NO BLACK GIRLS ALLOWED: A POSTSTRUCTURAL ANALYSIS OF CONTROLLING IMAGES IN BLACK GIRLS' UNDERGRADUATE MATHEMATICS LEARNING EXPERIENCES

By

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ABSTRACT

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Despite calls for more equity and justice-oriented mathematics teaching and learning
practices, certain groups have received more attention than others. Though there have been
strides made in areas regarding how race and gender separately mediate mathematics learning,
there have been few investigating the intersection of race and gender for mathematics learners.
This dissertation served to advance such studies by utilizing Black girls' stories to investigate the
nature of their mathematics learning experiences at the university level.

Controlling images of Black girls and women impact almost every aspect of their lives
and I wondered what the role of these controlling images is for mathematics learning. Using a
Poststructural Race Theory analysis informed by Black Feminist Thought, I asked the following:
1) What controlling images are implicated in the personal narratives that Black girls tell about
their undergraduate mathematics learning experiences? And 2) How do these personal narratives
about the mathematics learning experiences help us understand the interactions between the
controlling images and narratives of mathematics learning for Black girls?

Data collection took place over the course of one semester of mathematics learning with
seven Black girls in their first year attending a large, public university. Both individual
interviews (n = 14) and focus group interviews (n = 3) were conducted. WhatsApp voice notes
were also collected throughout the semester as a means of accessing the girls' mathematics
learning stories. Data were analyzed to explore which controlling images were invoked in the

girls' stories and their interactions with those controlling images and narratives of mathematics learning.

My analysis reveals specific linkages between the narratives of mathematics learning and the controlling images and narratives that influence the daily lives of Black girls and women. Findings indicate that there is a mismatch between the controlling images that are prevalent in the girls' daily lives and those prevalent in their mathematics learning spaces. While the girls often drew inspiration from counter images such as the strong Black woman and Black Girl Magic, those images were not present in their stories of mathematics learning. Furthermore, narratives of mathematics learning such as being right or wrong, the notion of the struggling mathematics learner, and other mathematics learning practices such as group work interacted prominently with controlling images creating spaces of mathematics learning that further marginalized Black girls.

"We are the women who marched from cotton fields into fields of medicine, entertainment, and the white house."

– Jada Pinkett Smith

"Black girl magic is a rallying call of recognition. Embedded in the everyday is a magnificence that is so easy to miss because we're so mired in the struggle and what society says we are."

– Ava Duvernay

To Stella, Marie, Tiffany, Lysha, Larry, Nicole, and Miranda,
Thank you for so willingly sharing your lives and stories with me in service of improving the learning experiences of those to come. Keep spreading that Black Girl Magic. The world could use much more of it. Just make sure you get what you need as well!

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me and providing for me even when times were extremely tough. More than anything, you've taught me the power of prayer, the act that just might be single-handedly responsible for where I stand today. I love you, Mommy Dearest.

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CHAPTER ONE: INTRODUCTION

Though it was more than 25 years ago, I vividly recall a time from my 11th-grade civics class. It was a warm, humid spring day as we sat in the dark 2nd-floor classroom listening to Mr. Ramsdell ramble on about the importance of the census and other government-sanctioned data collection. I had always been a good student - excellent attendance, engaged my teachers during class, and asked tons of questions. On this day, I fought to overcome the heat, darkness, hum of the fan from the overhead projector, and Mr. Ramsdell's monotone voice, though, at one point in the lecture, something more than the room temperature made me hot. "Poverty rates are higher among African-Americans than any other racial group. Low-income students are less likely to graduate high school and more likely to serve prison time. African-Americans are less likely than any other group to obtain a high school diploma and Black girls have the highest incidents of teenage pregnancy." He went on and on citing one statistic after another to our college preparatory civics class. My frustration overwhelmed me and soon the entire class knew it. Shaking, I raised my hand to share my thoughts on his indictment of African Americans and what I seemed destined to become as a young, Black girl from a low-income, single-parent home. I cannot remember what I said, but I do remember my classmates were silent and that I ended class in tears.

The stories we tell others are reflections of the stories we tell ourselves about our lived experiences. This story, in particular, highlights my sense-making of self as a 17-year old Black girl in a space with strong discursive framing practices that were less than affirming. It demonstrates both my intellectual and emotional labor as a result of identifying as a Black girl - a cost that was not quite the same for others in the space. Mr. Ramsdell (a middle-class, white man) was completely oblivious to the discursive devices he deployed until I spoke out.

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Controlling images are representations that circulate in society. Within Black Feminist Thought, these images are described as an attempt to control the narrative about who Black women are and can be while simultaneously controlling access to rights and resources (Collins, 2000). Discursive weapons like those shared above are constantly hurled at Black American girls and women in the form of controlling images (Collins, 2000). Harris (2015) posits that "maligning Black women, regardless of our personal or collective truth, is part of American's DNA (p. 3)." From love and marriage, familial and other social relationships, parenting, work-life, relationships, civic duty, media and entertainment - this maligning reaches into almost every facet of Black girls and women's lives (Collins, 2000; Harris, 2015; Harris-Perry, 2011). Mathematics learning spaces are no exception. Mathematics spaces have a problem with white supremacist patriarchy. I say this because they have a problem with white supremacy (Battey & Leyva, 2016; Martin, 2009, 2013, Shah, 2019; Stinson, 2011) and patriarchy (Beilock et al., 2010; Boaler, 2002; Ernest et al., 2019; Hottinger, 2016; Mendick, 2005; Robinson-Cimpian et al., 2014; Walkerdine, 1998). All things considered; this does beg the question of just how do Black girls experience mathematics learning.

Issues of access and equity have been a central concern of mathematics educators and researchers for the past three decades. There are social, cultural, and economic capital attached to mathematics and judgments made based on one's actual or perceived mathematical capability. Yet, both historically and currently, Black girls and women have traditionally not taken interest in, been given access to, and/or been full and present participants in school mathematics and the field of mathematics, more broadly, by way of their social identities as Black women (Joseph, Hailu, & Boston, 2017). Furthermore, the mathematics research community knows very little about the mathematics experiences of Black girls and women since they have effectually been

"hidden" in the literature. By this I mean that their experiences have been overshadowed by that of Black boys and men and white girls and women (Bullock, 2018; Gholson, 2016). More broadly, Evans-Winters (2011) posited that social science and educational research have either neglected Black girls, subsumed them under the experiences of White girls or Black boys, or pathologized them. By doing this, we "overlook the inimitable experiences of the Black girl" ignoring or minimizing her oppression (p. 13).

There is a cadre of scholars dedicated to the work of studying Black girls in mathematics (see Gholson, 2016; Gholson & Martin, 2014, 2019; Joseph, Hailu, & Boston, 2017; Joseph, Hailu, & Matthews, 2019) and a slightly larger group of scholars researching Black girls in STEM, more broadly (see Collins, Joseph, & Ford, 2020; King & Pringle, 2019; McGee & Bentley, 2017; Ireland et al., 2018). One underexplored factor in the mathematics learning experiences of Black girls and women is how discourses operate in those spaces. Discourse uses sign systems to construct and reflect the social world that we live and learn in (Rogers, 2011). There are broad societal discourses that reflect and construct how society portrays mathematics as well as discourses of anti-blackness and patriarchy that reflect who participates and achieves in the domain (Leyva, 2017; Martin, 2012;). These discourses sustain narratives like "Asians are good at math". When contrasted with narratives about Blacks as lazy and indifferent/ oppositional towards schooling and with the stereotype that men are innately better than women at mathematics, the discursive groundwork has been laid for the relegation of Black women to the margins of mathematics learning, participation, and achievement.

Due to the potential power and influence of discourses and the dearth of literature exploring Black girls' and women's experiences in mathematics, this dissertation aims to investigate how discourses are factors in shaping the experiences of Black girl undergraduates

learning mathematics in their first year of college. My approach first establishes that Black girls and women in mathematics and STEM are Black girls and women first and thus are constituted by all of the various gendered-racialized narratives. Then, as Black women in mathematics or STEM spaces, they are constituted and must navigate those narratives as they intersect with those of mathematics and STEM learning.

Motivation for the Project

Why discourses and narratives? If we can understand just how these controlling images and narratives are adversely positioning Black girls and women during their mathematics learning experiences as evidenced through the stories that they tell, then we can act by challenging these narratives, their underlying ideologies and corresponding practices and to change the inequities that result. As Harris-Perry (2011) reminds us, we should be concerned with narratives and misrecognition of Black women through controlling images because this misrecognition "profoundly and disproportionally affect Black women's material circumstances and opportunities" (p. 40 – 14). Challenging and changing narratives can happen through an agency on the part of the Black girls and young women, however, the burden cannot solely be on them. Black women have been challenging these narratives for centuries. As an educational community, we must also facilitate the production of counter-narratives to promote shifts in practice and policy that foster change. What we do and how we do it depends a great deal on understanding just how these young women are being positioned.

As a Black woman who has taught high school mathematics for twenty years, I have noticed the disproportionate under-participation and, in some cases, the underperformance of Black girls in on-level and advanced mathematics classes. I also recall being one of two Black girls studying mathematics at Michigan State University as an undergraduate in the late '90s. I

recently spoke with one of my former professors still teaching in the mathematics department and she confirmed that there have been no new Black mathematics faculty since the '80s and that she can scarcely recall any Black American undergraduate mathematics majors or graduate students. She attended to this because she founded the Math Learning Center (for tutoring) and actively sought undergraduate and graduate teaching assistants to work for the center.

The award-winning motion picture *Hidden Figures* (Gigliotti, Chernin, Topping, Williams, & Melfi, 2016) which portrayed Black women participating and excelling in mathematics and mathematics-related professions was released in 2016. This, being incongruent with my experiences, piqued my interest in investigating this phenomenon of Black women pursuing mathematics and what is necessary to navigate and persist in spaces often hostile towards them.

Joseph, Hailu, and Boston (2017) reviewed literature related to Black women and girls in mathematics and found that structures and systems, community and social influences, and individual resilience strategies were factors influencing Black women's and girls' participation and persistence. Undergirding the first two factors (structures and systems and community and social influences) are societal discourses about who can and should do mathematics (Shah, 2017). The third factor, resilience, relates to how Black women and girls actively respond to and interact within mathematics learning spaces. Taken all together, I concluded that there appeared to be ways in which societal discourses influenced policies and practices in mathematics learning spaces and that Black girls and women, simply by way of their social identities, have been taxed with combating those discourses. If mathematics spaces are commonly known as white and masculine (Battey & Leyva, 2016; Stinson, 2008; 2013), then Black girls and women are

seemingly always taxed with an undue burden to make room for themselves in ways that others do not.

My pilot work (Cosby, 2017; 2018) further informed the decision to pursue this line of inquiry as Black girls confirmed the salience of their gendered-racialized selves in mathematics classrooms and relayed messages about the stereotypes, societal narratives, and other factors affecting their mathematics identity development. For example, a heightened sensitivity to these aspects of their identities influenced participation and confidence. These high school seniors and first-year university students expressed beliefs about Asians and whites outperforming Blacks in mathematics achievement. They did not, however, ascribe to narratives about boys outperforming girls irrespective of race and positioned girls above boys in achievement, but not in interest. Notably, they perceived Black girls and women as least likely to major in mathematics when compared to women of other races. Differences in performance by race were attributed to the disproportionate distribution of resources, not student deficiencies. Other beliefs about the nature of mathematics and mathematics curriculum surfaced as impacting their developing mathematics identities. They spoke at length about tracking, privileging speed and accuracy, teacher relationships, pedagogy, and a focus on grades. For them, mathematics at the secondary and collegiate level is irrelevant and disconnected from the social issues they care about.

After reading *Hidden Figures* (Shetterly, 2016) watching the *Hidden Figures* motion picture (Gigliotti, Chernin, Topping, Williams, & Melfi, 2016) and familiarizing myself with the literature about persistence needed to become a Black and/or woman mathematician (Hottinger, 2016; Kenschaft, 1981; Kenschaft, 2005; Walker, 2014), I was convinced that pursuing an understanding of how broader discourses impact Black girls and women would be fruitful. An

extension of this line of inquiry would include both how they respond to those discourses extending beyond just knowing that these discourses are at work as well as what the broader community can do to disperse the effects of these discourses.

A Word about Gender Terminology Used

As for the use of the gender term girls versus women or young women, I am choosing the term "girl" or "girls" for several reasons. I find the term "girl" to be more inclusive though I do use the word "woman" when referring to the literature such as in BFT. Every Black woman was and may still consider herself a Black girl, but not every Black girl has been a Black woman. Secondly, the girls in the study were all 18-year-old first-year university students on the cusp of womanhood, which is closely associated with adulthood but is not quite there yet having just graduated from high school not even a year prior. Thirdly, both I and the girls all identified as a Black girl without hesitation, and "girl" was a term that the participants used much more often in their talk. Other empirical questions for a future study would dissect the differences in the way that girls see themselves in relation to Black women. Do they consider themselves as aspiring to be strong Black women someday? Is the Black Girl Magic counternarrative more inclusive than the strong Black woman counternarrative? These are all considerations for future work but were not a part of the analysis in this dissertation.

Research Purpose

The purpose of this study is to use the stories of Black girl undergraduates to investigate the qualitatively different ways controlling images are reflected in the way they speak about their mathematics learning experiences when taking a mathematics course in their first year of college. I intend to examine the controlling images prevalent in the lived experiences of Black girl mathematics learners and how these narratives interface with those of mathematics learning and

doing. The choice of first-year undergraduates is sensible as these students are on the cusp of making major decisions about their academic and professional futures. This study has implications for mathematics education in that, if we truly care about social issues including equity in mathematics education, recognizing and challenging these dominant narratives and the practices associated with them could prove productive.

Research Questions

1) What controlling images are implicated in the personal narratives that Black girls tell about their undergraduate mathematics learning experiences?

2) How do these personal narratives about the mathematics learning experiences help us understand the interactions between the controlling images and narratives of mathematics learning for Black girls?

Overview of the Chapters

In chapter 2, I provide a conceptual landscape for the study by defining the various constructs involved and the relationships between them. I discuss poststructural thought and Foucault's treatment of discourse as a system of representation, broadly. I also establish and clarify the major conceptual elements such as subject positions, narratives, and counternarratives, central to the analysis of the data in this study. I demonstrate the use of poststructural thought regarding how discourse operates through language and language-like structures and how it can be used to position people, specifically Black women, as particular kinds of people. I then argue that Poststructural Race Theory (PRT) (Shah & Leonardo, 2016) and Black Feminist Thought (BFT) (Collins, 2000) can be collectively employed as a means for understanding an aspect of the phenomenon that is Black girls learning mathematics. By conceptualizing how discourses operate in the lives of Black girls and women via controlling images, I can then more deeply

analyze their personal narratives for uncovering and understanding how Black women are positioned in mathematics and STEM learning spaces via these narratives.

In chapter 3, I situate this study that specifically concerns narratives positioning Black girls and women in mathematics learning spaces via controlling images in three ways. First, I focus on the literature on race and racialized narratives in mathematics educations. This is followed by a discussion of gender and gendered narratives in mathematics education literature. Finally, I contend with literature of gendered-racialized narratives in mathematics learning spaces which, where possible, address Black girls' mathematics learning experiences.

In chapter 4, I delineate the qualitative methodological approach to this research study. I describe how I used individual semi-structured interviews, focus group interviews, and a novel method that engaged the girls in storytelling via a digital messaging app called WhatsApp. I describe the study setting and girls who opted to participate. I also outline each phase of data collection, my sources of data, provide my researcher positionality and provide a synopsis of data analysis.

In chapter 5, I present the findings from my data analysis as it relates to the girls' awareness of their position in society as Black girls specifically as it is depicted through their use of language that either explicitly or implicitly invoked controlling images. This work answers one aspect of the first research question which is: What controlling images are implicated in the personal narratives that Black girls tell about their undergraduate mathematics learning experiences? This chapter draws on data from both individual and focus group interviews to establish the girls' awareness of these controlling images as they live "in the world." In this chapter, I present the results of my analyses intended to illuminate controlling images of Black

women both explicitly and implicitly present in the girls' personal narratives and what they mean for the girls' lives and educational opportunities.

