher, but just someone that does math in general.

K: So like a scientist or anything?

I: That could be, yeah.

K: Well they would have to be smart, so they would have to go through college. And they (2.2) they would be really smart. And they would be easy to learn and easy to- well not learn, but teach stuff too. And they would want to you know like at school, learn new stuff.

I: Okay. What about physically? What do you think they would look like?

K: (3.8) That's hard to say.° They would (4.0) they would probably, if they were a scientist, they'd have goggles and stuff. (3.3) But if it was like a math teacher, they'd just look like regular people. So I mean you can't really you know, if you were in a crowd of people, you can't be like oh my god. That person is wearing a pink shirt. They're a mathematician. So you know, they pretty much just look like regular people, unless you're a scientist. Then you wear goggles and gloves and a coat and stuff.

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