In chapter 6, the data analyzed regarding the girls' mathematics and STEM learning experiences were generated during the spring 2019 semester. These data were not reflections of earlier schooling experiences, but more immediate reflections of current mathematics learning experiences. This shifted the focus of the analysis from being singularly focused on controlling images to one of the interdiscursivities of these narratives with those of mathematics learning and doing.

In chapter 7, I discuss how this approach to understanding Black girls' mathematics learning experiences through an examination of controlling images relates to prior research and theory such as Black Feminist Thought. I also clarify the contributions of the study. Ultimately, this work is not about generalization, but rather it is about nuancing our understandings of how racialized-gendered narratives of Black girls, as their primary representation, results in material consequences for their learning. I discuss how this has concrete implications for mathematics teaching and learning practices as well as future research.

CHAPTER TWO: DISCOURSE AND CONTROLLING IMAGES AS A FRAME

"It can be hard to stand up straight in a crooked room." - Melissa Harris-Perry

Sound: Women's U.S. Open tennis match

Citizen 1 (Black female): And insane is what you think, one Sunday afternoon, drinking an Arnold Palmer, watching the 2009 Women's U.S. Open semifinals, when brought to full attention by the suddenly explosive behavior of Serena Williams. Serena in HD before your eyes becomes overcome by a rage you recognize and have been taught to hold at a distance for your own good.

Citizen 6 (White male): Serena's behavior, on this particular Sunday afternoon, suggests that all the injustice she has played through all the years of her illustrious career flashes before her and she decides finally to respond to all of it.

Citizen 1: (to herself) Oh my God, she's gone crazy.

Citizen 5 (White female): What does a victorious or defeated Black woman's body in a historically white space look like?

ALL: "I feel most colored when I am thrown against a sharp white background."

Citizen 6: This appropriated line from Zora Neale Hurston, stenciled on canvas by Glenn Ligon, seemed to be ad copy for some aspect of life for all black bodies.

ALL: "I feel most colored when I am thrown against a sharp white background."

Citizen 5: Serena and Venus. They win sometimes, they lose sometimes.

Citizen 6: They've been injured, happy, sad.

Citizen 5: Ignored, booed mightily, cheered.

Citizen 1: And through it all and evident to all were those people who are enraged they are there at all.

ALL: "I feel most colored when I am thrown against a sharp white background."

The opening stanzas are an excerpt from *Citizen: An American Lyric* by Claudia Rankin. This award-winning collection of poetry deals with contemporary issues of race and gender across various forms of media and social contexts. The passage highlights the reactions of Citizens 1, 5, & 6 as they narrate a segment of the action from the semi-finals of the 2009 U.S.

Open. In the scene, Serena Williams reacted to a foot fault violation call by one of the judges. That moment and Serena's "rage" are about more than just one incident in a single tennis match. At that moment, Serena is read as a gendered-racialized subject in a space where she and her sister, Venus, have experienced injustice for years. Despite the attempt of Citizens 5 and 6 to humanize the Williams sisters, in that moment, Serena could not escape the white gaze and find sympathy and understanding. Triggered by that foot fault, Serena could not be fully human, but merely an angry Black woman.

Chapter Overview

This chapter establishes the conceptual framework for the study including defining major constructs such as discourse, narratives, controlling images, and personal narratives and the relationship between those constructs. Building such a foundation will allow me to explore how controlling images of Black women interact with discourses of mathematics (or STEM) learning. I begin by tying the excerpt from *Citizen* controlling images - specific types of narratives about Black women central to Collin's (2000) critical social theory known as Black Feminist Thought (BFT). I then discuss discourse, broadly, as the primary construct as it is one way to understand how folks are positioned as particular kinds of people by controlling images through its employment of subject positions and societal and personal narratives. Personal narratives are primary conduit for accessing these ideas as the language used in the personal narratives signal societal narratives. Finally, I discuss the use of Poststructural Race Theory (PRT) (Shah & Leonardo, 2016) to demonstrate how a poststructural analysis privileging how discourse operates to position people as particular kinds of people. This framing allows for conceptualizing how discourse works in the lives of Black girls and women via subjectivation, and I can then analyze

Black girls' narratives to understand further just how they are positioned in mathematics and STEM learning spaces.

Recognition and *Citizen*

In *Citizen*, Serena was recognized as an angry Black woman. Recognition is a Hegelian philosophical construct that asserts that self-consciousness is not developed in isolation and is not an in-the-head phenomenon but in relation to and with others. People make sense of who they are and can be, partly, about others in one's community, culture, or society (Nasir, 2012). Systems of representation that provide cultural meaning through discourse (language and other sign systems) lead to the establishment of dominant cultural norms and normalized identities (Hall, 1997/2013). These systems relegate some to the margins making misrecognition - recognition of others through the lens of prevailing cultural norms and narratives - possible.

Misrecognitions have both immediate psychological consequences for individuals and also lead to significant material consequences illuminating institutionalized patterns of cultural value. Made necessary, then, is a politics of representation that resists misrepresentation and resists conforming to achieve respect, access, and full participation within a society (Fraser & Honneth, 2003). Any gaze on marginalized groups by those who are not is a political act that is never neutral or without effect. Recognition of those with marginalized social identities is not merely a matter of self-actualization, nor is it solely a matter of personal interactions between individuals but is bound to distribution of resources. Inequalities in distribution are related to the inability to "see" those from low-status, marginalized groups accurately. Challenging assumptions about what those with privilege see when they gaze on those without is critical for shifts towards equality (hooks, 2006).

How, then, does this understanding of recognition relate to Serena and the opening excerpt from Rankine's *Citizen*? Black women are not the norm in tennis and the citizens' talk is evidence of the ways her Black woman body is positioned in that space. Though there are several possible ways to understand the scene at that moment during the semifinals of the U.S. Open, her behavior was recognized and characterized by language like "explosive behavior," "rage," and "crazy." I argue that these are ways that discourse operates when interpreting passion emoted by a Black woman, no matter the context. The line "I feel most colored when I am thrown against a sharp white background" is powerful because it reveals the context (tennis = a sharp white background) as critical to heightened recognition as "colored." Notably, only race is identified not accounting for how Serena is misrecognized as gendered-racialized being. The citizens recognized Serena through representations of Black women in gendered - racialized discourse. Some constructed her at that moment as abnormal even though male tennis star, John McEnroe, engaged similar antics throughout his career receiving markedly different responses. Though Citizen 6 tried to give her the benefit of the doubt, she could not entirely escape misrepresentation, likely a condition of her entire tenure in the tennis world.

Intersectionality and Black Feminism

Serena's misrecognition as a gendered – racialized being makes an understanding of intersectionality central to a full interpretation of what she experienced. Harris-Perry (2011) asserts that there is a secure and transparent connection between misrecognition and Black women's experiences and that these experiences are unique to them as Black women at the intersection of race and gender. The labor that Black women put into combating these misrecognitions is tremendous and has consequences for their full participation in many aspects

of society. It is with this foundation that I approach my conceptual framework to address how

Black women's misrecognition shapes their mathematics and STEM learning experiences.

Consider this excerpt from Sojourner Truth's famous speech, "Ain't I a woman."

"Well, children, where there is so much racket, there must be something out of kilter, I

think between the Negroes of the South and the women of the North - all talking about

rights--the white men will be in a fix pretty soon. But what's all this talking about? That

man over there says that women need to be helped into carriages, and lifted over ditches,

and to have the best place everywhere. Nobody helps me any best place. And ain't I a

woman? Look at me! Look at my arm. I have plowed (sic) I have planted, and I have

gathered into barns. And no man could head me. And ain't I a woman? I could work as

much and eat as much as any man--when I could get it--and bear the lash as well! And

ain't I a woman? I have borne children and seen most of them sold into slavery, and when

I cried out with a mother's grief, none but Jesus heard me. And ain't I a woman? ..."

Truth, speaking in 1851 at the Women's Rights Convention in Akron, Ohio, so cleverly

conveyed the plight of Black women in U. S. culture and society (Brah & Phoenix, 2004). She

expressed her frustration with the lack of recognition for the unique oppression experienced by

Black women arguing for their representation in the movement of women's rights. In no

uncertain language and through vivid examples, Truth spoke about the lived experiences of

Black women in a way that both promoted them as equal to and different from Black men with

concerns that differ from those of white women in meaningful ways. As Brah and Phoenix

expressed, Black women's contentious relationship with American culture at the intersection of

race and gender has existed from the onset as they arrived as enslaved persons in the early 17th

century. Simultaneously, Black women began to "clap back" at the misogynoir (Bailey & Trudy,

2018) that so aggressively positioned them in society. Today, many draw on Black feminist scholars such as bell hooks, Kimberle' Crenshaw, and Patricia Hill-Collins for theorizing and commentary. Yet they stand on the shoulders of giants - Black feminists like Sojourner Truth and Anna Julia Cooper - who had already grappled with, orated, and wrote about these issues.

Crenshaw (2017), the originator of the term intersectionality stated that intersectionality is "about how structures make certain identities the consequence of and vehicle for vulnerability." An adequate treatment of intersectionality considers what practices, policies, and institutional structures play a role in contributing to the exclusion of some and not others. This work seeks to examine young Black women's experiences learning mathematics as Black women as well as how discourses make Black women vulnerable in mathematics learning spaces in ways that are unique to them. Though the salience of singular aspects of their identity may shape their experiences and allow a glimpse into the full range of diversity that exists within the group that is Black women, the primary focus is on the discourses that shape these mathematics learning experiences and opportunities for engagement in mathematics learning spaces.

Hidden Figures, both the book and the movie*,* were vital to shifting the narratives around Black women in STEM from one of the deficit perspectives to one of participation and achievement (Bullock, 2018). Understanding, however, that the project of oppressing Black bodies has been underway for longer than and with more force than any project seeking to support and develop Black mathematicians (Gholson & Wilkes, 2017), this shift in the narrative was slight. Race and gender discourses reach back to the very foundations of American society when Black women were treated as less than women, even less than human, mainly being bred to sustain the institution of slavery (Collins, 2000). This project sought to understand how the challenges faced by Black women in STEM are nested within broader societal discourses and

subsequent systems that negatively position Black girls and women. To this end, this dissertation considered how controlling images interact with dominant discourses of STEM learning in ways that complicate STEM spaces for Black girls and women. The goal is to understand how those same controlling images that played a role in Serena's misrecognition operate in mathematics and STEM learning as well. Next, I further explain controlling images through a discussion of Black Feminist Thought.

Black Feminist Thought

In American society both historically and contemporarily, representations of Black women and, consequently, treatment of Black women have been considerably unjust and misaligned with their reality. Burkhard (2019) asserts that the ways people read Black women's bodies are embedded in broader discourses while Collins (2000) notes that oppressions experienced by Black women at the intersection of race, gender, and class are the manifestation of engrained ideas about who Black women are and can be. Though these representational practices are usually written off merely as stereotypes, they have real and material consequences for Black women through political, educational, and other institutional access, opportunity, and power (Harris-Perry, 2011).

Black Feminist Thought (BFT) is a critical social theory that has been crucial in helping Black girls and women make sense of and reconfigure discourses. BFT provides a frame for recognizing just how Black girls and women are positioned in society (Collins, 2000). It was initiated in the 1970s as Black feminist scholars such as bell hooks, Audre Lorde, Alice Walker, and Angela Davis began to challenge the representation of Black women in the academic literature and popular culture (Simms, 2001). Black women have questioned the contradictions between dominant discourses of American womanhood and Black women's devalued status.

They noted the existence of narratives about women as passive and fragile, yet Black women are not treated as such. BFT also challenges narratives of what it means to be a good mother who stays at home with the children that are in stark contradiction with pushing Black women off of public assistance, forcing them to find jobs and put their children in daycare (Collins, 2000). BFT presents a viable way to investigate just how intersecting oppressions of race, gender, and class—also known as the matrix of domination— fosters these contradictions in a way that counteracts these narratives (Collins, 2000). As Collins (2000) states, "women internalize these controlling images and come to believe the stereotypes" which is evident in the words of a 14-year-old girl who said, "unless you want to get into an activist battle, you accept the stereotypes given to you and just try to reshape them along the way" (p. 27). This statement demonstrates that these insidious societal narratives about Black women are permeating the minds of our most vulnerable – young, Black girls.

Controlling Images

Controlling images are representations that circulate in society. Collins (2000) describes how, within BFT, controlling images are an attempt to control the narrative about who Black women are and can be and, simultaneously, control access to rights and resources. These narratives about Black women impact every aspect of Black women's lives and serve as a means of misrecognition and misrepresentation denying Black women of their full humanity (Collins, 2000; Harris, 2015; Harris-Perry, 2011). The primary historical controlling images addressed in BFT are: 1) the mammy, 2) the matriarch, 3) Jezebel, 4) welfare mother, and 5) the angry black women (Collins, 2000; Harris-Perry, 2011; Winfrey-Harris, 2015). The "strong black woman" and Black Girl Magic are counternarratives constructed in opposition to controlling images. These counternarratives represent the strength of the Black women "under the heel of

misogynoir" (Patel, 2019; Walton & Oyewuwo-Gassikia, 2017). In what follows, I discuss each controlling image followed by a brief discussion of each counternarrative before zooming back out to situate the study in the conceptual framework. It is there, in that zooming out, that I will talk more about narratives and counternarratives as they are constructed within discourse.

The mammy. Collins (2000) describes the mammy as a controlling image at the intersection of race, gender, sexuality, and class. This is the public face that whites expect Black women to be while in their presence. She is faithful, obedient, and stays in her place. As an asexual surrogate mother, she cares for the children of the white family she works for while also carrying out other domestic duties. Popularized by books like *The Help* (Stockett, 2009), she is "the ideal Black female relationship to elite white male power." (Collins, 2000, p. 72). She is supposed to teach her children about the white power structure perpetuating racial oppression, though she often does the opposite. White families economically exploited them and were able to maintain their middle-class social status because they underpaid "the help." Though the mammy image starts to dissipate as Black women move into better positions, the pay gap for Black women persists where Black women make $0.65 for every dollar that of white men in the same position makes (Patten, 2016). This economic exploitation furthers the narrative that Black women have to work twice as hard to earn half as much.

The matriarch. According to Collins (2000), this controlling image is contrary to the mammy. The mammy is the "good" Black mother and the matriarch is the "bad" Black mother that emasculates Black men. The matriarch is said to be the head of most Black households and are thought to be "overly aggressive" and "unfeminine." The construction of this image was a way of controlling the narrative of Black women who rejected the mammy image (p. 75). The case for the matriarch was institutionalized by the 1965 government report titled *The Negro*

Family: The Case for National Action, also known as the Moynihan Report. In this report, the matriarch was maligned for not fulfilling her "womanly" duties, including proper child-rearing, as these working mothers spent too much time away from home. This controlling image undermines Black women's assertiveness rendering them unfeminine, aggressive, and undesirable as a mate.

Welfare mother. Ronald Reagan popularized the welfare mother or "welfare queen" in the 1980s. This image, which also exists as the intersection of race, gender, and class, signaled Black women having children to exploit welfare benefits, with some even going as far as to cast Obama as the "food stamp president" (Collins, 2000; Morris, 2014). As Morris (2014) stated, "this image of the lazy African-American woman who refuses to get a job and keeps having kids is pretty enduring. It's always been a good way to distract the public from any meaningful conversations about poverty and inequality" (Morris, 2014, p. 138). Failing to pass on a strong work ethic to her children, the un-wed welfare mother is not altogether separate from the matriarch. Though she is thought to be a "bad" mother like the matriarch, she lacks the matriarch's assertiveness. While the matriarch is believed to be inaccessible to the children, the welfare mother is thought to be too accessible because she does not work outside of the home (Collins, 2000).

Jezebel. Also called "whore" or "hoochie momma", the jezebel controlling image exists at the intersection of race, gender, and sexuality. This image relegates Black women to the margins by categorizing them as sexually aggressive providing a compelling rationale for the sexual assault they experienced. This narrative harkens back to slavery as it was sometimes used to justify the treatment/rape of Black women by white men (Collins, 2000). This heteronormative controlling image also serves to juxtapose homosexual Black women as the

"oppositional, different, and inferior other (Collins, 2000, p. 83). While attempting to control the narrative about one group of Black women, this controlling image inadvertently seeks to control another pushing Black queer women even farther to the margins.

__The angry Black woman.__ Collins (2000) and Thomas, Witherspoon, and Speight (2004) choose not to separate the angry Black woman and the matriarch controlling images. Others find them related but distinct (Walley-Jean, 2009; Winfrey-Harris, 2015). This controlling image is sometimes referred to as Sapphire solidified in media through characters like Sapphire Stevens from the show Amos 'n Andy characterized as shrill, loud, argumentative, irrationally angry, and verbally abusive (West, 1995). Other angry Black women characters are Aunt Ester from *Sanford and Son* (Ruben, 1972) or, more recently, Cookie from the show *Empire* (Locke et al., 2015). Similar to the matriarch, the angry Black woman is also thought to be responsible for the "black marriage crisis" as Sapphires are also considered unable to be submissive and put men first (Winfrey-Harris, 2015). Michelle Obama, Serena Williams, and other public women have been characterized in this way having caricatures drawn of them relating their perceived anger closely with masculinity.
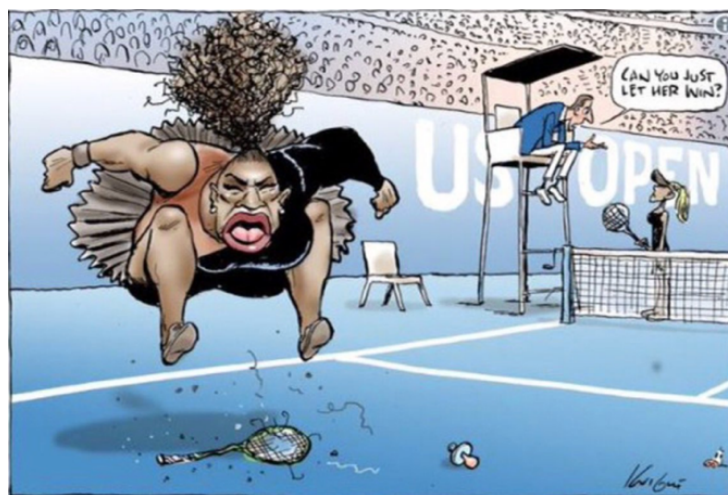
Figure 1. @Knightcartoons image of Serena Williams on Twitter

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Figure 2. Ben Garrison caricature of Michelle Obama and Melania Trump

Again, these controlling images are an attempt to control the narrative about Black women. They each distort the realities of Black women in disorienting ways, at best (Harris-Perry, 2011). Drawing on the work of Witkin and Goodenough (1977), Harris-Perry offered a powerful analogy for the distortion of these controlling images. She stated that "sometimes Black women can conquer negative myths, sometimes they are defeated and sometimes they choose not to fight. Whatever the outcome, we better understand sisters as citizens when we appreciate the crooked room in which they struggle to stand upright (p. 32)." These incessant stereotypes about Black women have been foundational contributors to Black women's oppression and the establishment of systems of social control supporting the subordination of Black women (Collins, 2000). As hooks (1992) declared, even though controlling images or stereotypes may be grossly inaccurate as they "serve as substitutions, standing in for what is real" (p. 341). She goes further to say that these stereotypes "abound when there is distance," which means that our post-

segregation separation in neighborhoods and communities, and thusly, schools let alone STEM spaces create multiple sites for gross misrepresentations of Black women to fester.

Prevalent Counternarratives

Though narratives and counternarratives will be discussed in-depth later in the chapter, I want to discuss the strong Black woman and Black Girl Magic as two counter images with corresponding counternarratives that have emerged as an intersectional, strength-based framing of Black girls and women (Harris-Perry, 2011; Walton & Oyewuwo-Gassikia, 2017). Harris-Perry says that the strong Black woman is related to the other controlling images of Black women. She writes,

> "She looks suspiciously like Mammy except that her loyalties are firm with Black communities. While not subjected to the racial dynamics of Mammy, her devotion to racial community may leave sisters without room to organize themselves. The strong Black woman has incorporated elements of the Jezebel myth because she does not require physical or economic protection from men. She cares for herself and her children, whether she has a male partner or not. The strong Black woman looks like a way to channel the angry Sapphire in a socially acceptable direction. Black women may believe that their anger must always be in service of others and rarely used in their own defense (p. 187).

Some question the viability the strong Black woman as a type of self-definition. This "do it all" mentality is curiously reflective of John Henryism – "a strong behavioral predisposition to cope actively with psychosocial environmental stressors (James, 1994, p. 1)" – even if it leads to their demise. Similar to the strong Black woman, Black Girl Magic is a term first originated in 2013 as a hashtag on Twitter created by CaShawn Thompson as a celebration of Black women's

perseverance - a modern strong Black woman (Halliday & Brown, 2018). It is used to celebrate the accomplishments of Black women for everything from positive representations of Black women on television and in movies to acceptances into Harvard or graduating from medical school.

Like the strong Black woman, Black Girl Magic has come under some scrutiny for limiting the acceptable range of Black girls' and women's responses to trauma and hardship and denying them access to being fully human (Walton & Oyewuwo-Gassikia, 2017). There is an engaging dialogue happening among the community of Black women about the use of the term. Ford (2016) argues that there is nothing wrong with the use of the phrase and that its purpose is to uplift Black women stating that the phrase is used on social media for "celebration, support, and self-love." Chavers (2016) argues to the contrary, saying that the use of the phrase is detrimental to Black women who should just be allowed to be human as opposed to superhuman or magical when they achieve. Otherwise, they run the risk of feeling like failures when the supernatural is not possible.

There is real tension brewing here. During self-defining, how do those belonging to a particular social group attempt to change the narrative and acknowledge and celebrate their individual and collective successes despite the systemic structures without casting them as superhuman? Though Black Girl Magic is a celebratory counternarrative, it is similar to the strong Black woman in that it dehumanizes Black women through expectations of super- or hyper-humanization. This kind of thinking leads to policies and practices in spaces that do not consider that Black women are just as vulnerable, if not more, across multiple aspects of life and in society. Instead, it might prove more fruitful to acknowledge the structures that made this

struggle to succeed possible, to begin with. Pointing to the structures allow for changes that will

make it such that Black girls and women can just be human going forward.

Now that the foundation of BFT has been laid, I zoom out to discuss discourse and

poststructuralism. By understanding how controlling images are used within discourse, I am able

to lay a foundation for the investigation of the presence of controlling images in stories about the

experiences of Black girls learning mathematics. =

A Note on Stereotypes

A stereotype is a psychological construct regarding beliefs shared by members of society

about the characteristics, attributes, or behaviors of members of a particular social group and

have implications for impacting aspects of one's social identification, particularly those

constructed based on categories such as gender, race, ethnicity, or religious beliefs. They often

take root in aspects of that stereotyped group's social identity (Hilton & Von Hippel, 1996;

Nasir, 2011). Stereotypes are communicated in various social settings and shape the way that

members of society conceive of and interact with one another; therefore, stereotypes could cause

one to take up an identity negatively positioning them in several domains (Larnell, Boston, &

Bragelman, 2014). Controlling images are related to stereotypes in that they are also

representations that circulate in society, but, within Black Feminist Thought, these images are

described as an attempt to control the narrative about who Black women are and can be while

simultaneously controlling access to rights and resources. Patricia Hill Collins (2000) sometimes

uses the terms interchangeably. She writes, "portraying African-American women as

stereotypical mammies, matriarchs, welfare recipients, and hot mommas helps justify U.S. Black

women's oppression. Challenging these controlling images has long been a core theme of Black

feminist thought (p. 70)." However, Jerald et al. (2017) distinguish between the two stating, "we

note that stereotype refers to a psychological construct related to attitudes and cognitions, while controlling image is a sociological construct relevant to ideology and structural inequality (p. 5)." They assert that stereotypes are a micro level psychological manifestation of more macro level controlling images.

Discourse and How it Operates

Generally speaking, discourses are broad, constitutive systems of meaning and knowledge realized through social language and practices associated with particular institutions (Sunderland, 2004). Foucault (1972) defined discourses as "practices that systematically form the objects of which they speak" - as a way of seeing and understanding the world with particular attention to issues of power (p. 49). Foucault emphasized that the scope of discourses is not merely at the single or individual level, but that they are effective at providing a targeted lens for producing knowledge and meaning in society (Talja, 1999). Discourses are expansive, often invisible, and historical. They are also transient or shift temporally and are continually produced and reproduced. Different sets of cues and traces trigger awareness of discourses at work for individuals based on social group membership (Evans, 2015; Sunderland, 2004).

Discourses serve to construct the social world through language, texts, and signs to invoke, produce, and position individuals to act, behave, and perform in particular ways (Sunderland, 2004). As language, broadly speaking, is the primary conduit for disseminating discourses, it will be the central unit of analysis in this study. Consider advertisements that position girls as princesses and boys as superheroes. These advertisements were created within discourse where the subject is gender. Gendered discourses maintain a knowledge system of gender to position boys and girls as particular kinds of people. Discursive practices are dialectical: being born out of and also contributing to the reproduction of unequal power

relations through the ways they represent and position people (Fairclough & Wodak, 1997; Leonardo, 2003). These structures of language, complex signs, and practices order and sustain sociocultural and sociohistorical racialized and gendered discourses such as the White male math myth discourse (Stinson, 2008). By this view, discourse is socially constructed and conditioned. It both aids in sustaining and reproducing the social status quo giving rise to issues of power while also contributing to transforming it.

Discourse and Subject Positions

Discourses, themselves, are the bearers of various subject positions concerning particular forms of knowledge. As Walshaw (2001) explains, "different discourses constitute key entities (e.g., numeracy, mental computation, differentiation) in different ways and position people differently as social subjects (e.g., academically challenged student, visual learner, senior mathematics teacher) (p. 481)." The subject is produced in discourse and cannot exist outside of this system of meaning (Hall, 1997/2013). The term language is used broadly to include text, spoken word, body language, and other signs and symbols that can be read and provide an orientation to meaning. As such, the individual is not thought to be "an individual who is fully endowed with consciousness; an autonomous and stable entity, the 'core' of the self, and the independent, authentic source of action and meaning" (Hall, 2013, p. 39). Instead, we part from a psychological view of the individual to one that, according to Foucault (1980), is produced by discourse and only exists within the discourse. For example, Serena, as a subject, is understood through the discourses of tennis and sportsmanship or also through discourses of race and gender. What discourses, for example, exist at the intersection of sports, race, and gender that allow one to protest injustices within tennis or during a match?

Hall (1997/2013) explains the concepts of the subject in this way. He writes,

"Foucault's 'subject' seems to be produced through discourse in two different senses or places. First, the discourse itself produces 'subjects' – figures who personify the particular forms of knowledge which the discourse produces. These subjects have the attributes we would expect as these are defined by the discourse – the madman, the hysterical woman, the homosexual, the individualized criminal and so on. These figures are specific to specific discursive regimes and historical periods. But the discourse also produces a place for the subject from which its particular knowledge and meaning makes the most sense. It is not inevitable that all individuals in a particular period will become the subjects of a particular discourse in this sense, and thus the bearers of its power/knowledge. But for them – us- to do so, they – we – must locate themselves/ourselves in the position from which the discourse makes most sense and thus become its 'subjects' by 'subjecting' ourselves to its meanings, power, and regulation. All discourses then, construct subject-positions, from which alone they make sense (p. 40)."

Davies and Harré (1990) also put forth a similar understanding of subject positions. They define subject positions as "incorporating both a conceptual repertoire and a location for persons within the structure of rights for those that use that repertoire (p. 46)." First, the conceptual repertoire can be likened to understanding the kinds of people we are likely to find within discourse, or as Hall put it, "figures who personify the particular forms of knowledge." We can only understand these subject positions through discourses. Secondly, if taken up by an individual, this position or point of view allows one to participate in the continual production of the discourse and engage from that viewpoint. This is what Hall means by "a place for the subject from which its particular knowledge and meaning makes the most sense." In this way, both Hall and Davies and Harré are explaining subject positions with the same two components.

Davies and Harré continue stating,

"Once having taken up a particular position as one's own, a person inevitably sees the world from the vantage point of that position and in terms of the particular images, metaphors, storylines, and concepts which are made relevant within the particular discursive practice in which they are positioned. At least a possibility of notional choice is inevitably involved because there are many and contradictory discursive practices that each person could engage in" (p.46).

By this, they mean that subject positions, and thereby discourse, is not deterministic. Arguably, this notion not only applies to one's subject positioning but also how one constitutes others in social interaction. This idea is particularly relevant as it relates to self and others in any given context. Both Hall (1997/2013) and Davies and Harré (1990) agree that the subject is constituted by or created within the discourse. The discourse provides the orientation for the subject to even begin to make sense or have meaning. Also, both agree the subject position created is taken up and enacted by those choosing to participate in the discourse. In this sense, the discourse dictates how one acts in relation to the knowledge system that the discourse produces. That does not mean that individuals do not have agency. They can refuse to be subjected, but that also means they would no longer participate in the discourse.

Let us revisit *Citizen* (Rankine, 2014) for an example of how this applies to Serena. On center court of the U.S. Open, Serena has several subject positions available to her – the calm, composed, and proper player, the crowd favorite, the passionate competitor, or the defeated opponent, for example. This is not an exhaustive list, just illustrative. However, because Serena is a Black woman, there are other subject positions within the discourse at the intersection of race and gender. These subject positions, what we now know as controlling images, are available

to Serena based on how she identifies and the space she inhabits. Serena possibly intended to take up the passionate competitor subject positions. According to Davies and Harré, this subject position would be the vantage point that she would have responded to the conditions of that match. It is clear, however, from the remaining commentary in *Citizen*, that some others may position her contrarily, perhaps as the angry Black woman in tennis. As it relates to the dissertation, I will interrogate just how discourses of race, gender, and mathematics make it possible for Black girls and women as the subjects to be positioned.

A Seat at the Table - Metaphor for Discourse and Subject Positions

I have devised a metaphor for the constructs of discourse and subject position that might serve to clarify how they relate to one another and the dissertation overall. Consider discourse as a dinner table with place settings. Each place setting represents a particular subject position within the discourse (see *Figure 3*). When one participates in discourse, they can occupy one of the seats at the table. However, the occupation of a place means that one participates from that subject position or "takes up" that subject position speaking and behaving in particular ways of understanding that position within the discourse. The seat does not exist or make sense outside of the discourse. It is a performance of sorts that everyone participating the discourse enacts.
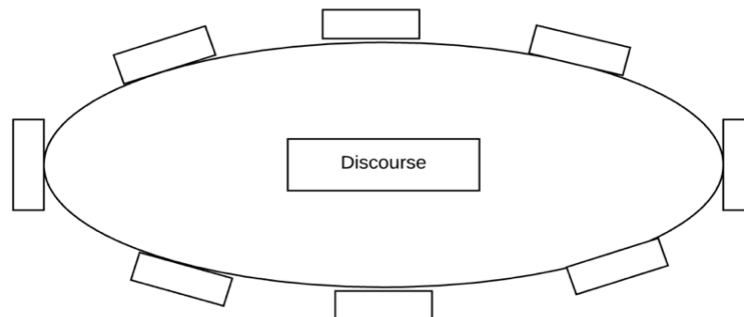
Figure 3. A Metaphor for Discourse and Subject Positions

There are two additional important aspects of these subject positions to consider. The first is that not everyone has a seat at the table. Recall Hall's statement that "it is not inevitable that all individuals in a particular period will become the subjects of a particular discourse." Additionally, while some may never occupy a seat at the table, others may have a place card but vacate the seat or are vacated from the seat by others at the table. This is what Hall meant by saying for a particular subject position, one "must locate themselves in the position from which the discourse makes most sense and thus become its 'subjects' by 'subjecting' ourselves to its meanings, power, and regulation." Davies and Harré also state that "at least a possibility of notional choice is inevitably involved because there are many and contradictory discursive practices that each person could engage in." My interpretation of this idea is that if one does not subject themselves (take up) to the meaning of a particular position, they can reject or alter the position making an argument for that position within the discourse. Doing such, however, could result in rejection from the discourse when there is no way to make sense of a particular position within the discourse.

According to Foucault, subjects related to 'madness' take on meaning within discourse and are meaningless outside of it. He writes about his conception in Madness and Civilization (1961). Later in his career, he shifts his gaze from mental illness to crime and punishment and sexuality. Hall (1997/2013) asserts that there are six elements to the study of the discourse of prevalent across Foucault's work. *Figure 4* lays out these elements based on the discourse of madness (see page 30 of Hall). I have constructed a parallel structure of the discourse of mathematics learning for relevance to this dissertation.

Discourse of 'Madness'	Discourse of Mathematics Learning
Statements about 'madness' which give us a certain kind of knowledge about it	Statements about mathematics learning which gives us a certain kind of knowledge about it
The rules which prescribe certain ways of talking about 'madness' and exclude other ways – which govern what is 'sayable' or 'thinkable' about insanity at a particular historical moment	The rules which prescribe certain ways of talking about mathematics learning and excludes other ways governing what is 'sayable' or 'thinkable' about mathematics learning in a particular historical moment
'Subjects' who personify the discourse – the madman, the hysterical woman – with the attributes we would expect these subjects to have given the way that knowledge about 'madness' is constructed at a particular historical time	'Subjects who personify the discourse – the struggling mathematics learner, the math geek – with the attributes we would expect these subjects to have given the way knowledge about mathematics learning is constructed at a particular historical time
How this knowledge about madness acquires authority, a sense of embodying the 'truth' about it at a historical moment	How this knowledge about mathematics learning acquires authority, a sense of embodying the 'truth' about it at a historical moment
The practices within medical institutions for dealing with the 'madness' such as medical treatment for the insane whose conduct is being regulated and organized according to those ideas	The practices within educational institutions for dealing with mathematics learning such as mathematics remediation whose conduct is being regulated and organized according to those ideas
Acknowledgement that a different discourse will arise at a later historical moment, supplanting the existing the existing one, opening up a new discursive formation, and producing a new conception of 'madness', new discourse of power and authority to regulate social practices in new ways	Acknowledgement that a different discourse will arise at a later historical moment, supplanting the existing one, opening up a new discursive formation, and producing a new conception of mathematics learning, new discourse of power and authority to regulate social practices in new ways

Figure 4. Elements of the Study of Discourse

In Hall's construction of the six elements of studying discourse, we can see how subject

positions arise and are deployed within discourse to provide meaning. We can also understand

the temporal notion of discourse and subject positions. Through discourse, we are able to discern

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what it means for an individual to occupy a seat at the table, an occupation for which understanding narratives within discourse is necessary.

The Role of Narratives and Counternarratives within Discourse

When discussing subject positions, Davies and Harré state that "once having taken up a particular position as one's own, a person inevitably sees the world from the vantage point of that position and in terms of the particular images, metaphors, storylines, and concepts which are made relevant within the particular discursive practice in which they are positioned." How does one know what the "particular images, metaphors, storylines, and concepts" are that are consistent with a particular subject position? That is the role of narratives.

According to Hall (1997/2013), a narrative represents "the production of the meaning of concepts in our minds through language. It is the link between concepts and language that allows us to refer to either real or imaginary objects, people, or events" (p. 3). Stereotyping is another example of a narrative or representational practice that concerns itself, mainly, with the representation of difference or what Fraser (2004) refers to as the "recognition of difference." The language "representing difference" automatically constructs dominant (read white) culture as normal. When this happens, we must consider which meaning is privileged in any given representation and who gets to decide. Take, for example, an image posted on social media of a scantily clad Black woman walking down a busy street. As people use cultural understandings to interpret both what is happening and who this woman is, they would be engaged in reading or deciphering messages that say something about people and their 'otherness' or difference (Hall, 2013). For this Black woman, difference is marked, it signifies, it speaks. And this all happens within the confines of discourse. The same kind of sense-making happens when a Black woman is in a STEM space. Since Black women are mostly invisible in mathematics and STEM spaces,

does that make the narratives of them hidden as well? How, then, do folks understand the Black woman's body in such spaces? It is this question that this study takes up.

Storylines and narratives[1] are stories that circulate in society propagated through media and social interaction (Nasir & Shah, 2011). Nasir et al. (2012) synthesized the processes involving racial storylines that influence learning. They define storylines as being wholly situated within racial discourse. These racial storylines serve as "vehicles for both how individuals make sense of race and how they appropriate and deploy race to position themselves and others in everyday activity (p. 289)". There are several prevalent racial storylines in American society, such as Blacks are good at sports, Latinx people are lazy, Jews are good with money, or Asians are good at math. However, these storylines are also relational such as in narratives about affirmative action. When a white person purports that they were not hired because the company had to hire a person of color, inherent in this narrative is that the person of color was not as qualified as the white applicant. Nasir et al. (2012) argue that it is the relational quality of this and other racial narratives that exist in racial discourse to create and sustain racial hierarchies. Gendered narratives and storylines are equally as relational and pervasive in American culture. Thinking intersectionally, gendered -racialized narratives persist as well and the previous commentary about controlling images gave us a glimpse into those narratives.

Counternarratives or counter-stories also exist as alternate narratives that function as a critique of dominant narratives and exist as a reconfiguration of discourse. They are established and circulated in resistance to already circulating (and usually pernicious) dominant narratives (Delgado & Stefancic, 2012; Nasir et al., 2012). Solórzano and Yosso (2002) define racial

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[1] Throughout the dissertation, I use the term narratives, but I understand narratives and storylines as relatively synonymous.

counter-storytelling as "a tool for exposing, analyzing, and challenging the majoritarian stories of racial privilege. Counter-stories can shatter complacency, challenge the dominant discourse on race, and further the struggle for racial reform (p. 32)". Part of what this dissertation addresses are the role of counternarratives such as those associated with the strong Black woman and Black Girl Magic in discourse for Black girls and their mathematics learning experiences. When the dominant narrative is unfavorable, unsavory, or particularly harmful, Black girls may choose to reject them and instead enact counternarratives. What, then, would that mean for the particular subject positions and their availability within the discourse? Some of these issues become clearer as the dissertation unfolds.

Taken altogether, narratives play a vital role in discourse and subject positions. Within discourse, narratives are the vehicle for communicating an understanding of what one must do or how one must behave. It is clear that these actions and behaviors within racial or gender discourses are limiting and oppressive for girls/women and people of color. The narratives active in the discursive production of particular subject positions are sometimes contrary to one's psychological and physical well-being. The alternative, then, would be to enact a counternarrative though it is unclear what the result may be and, therefore, we must investigate this aspect of the phenomenon.

Consideration for Interdiscursivity

Discourses often do not exist in isolation but with one another. For example, Shah and Leonardo (2016) demonstrate just how discourses of schooling, mathematics, and race converge. Several scholars are interested in how discourses of school mathematics constitute the meaning of mathematical reality for learners based on their social identities whether it be as girls, Asian learners, or Black boys and men (Hottinger, 2016; Mendick, 2005; Shah, 2017, 2019; Stinson,

2008, 2013; Walkerdine, 1990; Walshaw, 2001). This is referred to as interdiscursivity, which is the mixing together of different discourses (Sunderland, 2014). Consideration for interdiscursivity is particularly essential for this study as we consider the social identity markers of these young Black women and mathematics. They could be simultaneously positioned by schooling, mathematics, racial, gendered, and gendered - racialized discourses. This work cannot exist apart from the social identities of the participants as Black women and how power operates in ways that are both similar and different for each of them through their shared social identity markers.

In her analysis, Walshaw (2001) attempted to disentangle gendered discourses and discourses of mathematics learning for Donna, a calculus student. These simultaneously operating discourses compete in an interaction between Donna and another student, Brett. In the interaction, while working on a problem involving finding derivatives, Donna referenced a "woman's prerogative" and being "blonde" both in relation to doing mathematics. In Walshaw's analysis, then, it is imperative that she considered gendered messages that Donna had taken up within the discursive practice of doing mathematics. Similarly, Stinson (2013) discussed how discursive formations of the Black male adolescent as a "thug" were reconfigured as the "white male math myth" discourse was simultaneously rejected. Attention to interdiscursivity lends itself to a question posed by Stinson (2013). I paraphrase here. What might the schooling, academic, and mathematics outcomes of students with marginalized identities be if they did not have to expend so much energy negotiating a plethora of discourses that disproportionately either position them as a problem or as the solution (Prashad, 2000; Stinson, 2013)?

The Usefulness of Poststructuralism

Foucault wondered about what and how forces mediate the relationship between the individual and the social world (Hall, 1997/2013), and this dissertation is primarily concerned with what and how forces mediate the relationship between Black girls and mathematics learning. Therefore, Foucault's ideas and poststructuralist thought are a viable lens for examining this phenomenon. Whereas a structuralist would assume that humans operate independently of the social world and cultural contexts or that meaning can be determined separate from cultural context, poststructuralists such as Derrida asserted signs and signifying are all context-dependent and contingent on its use in the social world with some meanings are centered while others are marginalized (Hall, 1997/2013). In understanding how people operate in social spaces attention to conceptions of what is normalized must be considered. A critical component of poststructural thought considers how individuals are constituted as subjects through discourse with discursive representations making various subject positions available to some and not to others (Lewis & Moje, 2003; Shah & Leornardo, 2016). As Shah and Leonardo (2016) posit, "discourses regulate access to subject positions through representations, based on how those representations are configured and deployed" (p. 52). In this way, these representations aid in sense-making about who whole groups of people can be and what they can do. It normalizes some while marginalizing others. These knowledges, then, become understood as "truth." Poststructural theory calls us to understand these processes for and implications of this subjectification.

I should mention that the nature of identity is not a concept that is supported in poststructuralist thought, as some argue there is no quintessential notion of self. There is only the subject positioned self that travels from space to space (Foucault, 1982). The term identification is often used when discussing the relationship between the subject and the process of

subjectification, or who the subject can be, through discursive practices (Hall, 1997/2013). Hall (1996) states that "identification is constructed through recognition of some common origin or shared characteristic with another person or group, or with an idea, and with the natural closure of solidarity and allegiance established on this foundation," in our case each participant identified as Black or African American (used interchangeably) girls (p. 2). I present data to discuss awareness of the consequences of such identification with particular attention to controlling images. Additionally, I examine how narratives about Black women by way of controlling images can shape Black girls' ways of knowing and being both in and outside of mathematics and STEM spaces.

Poststructural Race Theory

If poststructuralism is concerned with power and its manifestation through discourse, then Poststructural Race Theory (PRT) in education, as conceptualized by Shah and Leonardo (2016), offers a framework for analyzing race using poststructuralism. Specifically, PRT examines how narratives about racial groups (i.e., racial representations) exercise racial power (Shah & Leonardo, 2016; Shah, 2019). PRT explores how knowledges about different racial groups are constructed through discourse and can deepen our understanding of racialized interactions by offering a new way to analyze how learners are positioned as having different academic potential. It helps us understand what, exactly, is being learned in these kinds of interactions.

This theory contends that race is a discourse that constructs cultural knowledge about such things as one's cognitive or intellectual worth, among other things (Leonardo, 2013, 2015). Considering my interest in a population that identifies at the intersection of race and gender, I use controlling images and Black Feminist Thought (BFT) to extend the theoretical framework that

is PRT to include narratives of a gendered-racialized group. Just as "race exerts power through its function as a system that regulates presentation," the same can be true at the intersection of race and gender (Shah & Leonardo, 2016, p. 56). Taken all together, I put forth this extended version of PRT to analyze how controlling images of Black women both position them in various spaces, including mathematics learning spaces and how they attempt to make sense of their belonging in those spaces as a result.

Both race and gender discourses serve the purpose of sorting students in schools, constructing norms for participation in academic subjects like mathematics. In this way, discourses of race, gender, and mathematics ability are already circulating even before the young Black women participating in the dissertation study set foot on campus (Shah & Leonardo, 2016). Black women hold very little political or cultural power to control the means of their representation. They are, therefore, subject to external forces that exert enormous influence on how the social world renders them intelligible (Shah & Leonardo, 2016, p. 56). Even though they may put forth counternarratives or counter representations (i.e., strong Black woman), they then run the risk of either being representative of all Black women since they do not control the politics of representation. I, personally, have felt this way. Consider the story that I shared from my 11th-grade civics class. Even as I write this dissertation, I feel as though my efforts to push back against dominant discourses of race and gender have been distorted and are often used as a vice to show other Black girls and women that, if they work hard enough, they can do it also. Instead of attending to harmful discourses and oppressive systems and structures, a discourse of meritocracy prevailed with me as the poster child of pulling one up by their bootstraps (Washington, 1901). What I shared at the opening of this dissertation and in this paragraph are examples of personal narratives. One can see how I made connections between my own personal

narrative and narratives nested within dominant discourse. It is the personal narrative to which I turn my attention next as it is the link between the girls' experiences and the discourses I have been discussing.

Personal Narratives

Language and other discursive practices are central to the development of identity (Weatherall, 2005; Evans, 2015). As Evans (2015) explained, "discourses can be powerful and can constrain individuals by dictating what can and what cannot be said. They can then shape what we are allowed to know" (p. 23 - 24). Individuals can internalize dominant narratives - commonly shared stories continually taken up and reproduced in society - from discourses (macro-level) and express them in their own stories or personal narratives at the level of interaction (micro-level) (Chouliaraki & Fairclough, 1999; Nasir & Shah, 2011). In this way, the stories that one tells about oneself can only be derived from available discourses. This highlights the potential for both positive and negative effects concerning the process of becoming. Consider that mathematics, as a discipline, along with the teaching and learning of it are embedded in sociocultural discourses and historical contexts. These have a significant effect on students' learning, performance, and identity formation, particularly for those with social identity markers that have been historically marginalized (Stinson, 2008).

Personal narratives are stories one tells about her experiences. It is the teller's representation of past events, includes sequencing, actors, an audience, setting or context, and communicates how she makes sense of herself in light of the event (Bamberg & Georgakopoulou, 2008; Wortham & Reyes, 2015). Some posit that narratives reflect aspects of identity and are even equivalent to identity (McAdams & McLean, 2013; Sfard & Prusak, 2005). Poststructuralists would examine these narratives for evidence of subject positioning as a means

of connecting micro-level processes to macro-level power and knowledge systems (Shah & Leonardo, 2016). Similarly, Patel (2019) contended that "narratives facilitate structures. The stories that individuals tell about themselves, their people, their nation, other people, and success or failure all have material force in the shape and functions that institutions perform in society" (Patel, 2019, p. 253). According to Souto-Manning (2014), narrative stories are a form of sense-making through the sequencing of experienced events, including what is valued and provide the necessary meaning for understanding our world and our relationship to it. And Ochs and Capps (2001) argue that this understanding is realized through the relationship between everyday talk and the construction of cultural norms.

Though people unconsciously use narratives to chronicle and communicate personal experiences that are reflective of broader societal discourses, it is possible that such narratives could serve to counteract or challenge the positioning presence of such dominant discourses. These conflicting discourses are generally nurtured by and exist within minoritized communities consisting of folks with similar social identities (e.g., the Black community, the LGBTQ community). With volition, individuals can produce utterances aimed at contesting dominant discourses (Sunderland, 2004). Concerning Black women, the "strong black woman" is an example of this. Speaking in this way, as Black feminist scholar bell hooks (1989) asserts, is an act of self-transformation where one moves from determinism to determining their path forward.

Situating the Dissertation in the Conceptual Framework

In this conceptual framework, I have established that narratives about Black women lead to real and material consequences for their lives with the potential for interactions with discourses of mathematics (or STEM) learning and doing. I have demonstrated using poststructuralism just how discourse operates through language and language-like structures and

how it can be used to position folks, specifically Black women, as particular kinds of people. I have argued that PRT and BFT can be used in conjunction with one another as a means for understanding an aspect of the phenomenon that is Black girls learning mathematics. By conceptualizing how discourses operate in the lives of Black women via controlling images, I am now in a position to more deeply examine through analyzing their personal narratives how Black women are positioned in mathematics and STEM learning spaces.

Discourse: system of meaning and knowledge
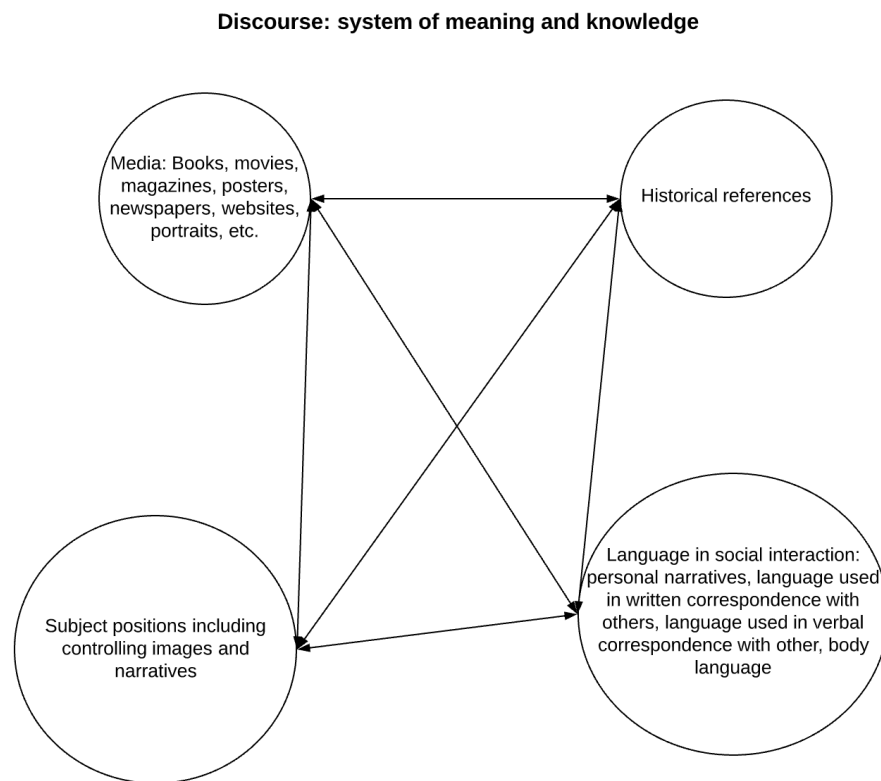
Figure 5. Discourse as a constitutive system

Let us revisit our previous discussion of discourse and what it is to help explain the representation in Figure 5. I previously defined discourses as broad, constitutive systems of meaning and knowledge realized through social language and practices associated with particular institutions (Sunderland, 2004) that "form the objects of which they speak" - as a way of seeing and understanding the world (Foucault, 1972, p. 49). I represent discourse as a constitutive

system of interaction between media, historical references, subject positions, and language in social interactions. As Fendler (2014) argues, "there are no clear boundaries to discourse" therefore, it would be possible to add additional nodes to the system (p. 37). Inarguably, though, these nodes are all part of discourse and interact with one another to construct a system of meaning. Hottinger (2016), for example, considered media, portraits of mathematicians, and the ethnomathematics as she tried to understand how mathematical discourses establish mathematical subjectivity for women and girls. This dissertation is situated squarely within the bottom half of the diagram (see Figure 6) as I consider just how references to controlling images are present within Black girls' talk during a semester of mathematics learning and how mathematics discourse and narratives of mathematics learning and doing interact with these controlling images.

Subject positions including controlling images and narratives

Language in social interaction: personal narratives, language used in written correspondence with others, language used in verbal correspondence with other, body language
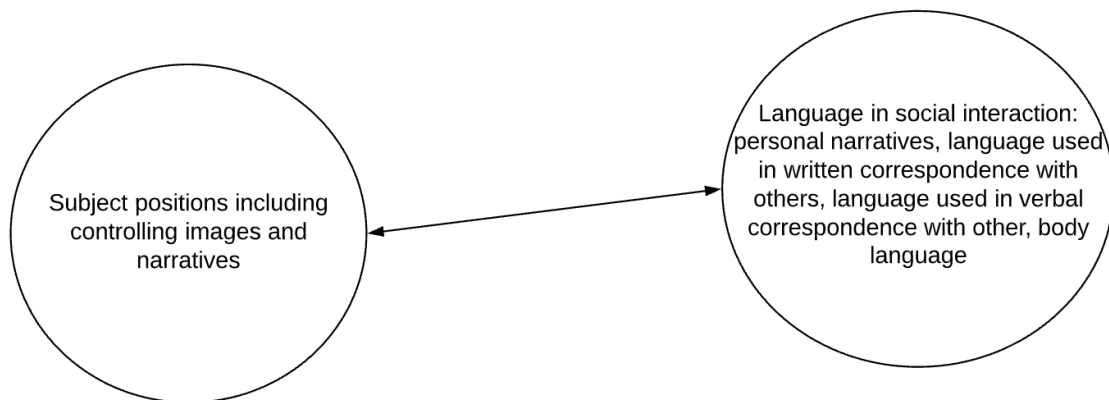
Figure 6. Components of discourse examined in this study

Do these historical controlling images extend into this current climate? How are these images read and interpreted by girls coming to be and understand themselves as Black women? Are there new controlling images to be considered in this era of social media and Black Girl Magic, or are these just rebranding of the historically rooted controlling images? And how do these controlling images and narratives of misogynoir impact the mathematics (or STEM) learning experiences of these young Black girls when mathematics (or STEM) spaces are

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characterized as mostly white and male? Some of these questions I ask rhetorically, yet it is this line of questioning that is the central concern of this study. The following is a review of the literature of what we currently know about the schooling and mathematics learning experiences of Black girls and young women as it relates to controlling images and other narratives.

CHAPTER THREE: REVIEW OF RELEVANT LITERATURE

Anti-Black societal narratives are prevalent and do not begin or end at the doors of schools or mathematics classrooms. One Black teenage girl expressed how these narratives permeate her school experiences. She stated, "we don't have support at all. We have a lack of books, resources, anything you can think of. But when we go in contact with these White children, they don't know how to act because they think they're better than us. And we don't know how to act because we think they're better than us" (Oliver, 2016). This statement illustrates the harsh consequences of practices connected to discourses of Black education as deficient. Discourses continue to operate adversely positioning Black students in school as well as in the mathematics classroom where racially stratified academic hierarchies create and sustain what has been deemed second-generation segregation through tracking practices. (Archer-Banks & Behar-Horenstein, 2012; O'Connor, Mueller, Lewis, Rivas-Drake, and Rosenberg's, 2011). At the intersection of race and gender, school practices and policies effectively marginalize young Black women fostered by negative dominant narratives of them as academically undisciplined and displaying behaviors misaligned with school norms (i.e., "Black girls are loud"). (Archer-Banks & Behar-Horenstein, 2012; Neal-Jackson, 2018).

To understand how "for many Black girls, schools are toxic, traumatizing places where they receive mixed messages about who and what is valued" (Carter Andrews et al., 2019, p. 2532), a concentrated group of scholars have been laser-focused on increasing the production of scholarship in the schooling experiences of Black girls and women (see Butler, 2018; Carter Andrews et al., 2019; Chavous & Cogburn, 2007; Evans-Winters & Esposito, 2010; Hines-Datiri & Carter Andrews, 2017; Morris, 2016). These scholars have leveraged critical social theories such as Critical Race Theory (Delgado & Stefancic, 2017), Black Girl Cartography (Butler,

2018), Black Feminist Thought Collins, 2000), and Critical Race Feminism (Wing, 1997), to understand a broad range of aspects of the Black girl schooling experience.

When considering mathematics learning experiences, as evidenced by chapters in the *Compendium for Research in Mathematics Education* (Cai, 2017) and other mathematics education scholarship, the literature primarily engages issues of race and gender independently (Ganley & Lubienski, 2016; Hottinger, 2016, Leyva, 2017; Lubienski & Ganley, 2017; Martin, 2010; Martin, Rousseau Anderson, & Shah, 2017; McGee & Martin, 2011). Patricia Kenschaft (1981) was among the first scholars to write about the experiences of Black women in mathematics in the United States. More recently, a small group of scholars has employed the critical social theories previously mentioned to explore interests in the mathematics learning experiences of Black girls (Borum & Walker, 2011, 2012; Jones, 2003; Gholson & Martin, 2014, 2019; Joseph, Hailu, & Matthews, 2019). Additionally, Joseph, Hailu, and Boston (2017) and Ireland, Freeman, Winston-Parker, Delaine, and McDonald-Lowe (2018) have reviewed the literature for Black girls in mathematics and Black girls in STEM, respectively. For this abbreviated review of the research, I discuss the findings of these two literature reviews and then pivot to issues in the literature that specifically concern narratives positioning students in mathematics learning spaces. I divide the discussion into three subsections: race, gender, and then the intersection of race and gender. I conclude with a brief review of how two critical mathematics education studies, in particular, tackle discourses around race (Shah, 2017) and race and gender (Stinson, 2008, 2013) in ways that spurred my thinking around this current inquiry.

A Broad View of the literature regarding Black girls in mathematics and STEM

Gholson (2016) noted that over the past eighteen years and since the sociocultural and sociopolitical turns in mathematics education (Lerman, 2000; Gutierrez, 2013), there had been a

wealth of scholarship generated about Black mathematics learners in general, and Black boys and men as mathematics learners, more specifically (e.g., Berry, Thunder, & McClain, 2011; Davis, 2018; Larnell, 2016; Lundy-Wagner, 2013; Martin, 2012; McGee & Martin, 2011; McGee & Pearman, 2014; Nasir & Shah, 2011; Stinson, 2008; Stinson, 2013). The scholarship generated considering Black girls in mathematics has examined the role of social networks for elementary-aged Black girls (Gholson & Martin, 2014), performances of racial identity and womanhood as high school Black girls negotiate of mathematics learning spaces (Marsh, 2013), on through to Black women's paths from undergraduates in STEM through to their doctorate (Joseph, Hailu, & Boston, 2017) among others topics.

In their review of the literature, Joseph, Hailu, & Boston (2017) found that structural factors, community influences, and the use of resilience strategies all contribute to Black girls' persistence and shape their experiences (P-20) in mathematics. Structural factors involve the distribution of material resources, culturally relevant, responsive, and sustaining curricula, and consideration for the impact of various other policies and practices such as tracking or single-sex classrooms (Bowe, Desjardins, Covington Clarkson, & Lawrenz, 2017; Campbell, 2012; Young, Young, and Capraro, 2017, 2018). Community influences include family, peers, and social networks (Gholson & Martin, 2014; Jones, 2003; Marsh, 2013). And resilience strategies include the active role that Black girls take in mathematics learning spaces that contribute to their persistence and success (Borum & Walker, 2011, 2012; McGee & Martin, 2011).

Relatedly, Ireland et al. (2018) engaged intersectionality as it pertained to key psychological processes associated with Black girls' identity development and STEM experiences. Their systematic review was limited to scholarship that employed intersectionality to produce new knowledge. They were concerned primarily with psychological processes such as

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self-efficacy, belonging, stereotype threat, motivation, and persistence through four emergent themes: 1) identity, 2) interest, 3) achievement and ability perception, and 4) socializers and support systems. Though the terms used may vary, their emergent themes are similar to those found by Joseph, Hailu, and Boston (2017), who looked explicitly at mathematics persistence. One key implication for practice from the Ireland et al. (2018) review extends the need for culturally relevant, responsive, and sustaining curriculum, and various other policies and practices by strongly suggesting that resources be allotted to specifically address the psychosocial and emotional needs of Black women and girls in STEM. This need has traditionally been subsumed in the programmatic offerings such as Women in Engineering (WIE) or the National Society of Black Engineers (NSBE) wherein there is mentoring. However, this call is for a more concentrated and intentional approach, specifically for Black women, especially for those in post-secondary settings (Rincón & George-Jackson, 2016).

Still, many questions remain. For example, Gholson (2016) pointed out that when Black girls and women display confidence, assertiveness, or defend their ideas, it is often construed pejoratively as 'being loud'- a positioning incongruent with hegemonic notions of White femininity. Yet these, what some consider, masculine traits generally associated with success and participation in mathematics do not benefit them in mathematics learning spaces. Gholson began to investigate one aspect of this phenomenon (Gholson & Martin, 2019) because such contradictions signal the need for special attention to the experience of Black girls and women to more fully understand their experiences as they are unique to them by way of their gendered-racialized social identities. Additionally, narratives and controlling images of Black women are prevalent and pervasive in every aspect of Black girls' and women's lives (Collins, 2000; Harris,

2015; Harris-Perry, 2011), yet little of the current literature deals explicitly with the presence of such narratives in mathematics or STEM learning settings.

In the next section, I first discuss the stereotype threat literature as this construct is related to that of controlling images and narratives. I then discuss how the literature has dealt with narratives in mathematics learning spaces. First, I focus on spaces where race was salient, followed by gender, and conclude with gendered-racialized narratives present in mathematics learning spaces. There are not many studies that specifically address this aspect of Black girls' mathematics learning. However, I have located a few for which there was an intention to examine this aspect of mathematics learning or for which this aspect of mathematics learning emerged in the findings.

Stereotype Threat

As stereotypes are so closely related to controlling images, I thought that it would be a worthy task to consider the role that stereotypes play in mathematics learning and achievement, particularly, as it relates to race and gender. One prominent area of research in educational psychology that has attended to the effects of stereotypes is the work of Claude Steele and Joshua Aronson on stereotype threat. Stereotype threat is a psychological mechanism that explains the depression of performance on a difficult task for members of a social group who are at risk of confirming a negative stereotype about the social group to which they belong (Steele & Aronson, 1995). Put simply, stereotype threat is the threat of being viewed through the lens of a negative stereotype or the fear of behaving in a way that would unintentionally confirm the stereotype (Perry, Steele, & Hilliard, 2003). There is a thread of literature noting the suppression in performance under stereotype threat as it relates to race, ethnicity, and gender (Steele, 1997, 2010).

Steele and Aronson's (1995) groundbreaking study and heavily cited study has sparked an ever-growing body of work. The study was initiated by an exploration of the idea that stigmatization via stereotypes could be partially responsible for the underperformance of Black university students (Steele, 2010). To investigate this notion, Steele and Aronson gave Black and white Stanford students a difficult verbal examination. Prior to administering the exam, some of the participants were primed by statements made by the proctor invoking the stereotype that Blacks are less intelligent than their white counterparts while a control group were examined unprimed. The results showed that Black students who were primed scored significantly lower than those in the control group and that white students were unaffected under either condition.

This initial study inspired others to extend the work questioning the role of stereotype threat under various conditions and in a variety of contexts such as women in mathematics (Spencer, Steele, & Quinn, 1999). As anticipated, gender differences were found when the stereotype was invoked and no gender difference otherwise (Spencer, Steele, & Quinn, 1999).

Stereotype threat and intersectionality

Two studies address the intersectionality of race and gender with regards to effects of stereotype threat. Aronson et al. (1999) explored the possibility of invoking stereotype threat to depress the performance for white men in mathematics, a population for whom no negative stereotype exists in this domain. They found that the existence of historic narratives of marginalization are not necessary to invoke threatened behavior and impact outcomes. White male performance on a difficult mathematics test was impaired when it was made salient that Asian men were superior in the domain demonstrating the fragility of identities in certain contexts. It also notes that there are qualitatively different ways that people experience stereotype threat in lieu of these identities as these otherwise non-stigmatized white men are not in danger

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of decreased identification with mathematics in the same way that women, in general, and Black women, more specifically, are. Secondly, Pittinsky, Shih, & Ambady (1999) were also interested in the intersectionality of gender and ethnicity for Asian women as it relates to their performance in mathematics as positive stereotypes exist about the mathematics ability of Asians while negative stereotypes exist about women's mathematics abilities. In their study including Asian women from both the United States and Canada, they found that when female identity is made salient, performance on a mathematics test is impaired, yet performance is enhanced for American participants when their Asian identity is made salient.

The research presented here focuses on stereotype threat converges with the findings from the qualitative studies from the previous sections of this review to confirm that awareness of a stereotypes has the power to transform outcomes by race and gender separately in specified domains while the intersectionality of race and gender introduces complexities that are underexplored. These complexities indicate that there are qualitatively different ways that the effects of stereotypes can be experienced based on positioning relative to others, strength of identification with the domain, strength of identification with the social group, and, perhaps, salience of the stereotype as a dominant narrative.

Research Centering Racialized Narratives in Mathematics Learning

Much of the work regarding stereotypes or narratives in mathematics has centered gender (i.e., Hottinger, 2016; Kurtz-Costes, Rowley, Harris-Britt, & Woods, 2008; Mendick, 2005; Rodd & Bartholomew, 2006; Spencer, Steele, & Quinn, 1999; Tiedemann, 2002; Walkerdine, 1998). Perhaps this is because gender constructs are international while race is mainly prevalent in the U.S. context. Engagement in work around racial narratives (McGee & Martin, 2011; Nasir & Shah, 2011; Shah, 2017; Snyder, Shah, and ross, 2012) is less prevalent but equally as

important. Racial narratives and stereotypes tend to be taken up in education, more broadly, with issues related to intellectual ability being front and center with one of the most common areas of research steeped in racial narratives is work focused on achievement gaps in mathematics (Shah, 2019). In STEM, McGee and Martin's (2011) work focused on academically successful and resilient Black mathematics and engineering at various levels of post-secondary study. They investigated how students managed stereotypes rooted in what it means to be Black, and this stereotype management was seen as explanatory for their success. As expected, the stereotypes most encountered and negotiated in mathematics classrooms related to intellectual ability. Students invested immense amounts of attention and psychological resources to attempting to self-define while also proving the stereotypes wrong.

Shah's (2017) work more intensely dissected racial narratives, not only for Black students but for a diverse group of high school students. He demonstrated the role of racial narratives in mathematics learning spaces, finding them present and interdiscursively invoked by high school students demonstrating how mathematics (and broader academic) abilities of learners from diverse racial and ethnic backgrounds are constructed with respect to one another. Notably, the students in this study expressed conversational narratives consistent with broader societal narratives of the racial hierarchy in mathematics ability by positioning non-Asian students of color as mathematically inferior and endorsing the "Asians are good at math" narrative. Shah (2019) further expanded on this work with strong consideration for how racialized narratives more narrowly impact Asian students. Interested in characterizing forms of sub-personhood and the discursive processes through which they are imposed, Shah used PRT and racial contracts (Mills, 1997) to demonstrate how the "Asians are good at math" narrative negatively positions

and dehumanizes Asian mathematics learners. He beckons the field to consider who can be fully human in STEM spaces and implicating STEM spaces as racialized and dehumanizing.

Larnell (2016) also specifically considered the role of racialized narratives as it relates to the mathematics learning experiences of Black students in their first year attending PWI for undergraduate study. He found that, for Cedric and Vanessa, their mathematics identities were co-constructed with racialized narratives through peer-influence and critical mass cues. Pointedly, he noted that narratives of mathematics learning such as high or low achievers often result in stimulating "overwhelming contingencies for young protagonists" as they negotiate these barriers, particularly when they intersect with existing racialized narratives (p. 262).

Research Centering Gendered Narratives in Mathematics Learning

Several scholars produce work focusing on poststructural analyses of gendered narratives in mathematics learning (Barnes, 2000; Hottinger, 2016; Mendick, 2005, 2006; Walkerdine, 1998; Walshaw, 2001). Leyva (2017) completed a particularly thorough review of gender in mathematics education detailing 45 years of methodological and theoretical shifts in approaches to this work. Most of the gender-based participation studies, similar to race, conceptualize gender as a social construct equating what it means to do mathematics with a performance masculinity. These studies employed poststructural analyses to understand better how girls "positioned themselves along the gendered hierarchy of mathematics success (p. 413)." Notably, much of the gender-participation work takes place outside of the U.S. context making it difficult to consider the intersection of gender and race as race is not as prevalent a social identity in countries outside of the U.S.

Though there is more written about gender and mathematics, I want to call our attention to one study, in particular, that takes place within the U.S. context. Langer-Osuna's (2011) study

is critical because it is an example of using language in a way that implicitly references gendered narratives in mathematics learning spaces. In a ninth-grade Algebra classroom, Langer-Osuna (2011) found that collaborative group work can be a site where girls are adversely positioned impacting mathematics identity formation. This study demonstrated how group members interpreted commands or directions in gendered ways. Brianna, the only girl in the group, displays of authority and leadership were cast as inappropriate, yet Kofi's display of authority and leadership was embraced. One episode, in particular, exemplified how this positioning occurred in implicit or coded ways that did not go unnoticed by Brianna (Shah et. al, 2020). Four Black students (Brianna, Brandon, Terrance, and Kofi) are working on a project-based learning task. Brianna, as the group leader at the time, gave directions to the rest of the group. As Brianna dictated what everyone in the group should be working on, Terrance interrupted her stating that she was working on "being bossy." Both Terrance and Brandon continued to talk about how Brianna was "so damn bossy" (p. 212). In subsequent group sessions, Brianna was relegated to the role of group secretary while Kofi emerged as the group leader.

The term "bossy" is both gendered and pejorative as it connotes an excessive use of the authority to order and direct people and is much more often used to describe girls and women. This is not what is implicit about the use of the term. Shah et al. (2020) argue that it is a form of coded language that does not explicitly signal how Brianna is being positioned as a Black girl, but that linguistically indexes these social identity markers. When the term "bossy" is deployed against girls or women, a performative linguistic ideology indexes authority itself as a masculine trait where only men are warranted the right to issue orders. For girls or women, their actions are seen as perverse and incompatible with femininity. The use of the term adversely positions girls and women by twisting their realities and distorting their exercise of leadership. Langer-Osuna

made the empirical claim that "bossy" *did* cause harm, which was evident in Brianna's interview, where she conveyed she felt the boys would not listen to her because she was a girl and that she needed to yell to assert authority. Even without Brianna's perceptions, Shah et al. (2020) argue that an analyst could reasonably claim harm from the observational data alone and the gendered history of the term "bossy."

Research centering gendered - racialized narratives in mathematics learning

There are three studies, in particular, that tackle narratives in mathematics learning at the intersection of gender and race. I briefly discuss each here as they all have connections to this dissertation study either through race, gender, level of schooling, or a combination of the three.

Stinson's (2008; 2013) study focused explicitly on sociocultural and sociohistorical discourses as they relate to mathematically successful Black men. Stinson examined how five Black men between the ages of 20 and 25 negotiated these discourses. Using a participatory methodology, Stinson (2008, 2013) concluded that the young men were continually positioned by narratives implicating both racialized and gendered-racialized discourses such as the "White Male Math Myth" or white male performance in mathematics as normative (Martin 2009, Stinson, 2008; 2013). These discourses worked to limit the black men's understanding of themselves as mathematical knowers. However, Stinson demonstrated the non-deterministic aspect of discourses as these young men could take up these discourses, compromise, or refuse to yield.

Stinson also discussed how the young men accommodated, reconfigured, or resisted the discourses through the use of counter-storytelling - storytelling purposefully used because it honors and values the stories and experiences of racialized people. More specifically, the young men rejected the "White Male Math Myth", and both rejected and sometimes endorsed narratives

of Black males as thugs. They conveyed discourses of difference, namely that of Black girls as "smarter" than Black boys, a discourse of deficiency, and discourse of academic rejection with the young arguing that this rejection of Blackness is not a prerequisite for academic success.

I now shift from Black men to research centering a third-grade Black girl named Patti. Through a feminist lens and intersectional approach, Jones (2003) chronicled the mathematics learning and identity formation of Patti across three spaces; in her classroom, with her mother, and in an after-school mathematics club. Jones (2003) found that, for Patti and Black girls more broadly, limited subjectivities were made available to them in mathematics learning spaces. They were seldom allowed to develop as mathematics doers while simultaneously flourishing in their Black girlhood in mathematics learning spaces that promoted and upheld both feminine and masculine, white, middle-class, values and identities (Battey & Leyva, 2016; Hottinger, 2016; Walkerdine, 1989). For example, Patti's white, middle-class mathematics teachers described her as "big," "aggressive," and "loud" (p. 225) - a prelude to the Angry Black woman - and did not characterize her as a strong mathematics student despite Jones' observations to the contrary. The subjectivities available to Patti in the classroom were also manifested in the after-school math club by Patti's classmates. Jones created the space with attention to the promotion and value of intersectional identities. However, Patti's classmates routinely positioned her as a troublemaker and isolated her causing Jones to take explicit actions to position Patti positively as a mathematics knower and doer. Due to Jones's intervention, Patti eventually shifted from someone who hated mathematics to someone who saw mathematics as an ever-present part of her life and was able to make connections previously unavailable to her with both mathematics and her peers.

For Patti, it was not as simple as either taking up or rejecting the ways she was positioned at the intersection of race, gender, and class. At that age, it is difficult to know if she was able even to make sense of the ways she was being positioned in any critical way. Jones did note, however, that Patti received more positive attention from her teachers when displaying white, middle-class notions of femininity such as wearing earrings, wearing a "girly" outfit, or carrying a backpack purse. Additionally, Patti discusses how her and others' actions and behaviors during mathematics learning lead to moments of embarrassment or being "called out" by their teacher. When she or others blurt out incorrect answers, her teacher made a public statement - something to the effect of "that's why you be getting low scores" (p. 226). Here we see the relationship between discourses of femininity with that of being a good mathematics learner or doer. When Patti participated in these performances or exhibited these behaviors, she is routinely embarrassed by her math teacher - far from the praise she received when she wore earrings and sat quietly. Unfortunately, the math club space was only available for Patti and the other girls for that school year as Jones had to leave that placement. This saddened Jones as she noted that Patti was "thrust back into classrooms where dominant discourses of stereotypical femininity and white, middle-class academic achievement constructed narrowly defined notions of who could succeed in mathematics" (p. 231). Patti's case highlights just how she was constructed at the intersection of race, gender, and class, with adverse effects on who she could be and what she could do in mathematics.

Lastly, I discuss research centering both Black men and women conducted at the post-secondary level. McGee and Martin (2011) found that for the Black men and women who participated in their study, there were ways in which they were positioned differently by gender. Their study revealed that, in their self-definition and proving stereotypes wrong, Black men

spoke of always being "on point" as well as feeling as if others were afraid of them constantly negotiated this perception that others had of them as being a "thug" or dangerous. This mirrors Stinson's (2008, 2013) findings. Black women, on the other hand, spoke about the burden of the "double-negative" being both Black and a woman and how that impacted their sense of belongingness in mathematics learning spaces (McGee & Martin, 2011). Interestedly, McGee and Martin (2011) found the Black undergraduates were able to use their success in mathematics to their advantage and leveraged it to be perceived as smart.

Across these three studies, there are many differences ranging from compositions of race, gender, class, and age. Despite the differences, there is much to draw from the findings of these studies. There are three issues that arise that I would like to call our attention to. First, there are ways in which narratives of race and gender are implicated both independently and jointly for these Black mathematics learners as was evident in the McGee and Martin (2011) study. Similarly, there are also times when gendered – racialized narratives co-exist and interact with narratives of mathematics learning which was the case in all three studies. This is all to say that narratives of race, gender, and mathematics are all circulating sometimes independently and sometimes collectively. Teasing apart just how this happens could be of great benefit to the field.

Secondly, several individuals are active in both conveying and performing these narratives. Stinson's participants advanced narratives at the intersection of gender and mathematics saying that girls were "smarter" than boys. Both their mathematics learning peers and teachers and other instructors sometimes advanced the narratives such as in Patti's case. Sometimes the messages communicated via these gendered-racialized narratives were disembodied as evident by impact of McGee and Martin's finding that young Black women's sense of belonging in mathematics spaces.

Lastly, in the case of the older students, there is evidence of negotiating these narratives via counter-storytelling or counternarratives. These negotiations and counter-storytelling often happened through participation in mathematics as was the case for the young men in Stinson's study. All three of these issues are aspects of learning at the intersection of race, gender, and mathematics that are also implicated in this dissertation. These issues communicate the need for more research to disentangle these narratives and learn how they circulate both independently and in relationship to one another for a more in-depth understanding of the mathematics learning experiences of Black learners, especially for Black girls.

The Role of Discourses of Mathematics Learning and Doing

Hottinger (2016) takes a different approach to the conversation of subjectivity while learning and doing mathematics. Instead of attending first to gendered narratives, she argues that mathematical subjectivity is incompatible with femininity. She stated that "mathematical subjectivity is constructed in ways that limit access to select groups of people" (p. 8) She is not arguing that other subjectivities disappear in mathematics learning spaces but she is making the distinction that the normative white, masculine subjectivities in mathematics relegate others to the margins. She also challenged the construction of mathematics as a rational, universal system of logic and truth (culture-free or culture-neutral). According to Hottinger, it is anything but. In actuality, it is tied to the construction of the West itself. Through her work, she exposed where we get our ideas from about who can engage in the production of mathematical knowledge and how a mathematical subject is constituted via discourse - how an individual becomes subjected in practice through textbooks, mathematics history, portraits of mathematicians, and the field of ethnomathematics. Through these means, stories underlie and reify the discursive construction of subjects.

Discourses of mathematics include the notion of the highly intelligent subject. It is often thought that those who know and do mathematics are incredibly smart (Featherstone et. al, 2011; Hatt, 2012). It is this subjectivity created within the discourses of mathematics that the participants in both Stinson (2008, 2013) and McGee and Martin (2011) drew on as they leveraged their mathematical "smartness" to negotiate deficit narratives of race and gender.

Literature Motivating this Dissertation Work

Both Shah (2017) and Stinson (2008; 2013) establish a foundation for empirical work around racialized narratives, discourses, and the implications for students of color more broadly, and Black men, more specifically. Yet Gholson (2016) reminds us that Black girls and women doing mathematics is a "phenomenon uniquely shaped by their position within the U.S. social order" (p. 290) yet none of the studies in this review soley address the mathematics learning of Black girls, especially at the secondary and post-secondary level. Put Shah's (2017) and Stinson's (2008; 2013) findings in conversation with the assertion made by Gholson, and it is not a stretch to imagine that the same racialized, gendered, or gendered-racialized narratives that exist in broader society about Black girls and women are fully present and operating within mathematics learning spaces. Not only are they present and working, but they are now swirling around with narratives of mathematics learning. Yet, we know little about the consequences of their operation.

This dissertation sought to advance existing knowledge in three ways. Firstly, literature is scarce on the experience of Black girls and women in mathematics, especially as it relates to gendered-racialized narratives positioning them in all aspects of their lives. This study sought to continue to build this body of literature. Secondly, this study is unique in its methodological approach. Current studies used ethnographic or participatory methods that depend on the

presence of the researcher to capture the phenomenon. Other studies rely on historical accounts of their mathematics learning experiences in semi-structured interviews, focus groups, or through mathematical autobiographies. This study used BFT and a novel method ("Issa moment" audio logs) similar to Smagorinsky's (1997) situated protocols. This is beneficial in two ways – the audio logs can capture close to real-time narrations of the young women's experiences and discourses that those narratives map onto in ways that are not solely dependent on the presence of the researcher and are not too far removed in time from the young women's actual experiences. Thirdly, using PRT and BFT allow for an understanding of the interaction between controlling images and personal narratives at play in more nuanced ways. Instead of merely identifying patriarchal or racist narratives, I examine how they operate interdiscursively, particularly with narrative of mathematics learning.

CHAPTER FOUR: DESIGN, SETTING, PARTICIPANTS, AND METHODS

In the previous chapters, I provided a rationale and framing for studying the phenomenon of Black girls' mathematics learning experiences in relationship to controlling images. Additionally, I offered the conceptual framing for this work steeped in Poststructural Race Theory and Black Feminist Thought. I connected the present study to the broader body of literature around racial, gendered, and gendered-racialized narratives in mathematics education. I make mention of how those narratives are intertwined with narratives of mathematics learning often with adverse effects for those outside of the "White Male Math Myth," or the "Asians are good at math" narrative (Stinson, 2008, 2013; Shah, 2017, 2019). I argue that controlling images of Black women across all contexts are designed to limit access to psychological, social, and material resources in these spaces, mathematics spaces included, by adversely positioning Black girls and women or by making them invisible altogether. The purpose of this chapter is to discuss my methodological approach to the study's design and provide more detail about the empirical elements of the study, the context, participants, timeline, and data collection methods. This qualitative investigation engaged both Poststructural Race Theory (PRT) and Black feminist thought (BFT). In this section, I discuss how BFT and PRT influenced both the methods used for data collection and data analysis in this study.

Black Feminism

Anchored by a Black feminist perspective, this study allowed for the investigation of the narratives offered by Black women undergraduates throughout a semester-long mathematics course attending to how cultural narratives of Black women and mathematics learning are present and interact. Feminist methodologies have "a shared commitment to drawing attention to the deep and irreducible connections between knowledge and power, and to making problematic

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gender in society and social institutions to develop theories that advance practices of gender justice" (Burns & Walker, 2005, p. 66). I invoke this shared commitment by grounding this qualitative inquiry in BFT (Collins, 2000), a feminist methodology that exclusively addresses the epistemology of Black women. Patricia Hill Collins (2009) recognized a void, located Black women's voices to fill it, executed an analysis of lessons learned from those voices, and offered an interpretation of what it all means (Dotson, 2015). BFT (2000) is an exploration of the words and works of Black women intellectuals, writers, and artists to bring their work and theories to light, essentially offering Black woman-centered epistemologies. It is with this grounding that I draw on *Talking Back: Thinking Feminist, Thinking Black* (hooks, 1989), and Issa mirror moments from the HBO television series *Insecure* (Rae, 2016). These are two are examples of the deployment of BFT as the methodological grounding for the methods used to investigate the dialectic between personal narratives and controlling images.

In *Talking Back:Thinking Feminist, Thinking Black,* hooks writes about the power of women, particularly Black women, finding their voice and what it means for feminist consciousness for overcoming white male supremacy. As hooks writes, "moving from silence into speech is for the oppressed, the colonized, the exploited, and those who stand and struggle side by side a gesture of act of speech, of "talking back," that is no mere gesture of empty words, that is the expression of our movement from object to subject - the liberated voice" (p. 9). hooks frames this "talking back" as an act of agency and liberation. In a similar vein, Issa, *Insecure's* main character, is a Black woman trying to navigate the perils of relationships, career pursuits, and friendships in Los Angeles. This Emmy-nominated show is in its fourth season on HBO. Almost every episode includes "Issa moments" as I have named them. Issa raps in the mirror to prepare for or in response to something she has or expects to experience. In one episode, Issa is

preparing to go out for the evening. She had recently split from her partner of five years and was trying to figure out how to date again. In the mirror, Issa switched back and forth between lipstick colors uttering phrases that she could say to potential suitors. She cycles through a litany of personas, finally landing on wearing a clear lip balm and smiling awkwardly into the mirror before leaving for the night. This particular mirror moment demonstrated her attention to dominant narratives about who Black women are supposed to be. As Gee (2014) mentioned, discourses shape the kinds of people we think we are or can become. These "Issa moments" reflect her accessing broader narratives to make sense of her life experiences. Issa draws from a variety of narratives during these cinematographic clips shifting between countering these narratives through her raps while, at other times, succumbing to them.

Both *Talking Back* and *Insecure* are examples of Black women's epistemologies as they use voice to make sense of, navigate, and realize their power through the exercising of agency. Both are examples of the importance of Black women narrating their own experiences – narrations that could be analyzed using PRT to identify corresponding discourses and attend to power and positioning. As an empirical extension, future work could highlight agentive repositioning that leads to generative action for Black women in mathematics learning spaces.

The Case for Personal Narratives

Through personal or conversational narratives, individuals can concretely begin to interrogate their lived experiences identifying the socio-ideological influences of discourses on their beliefs, practices, and on conceptions of their worlds (Bakhtin 1981; Souto-Manning, 2014). This could lead to envisioning ways to problem solve and promote change (Ochs, Smith, & Taylor 1996). Through their personal narratives, the girls make sense of what they know, feel, and experience in their mathematics learning spaces. Souto-Manning (2014) asserts that

identities are constructed and (re)conceptualized through sharing these personal narratives, and these are critical to understanding both the nature of narrative more broadly, as well as its relationship to the social construction of cultural norms and various discourses.

Participants and Setting

Setting

I conducted this study during the spring semester of 2019 at Michigan State University, a large, public, four-year research-oriented university in Michigan. Michigan State University boasts that the entering class Fall 2018 (the class that the participants were a part of) was the largest, most diverse in the school's history where students of color represented 23.8 percent which increased the total number of students of color by 6.7 percent from the previous year. The racial composition of the undergraduate population is as follows: 75.5% white, 8.3% Black/African American, 6.3% Asian, 5.3% Hispanic/Latinx, 3.6% two or more races, 0.2% American Indian/Alaskan native, and 0.1% Hawaiian/Pacific Islander. Concerning gender, the student body was 49.3% male and 50.7% female according to the Office of Inclusion and Intercultural Initiatives (retrieved from

https://inclusion.msu.edu/_assets/documents/about/annual-reports/2017-18-Diversity-at-MSU-Student-and-Workforce-Report-FINAL-Accessible.pdf)

Participants

Seven first-year university students self-identifying as Black girls participated in the study, sharing a range of rich stories and experiences. Though all had attended high school in various school districts across the state of Michigan, at least two lived a portion of their childhoods outside of Michigan (Stella and Tiffany). There were initially nine participants, but two were unable to meet the requirements for data collection and, subsequently, did not continue

until the end of the semester. Their data was not used in the study. Each of the seven remaining participants was enrolled in a mathematics course during the spring semester of 2019 (January – April) throughout the time of data collection. Enrollment in a mathematics course was necessary for data collection as I was interested in eliciting data in "real-time" across the span of one semester instead of relying on more recollections of temporally distant events. Participants were recruited via flyers posted around campus, announcements sent out via the university email system to relevant groups such as Black Student Alliance, Women in Engineering (WIE), and the National Society of Black Engineers (NSBE) as well as to instructors of courses whose predominant enrollment is first-year students. Additionally, I used snowball sampling to expand beyond those who initially agreed to participate.

Table 1. Study Participants

Name (pseudonym)	Major	Math course enrollment
Larry*	Communications	Quantitative Literacy II
Lysha	Political Science - Pre-Law	Quantitative Literacy II
Marie	Arts and Humanities	Quantitative Literacy II
Miranda	Special Education - Learning Disabilities	Elementary Mathematics for Teachers
Nicole	Public Affairs/Public Policy	Quantitative Literacy II
Stella	Engineering	Calculus I
Tiffany	Neuroscience	Survey of Calculus I

*Though Larry is traditionally a male name, this participant insisted on using it as her pseudonym as a symbol of her love for her favorite basketball player.

Overview of Study Design and Analysis

This study is concerned with making connections between the personal narratives of Black girls enrolled in undergraduate mathematics courses, controlling images, and narratives of mathematics learning. Therefore, the study was designed to provide access to those personal narratives or stories. I used individual interviews, focus group interviews, and WhatsApp voice notes for data generation. In each of the individual interviews, one at the start of the semester and another and the end of the semester, the girls told personal stories about their mathematics and other STEM learning experiences. The focus group meetings were another time in which this took place, though most of these stories were about their current mathematics and other STEM learning experiences in the university setting. Lastly, each of the girls submitted WhatsApp voice notes detailing specifics incidents that took place during their mathematics and STEM learning throughout the semester. Collectively, all three data sources provided rich stories for analysis.

I begin with Søndergaard's (2002) stance that a "poststructuralist-inspired empirical analysis is not something that can be acquired as a sort of technique", but rather is an analytical approach influenced by postructuralist thinking (p. 187). Shah (2019) explains that a poststructural approach to analysis considers that discourses exercise power by constituting people as discursive subjects by making available subject positions. Those subject positions in the form of controlling images about groups of people are cultural representations that usher individuals into various forms of subjectivity. It is these controlling images as well as narratives of mathematics learning that form the core of my analysis and for which I look for evidence of in the girls talk.

Once the data were collected, the analysis interrogated language used in the data at the level of words and sentences for similarity and likenesses to broader gendered-racialized

narratives, prevalent narratives of mathematics learning, or both. In chapter five, the analysis was rooted in making connections between the language the girls used and controlling images, but it also honors the spirit of Black Feminist Thought which broadens the range of what is meant by scholarship and expands expressions of Black women's lived experiences to poetry, music, and other mediums of popular culture. In chapter six, the analysis continues in this vein, but then also extends to dominant narratives of mathematics learning. For each passage of data, I asked what is present in the language, but also ask what dominant narratives are curiously missing. Taken altogether, I use any apparent relationships between the controlling images and the narratives of mathematics learning to make claims about what I have found in the data.

The sample was limited to first-year college students because this is a critical period in one's educational journey when they are making decisions regarding future occupations. During this time, many university students are taking general university requirements and, though they may have some idea what they hope to pursue, have not yet declared a major. Experiences during this year could be pivotal in this decision-making process.

Through the data collection portion of the project, I took appropriate steps to ensure that I followed the Human Research Protection Program at Michigan State University. I submitted my proposal to the Michigan State University's Institutional Review Board and received approval to conduct the study (see Appendix F). I also obtained consent from each participant via a consent form. At the end of the semester, all participants received a $50 Amazon gift card and a show of appreciation for participating. I took care to protect participants' confidentiality. Their identities have been kept secure on a password-protected computer using pseudonyms.

Data Collection

Including the pre-interview preparation, this study proceeded through seven phases (see Table 2) beginning in January 2019, with the final interview being conducted in late April 2019. Data sources include focus group session data, participant audio logs, individual semi-structured interviews, and researcher field notes. The first round of recruitment yielded four participants (Larry, Lysha, Marie, and Miranda). They each watched *Hidden Figures* (more about this to come), and their initial individual semi-structured interviews took place from January 13 - 17, with the first focus group meeting being held on January 22. During this period, another round of recruitment took place, which resulted in Tiffany, Stella, and Nicole joining the project. They also watched *Hidden Figures* and their initial interviews took place from January 30 - 31st, with a second focus group meeting being held on February 5. More detail in each phase of the project is below.

Table 2. Data collection schedule

Dates	Data collection activity
January 13 - 31	Initial individual semi-structured interviews
January 22 & February 5	First focus group
January 22 - March 12	Audio log generation and collection (Round 1)
March 12	Second focus group
March 12 – April 20	Audio log generation and collection (Round 2)
April 15 – April 20	Final individual semi-structured interviews

These data-generating activities resulted in a total of fourteen individual semi-structured interviews, three focus group sessions, and fifty recorded or typed audio logs.

Phase 1: Pre-interview Preparation

As each girl agreed to participate, they were given both a verbal overview and email with the details of the semester-long study. Before our first meeting, each watched *Hidden Figures* (Gigliotti, Chernin, Topping, Williams, & Melfi, 2016) in preparation for our initial focus group session. Throughout the movie, there were numerous cues, both blatant and masked, about Black women's competence and belonging as learners and doers of mathematics. The movie, itself, likely reified the existence of controlling images of Black women. I chose this film as the stimulant for the first focus group discussion. During the viewing, I asked the participants to take notes in a Google document to be shared with me that include the messages they notice about the experiences of Black women learning and doing mathematics. Stella, Miranda, Tiffany, Larry, Marie, and Nicole took notes while viewing and Lysha did not submit notes. If participants had previously viewed the film, I asked them to watch it again in preparation for our meeting. I also offered the participants the option of reading the book *Hidden Figures* (Shetterly, 2016), yet none of them opted to do so. The purpose of this phase is to prime participants' thinking about Black women's relationship to mathematics and the messages about Black women as doers of mathematics.

Phase 2: Initial Individual Semi-structured Interviews

During this phase, I met individually with and interviewed all participants. Due to inclement weather that canceled classes for only the seventh time in the history of the university, interviews with Stella, Nicole, and Tiffany were conducted via Zoom web conferencing. Each interview was audio-recorded and later transcribed. During these interviews, I built a rapport with the young women, oriented them towards the project, and asked questions to gather some background information. The young women were allowed to speak explicitly about the role of

race and gender in their lives, more broadly, and their mathematics learning experiences, more specifically. See Appendix A for the information participant information sheet and semi-structured interview protocol used.

Phase 3: Focus Group Sessions

Phase 3 is the first of two focus group sessions held during data collection. Again, this phase occurred over two different periods (January 22 and February 5). Both meetings lasted approximately one hour, and the participants met one another for the first time and had the opportunity to interact. Marie, Larry, Marie, and Miranda all met one another for the first time that evening. However, Tiffany, Stella, and Nicole all attended the same high school and were friends. During these focus group sessions, the young women were prompted to speak explicitly about race and gender as we discussed Hidden Figures and the various messages they noticed. We also viewed two separate movie clips and discussed the experiences of the Black women in the movie in ways that it both related and deviated from their own lives (https://www.youtube.com/watch?v=6DJ8jYRh_0E and https://www.youtube.com/watch?v=9j6p7ajuh-E).

I concluded the focus group interviews with a discussion of *Insecure* and "Issa moments" (see the Black Feminism section above) as the impetus for the audio logs. These brief discussions prepared the girls for recording their audio logs in subsequent phases of the project. This included making sure that each had access to and could operate the technology needed for the audio logs. Both focus group interviews were video and audio recorded and fully transcribed. The purpose of this phase is to orient the young women to the ways that Black women (both in the movie and among their group) are positioned in various ways and to familiarize them with

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these various positioning in their own lives. Sessions were held on the campus following the same semi-structured interview protocol found in Appendix B.

Phase 4: Audio Logs

Phase 4 is the first segment of audio log data collection. Again, these audio logs are analogous to the "Issa moments" described in the Black Feminism section at the start of this chapter. These audio logs were recorded and sent to me as voice notes in the WhatsApp application for smartphones. In these voice notes, I asked participants to recap an experience related to their mathematics learning at least once each week ranging from one to five minutes in length. If there was a week where participants did not feel as if they have received any of the messages or were not adversely positioned in their mathematics learning experience such as those we discussed in the focus group meeting, they sent audio logs describing their week of learning, any assessments they took, how they felt about their performance, etc. I communicated that they did not need to emulate Issa in their audio logs and that I used Issa as an example to demonstrate how Black women might recant stories of their experiences. Most of the young women simply spoke to me as if they were talking to a peer or mentor.

In my WhatsApp application, each participant had a dedicated chat channel (using their pseudonyms) that could only be seen by the participant and me (see Figure 7). As I listened to each voice note, I sent a private message responding to the participant and asked for more detail where necessary. Both the voice note audio logs, as well as any texts exchanged in WhatsApp, served as data for this phase. Due to the girls' busy lives and the nature of the phenomenon under investigation, they did not always send one per week and the messages they did send varied in length. I transcribed each audio log and subsequent typed messages and organized by participant in a spreadsheet along with the date, time, length of the message, and any other correspondence.

This is arguably one of the most critical phases of the project as it represents the personal narratives that the young women tell about their current mathematics learning experiences and how they are positioned in those spaces. Data from these audio logs will be featured prominently in the second findings chapter.
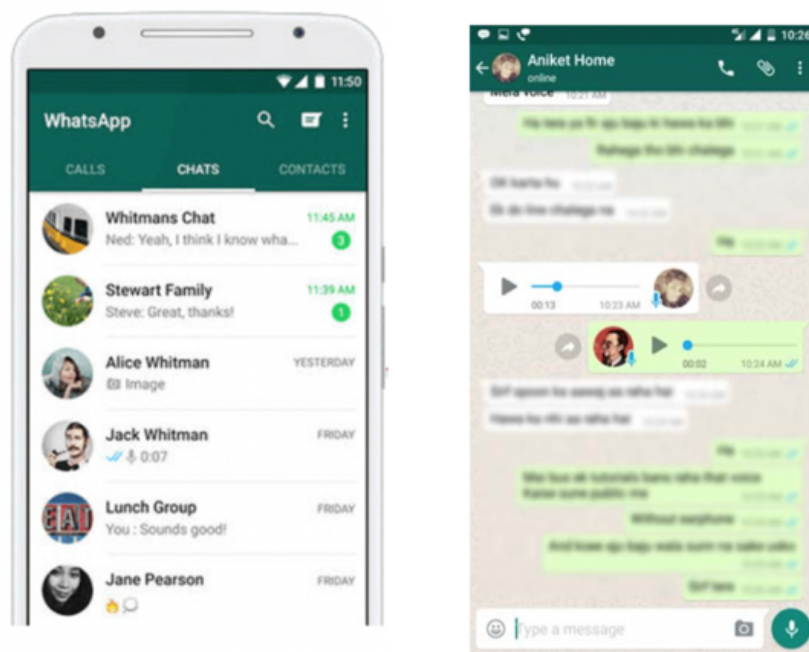
Figure 7. Example of WhatsApp chat

Phase 5: Focus Group Check-in

Everyone except Lysha was present for the mid-semester focus group meeting. Lysha could not make it because she was scheduled to work and could not change her schedule. The purpose of this second focus group session was to check in with the young women and provide a time to debrief the first part of the semester. We did the Diversity Toss activity (Jilk, 2012; Nieto, 2004) which focuses the participants thinking on the salience of various social identity markers to spark discussion, and then everyone was able to share experiences from the first part of the semester. A copy of the slides used to facilitate this session can be found in Appendix D. At the end of the session, I discussed the quality of the audio logs that I had received thus far, and some

of the young women offered examples of the types of stories they had been sharing. This session was both video and audio recorded.

Additionally, during this focus group, I shared Table 3 as categorized examples of discourses and their corresponding narratives. We talked about where their current experiences would be classified and whether or not additional columns should be added. They asked me to add a column about mathematics teaching as many of their experiences and frustrations stemmed from mathematics teaching strategies.

Table 3. Categories of discourses and examples of messages consistent with those discourses

Mathematical	Gender	Racial	Black girls and women	Schooling	Interdiscursivity
One right answer	Women are more intuitive than men	Black people are lazy.	Loud	Meritocracy	Math spaces are white, male spaces
Speed matters	Women are more emotional	Black families do not value education.	More mature	Achievement gap	Whites and Asians outperform all others in math.
Logical, not intuitive		Less intelligent	More independent		Men are innately better at math than women
Innate ability			Need less care and nurturing		Asians are good at math
Culturally neutral			Less feminine		

Phase 6: Additional Audio Logs

This sixth phase of audio log data collection is a continuation of the fourth phase, but with the insights taken from the focus group meeting. Again, as I listened to each voice note and sent private messages asking for more detail, when necessary. Both the voice note audio logs, as

well as any texts exchanged in WhatsApp served as data for this phase and were added to the spreadsheet that I started during phase four.

Phase 7: Final Individual Semi-structured Interviews

Individual semi-structured interviews were conducted in person with each of the seven girls for this final phase of data collection. These interviews serve several purposes. This was a time during which we unpacked some of their "Issa moment" audio logs. The selection of audio logs was based on those for which I needed more information and context to understand the story entirely. I also gave priority to audio logs that seemed particularly impactful for the young women providing them an opportunity to unpack those experiences further. As a researcher hoping to employ humanizing research practices and sensitive to going into communities and extracting without depositing, I hoped this exercise would help the girls realize their own power and agency as authors of their own lives and provide them with the closure they may otherwise not have gotten at the end of a process such as this. These interviews also served as a time for me to follow-up on any of the other audio logs they shared. With this opportunity, we may be able to we might listen back to an audio log or two together and allow participants to provide more context or to talk about what followed those moments as the semester progressed. Finally, these interviews allowed time for reflection and to talk about their academic and mathematical lives moving forward. After all, one expressed purpose of this study was to understand the impact of narratives further. Each interview lasted approximately one hour and was audio-recorded and transcribed.

Researcher Field Notes

Throughout the entire process, I maintained a field notes journal. It is here that I recorded notes about interactions that took place with participants via email, in focus groups, in person,

after listening to one of the audio logs, and about exchanges that took place in WhatsApp. These notes were both descriptive and analytic, attending to problems that might arise during data collection, questions that might arise, and notes and themes that seemed to be emerging (Glesne, 2016). These notes were minimally consulted during data analysis.

Personal Identifying and Researcher Positioning

At the time of the study, I identify as a Black girl or woman with a strong mathematics identity, having earned a bachelor's degree in mathematics and being a high school mathematics teacher for the past twenty years. These aspects of my identity also intersect with my identifying as a middle-class, cisgender, heterosexual, feminine performing female, and a mother of three teenagers - two of which are just a year or so younger than the girls in the study and two of which are Black girls. As such, I am a past member of the group whose experiences I study.

During data collection and analysis, my positionality was crucial to both what participants chose to disclose and the interpretation of their personal narratives. As a past member and current partial present member, I hope my identification as a Black woman allowed the young women to feel a level of comfort that they may not have otherwise felt and that it fostered an authentic connection and sharing. I drew on perceived shared experiences to establish social connectedness with them in ways that hopefully increased their level of comfort with sharing their experiences with one another and with me. Through both focus group and individual interview sessions, I also drew on perceived shared experiences and familiarity of context to increase their level of comfort. We each shared stories about family, community, and school experiences that extended beyond the boundaries of the study and interview protocol as these issues were intertwined with both genuine interaction and the phenomenon under

investigation. Though I developed the protocol before the interview, I readily adapted to the rhythm of the interviews and adjusted the order of questions, as needed.

Initially, due to my identifying as a Black girl, I did not think that girls would be as verbal and complete in sharing their thoughts and expressed these concerns to my advisor. Often times, when communicating with someone with whom we feel we share common experiences, we may end comments with statements like "you know what I mean." Since language is so critical to my analysis, this could have impeded the data collection process. Thankfully, I did not find this to be true. The girls were very communicative and, when I needed more information, I would ask, and they obliged.

For me, being a Black girl/woman was an asset during analysis. This dissertation marries culture, race and gender, and mathematics. The experience growing up as a little Black girl learning mathematics in the U.S. context allowed me to make cultural connections in ways that someone without these experiences may not have been able to. I did not worry as much about projecting my own identity onto the girls during analysis due to the fact that I was conducting a poststructural analysis with language as the unit of analysis. The next section delves deeper into data analysis.

Overview of Data Analysis

Within discourse, controlling images construct Black girls and women as particular kinds of individuals signally them into different forms of subjectivity functioning to facilitate knowledges or regimes of truth about individuals and groups of people (Althusser, 1971; Foucault, 1980). As such, my analysis sought to reveal aspects of these controlling images in the girls' talk as language is more than just a reflection of meaning but also evidence of an enactment, rejection, or reconfiguration of narratives and subject positions. The goal is not to offer explanations or

make claims as empirically true. Instead, it is open-ended and relational where the purpose is to uncover the manifold ways people are deploying language and interrogating how discourse even makes spaces for particular words to be used and subject positions to be made available (Shah, 2019; Walshaw, 2001). To this end, in this section, I discuss the analytical methods employed in the dissertation.

A primary goal was to understand better how controlling images of Black girls position them in mathematics learning spaces. Consistent with PRT, this analysis focused on multiple meanings in the personal narratives the girls share (Shah & Leonardo, 2016). I partially relied on the girls to recognize the presence of such images in operation. However, I can analytically discern controlling images operating through cues from the language used in the telling of their personal narratives. Therefore, language signaling gendered, racialized, and gendered-racialized narratives as well as language signaling mathematics learning are the unit of analysis for this study. Though there were 38 passages of data with mentions of various social identity markers (race, gender, class, religion, and sexuality), the number included in the final analysis and findings chapter decreased significantly once narrowed solely to gendered – racialized narratives in the form of controlling images. The data sources most central to the study are both the audio logs as well as stories told during both the individual and focus group interviews.

For the purposes of the study, I was primarily concerned with gendered-racialized narratives in the form of controlling images present in the personal narratives shared by the young women about their experiences learning mathematics (and other STEM subjects). I examined each personal narrative or interaction in the focus group sessions for examples of these narratives. Still, I could not ignore the presence of either gendered narratives or racialized

narratives that emerged across the data corpus. I tagged narratives like those portraying women as nurturers, the racial achievement gap, and "Asians are good at math" that emerged in the data.

I took four passes through the data (audio logs, individual interviews, and focus group interviews) for analysis. During the first pass, I coded for the location or context of the personal narratives that included either explicit or implicit reference to controlling images as the girls tried to make sense of a particular social interaction. I separated the data into two categories: non-mathematics (or STEM) spaces and mathematics (or STEM) spaces. I discuss the former in Chapter 5 and the latter in Chapter 6. I noted whether these were informed by past events as mentioned in the interviews or focus group sessions or whether they happened during the semester and were data generated via audio log. This distinction is important because it speaks to a type of critical consciousness that may have been present before the start of the study or that may have developed during the study.

For the second pass through the data, I specifically attended to the nature of the controlling image. I acknowledged language signaling any of the previously discussed controlling images. When there was no specific controlling image mentioned, I noted how the language of the personal narrative demonstrated an awareness of controlling images, more broadly. This would include instances where the young women spoke about how they were positioned in a particular interaction by either their professor, TA, or peers because this positioning happens at the level of interaction as people draw on cultural narratives (Shah & Leonardo, 2016). During the third pass through the data, I attended to both explicit and implicit references to controlling images and other gendered-racialized narratives.

For the fourth and final pass through the data, I attended to narratives of mathematics learning and doing and examined relationships between those narratives and the gendered-

racialized narratives present in the data. This would include when gendered – racialized narratives were coupled with particular narrative of mathematics learning. For example, I noted if and when the angry Black woman controlling image was paired with narratives of mathematics underperformance. There were 14 passages of data relating various social identity markers to learning experiences in mathematics and other STEM learning spaces, but this narrowed when only gendered-racialized narratives in the form of controlling images were considered. The results of this analysis are the substance of the findings discussed in Chapter 6.

A Note about the Final Outcomes of the Analysis

I realize that I cannot tell stories about these Black girls' mathematical lives that draw neat arrows from controlling images of Black women to their academic choices. I fully recognize that Black girls and women are too varied and not a monolith. Furthermore, history is subjective and causal inferences wholly impossible for constructing such simple narratives. Yet, inspired by Harris-Perry (2011), I contend that it is worth trying to understand the messiness of their human experience in this world that is intimately tied to their emotional, psychological, economic, and political futures. This analysis attempted to do just that.

CHAPTER FIVE: CONTROLLING IMAGES AND THE BLACK GIRL EXPERIENCE

"We understand we are the backbone despite the backhand."
-Mahogany L. Browne, The BreakBeat Poets, Vol. 2: Black Girl Magic

The purpose of this chapter is two-fold. I first seek to establish the girls' awareness and understandings of their position in society as Black girls and then examine their personal narratives that either explicitly or implicitly invoke controlling images. This second expressed purpose addresses one aspect of the first research question guiding this study: What gendered-racialized narratives are implicated in the personal narratives that Black girls tell about their undergraduate mathematics learning experiences? The first set of narratives are representative of social and cultural character. They are the controlling images in the shared cultural air. Whereas the personal narratives are girls' stories shared as a rendering of their personal experiences in the world. This chapter draws on data from both individual and focus group interviews to establish the girls' awareness of these images as they live "in the world." I did not use the voice notes as a data source here because those relate specifically to mathematics and other STEM learning experiences. The latter findings chapter delves more deeply into how controlling images surface in conjunction with discourses of mathematics learning and doing in those spaces. In this chapter, I present the results of my analyses intended to illuminate controlling images of Black women both explicitly and implicitly present in the girls' personal narratives and what they mean for the girls' lives and educational opportunities.

This chapter is organized into four sections. First, I use the data to demonstrate how notions of Black girl otherness seem to be reflected in the girls' thoughts and actions in significant ways. This is demonstrated by the choices that Stella made during one of our focus group sessions. This serves as a prelude to my argument about the presence of controlling images

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- a glimpse into the ways that they operate in the girls' lives. The next section addresses how the

strong Black woman, Matriarch, Angry Black woman, mammy, struggling Black woman, and

Black Girl Magic are represented in the girls' narratives both as controlling images and through

the Black Feminist Thought practice of self-definition. This section includes two subsections

with a more in-depth treatment of two counternarratives – the strong Black woman and Black

Girl Magic. Other controlling images, such as the Jezebel (promiscuous Black women) or the

welfare mother, do not arise from the data. The chapter concludes with a high-level discussion of

the overall findings as they relate to the emergence of and relationship between the girls'

narratives and the controlling images.

Reviewing Controlling Images and Counternarratives

Briefly, I wanted to remind the reader of the controlling images and accompanying

narratives as well as the counter images and counternarratives prevalent in the literature and that

I attended to during analysis. As a reminder, controlling images are the subject positions with

accompanying societal narratives that attempt to control just who Black women are and can be

while counternarratives are Black women's attempt at self-definition.

Table 4 is not intended to be an exhaustive list of the narratives coupled with each of the

controlling images nor was it intended to relay how the narrative was being controlled and by

who. It is meant to be a snapshot of the controlling images for ease of reading and as a reminder

for analytic interpretation.

Table 4. Controlling Images and Counternarratives

Controlling image	Narratives
Mammy	- Ideal black mother - Respects white authority - Teaches her children their place in society - Asexual
Matriarch	- Bad Black mother - Emasculates Black men - Head of household - Not home to raise her children so they are not properly reared - Unfeminine
Welfare mother	- Bad Black mother - Dependent on and exploits state and federal support - Lacks ambitious and does not work outside of the home - Does not teach her children to be ambitious and self-sufficient
Jezebel	- Promiscuous - Sexually aggressive
Angry Black woman	- Nicknamed Sapphire - Sassy, loud, and argumentative - Irrationally angry and verbally abusive
Strong Black Woman	- Ambitious - Community-focused - Hard-working - Caretaker to many - Able to handle unbearable amounts of stress - Persistent - Independent
Black Girl Magic	- Raises the bar and paving the way - Often a "first" (i.e. first Black woman elected President of the Harvard Law Review) - Stylish or Trendsetter - Leader

Establishing Race and Gender as Salient for the Girls

Controlling images are a kind of subject position with a specific set of gendered-racialized narratives. Recognition of these controlling images is increased for those with an orientation towards thinking about the operation of race and gender in society. The purpose of this section is to provide evidence that the girls are thinking about race and gender, more broadly, as it relates to their lives.

I begin with excerpts of data from focus group sessions when all except Lysha were present. I opened the session with an activity called Diversity Toss (Jilk, 2012; Nieto, 2004). The goal of the activity was to spark the girls' thinking about various aspects of their identity (i.e., gender, race, religion) and their meaning-making around these social identity markers. Holding five index cards with their name, race (Black), gender (girl), religion or faith, and a hobby or activity they strongly identify with (examples from the girls - doing hair, DIY, LGBTQ, shopping, reader), the girls were asked if this was a reasonable representation of who they are. They nodded in agreement. I then asked them to eliminate one card by placing it on the table. The specific language that I used was "give one away, put one face down on the table." They each made a choice and placed the first card down without discussion. I asked them to repeat that action twice more while holding only four and then three remaining cards. For the last portion of the activity, they turned to someone sitting near them and asked them to remove one of their final two cards (without knowing what was written on them), leaving each with one card. We debriefed this activity by discussing how the activity made them feel and why. We also discussed the decisions they made for discarding certain cards. For more details about the Diversity Toss activity and the slideshow used to facilitate the focus group session, see Appendix D. The discussion generated the following data.

MC - How did that activity make you feel and why?

Stella - Well, I thought about it like if I was introducing myself to somebody with those cards, what would I not want them to know about me before. Not necessarily like I'm ashamed of it or anything. I would just leave that thing out before any of these other cards.

MC - What were the first two cards you put down and why?

Stella - I put down my race and my gender because that's what people judge you the most on. The rest of it don't really matter like my name and my hobby. And for my religion, people don't really think about that as much…I think about race and gender a lot, not to the extent that other people do.

Nicole - I would say I think about it a lot, especially being a Black woman at a PWI. It's like every day you encounter white people and just different things. It's definitely something that is serious for me. I think about it very frequently.

Stella's responses indicate that Black girls and women are constituted as gendered-racialized subjects with very particular expectations for the kinds of people they are and can be. Stella started by saying that she would eliminate race and gender when meeting someone for the first time because she would not want to be judged by those social identity markers – markers that she perceived she is judged by most. She also added that she is "not ashamed" of her race or gender, just that she would not want to be judged by them. The choice of the word "ashamed" is telling. It connotes that one is embarrassed or guilty based on a certain characterization. This word was used in relation to being a Black girl leading one to believe that there exists narratives about Black women that cause shame – narratives to which Stella felt the need to counter and say that she was, indeed, not ashamed. These actions and her rationale speak to the way that both race and gender, at the intersection, organize Black girls' social lives. Though she mentioned not being "ashamed" of being a Black girl, she demonstrated awareness of how these social identity markers controlled or limited the subject positions available to her – she would not want someone to know these things about her beforehand.

Both Nicole and Stella, who attended predominately Black high schools and wanted to attend HBCUs, responded that they consider race and gender a great deal in their daily lives. Stella's fear is not unwarranted. Studies have shown that assumptions about race, ethnicity, and gender, even when solely based on one's name, have had material consequences for people. This is the case, for example, in hiring practices or for educational opportunities such as teachers' perceptions of who can do mathematics (Bertrand & Mullainathan, 2004; Copur-Gencturk, Cimpian, Lubienski, & Thacker, 2019; Kang, DeCelles, Tilcsik, & Jun, 2016; Moss-Racusin et al., 2012).

There is a history related to the judgment that Stella felt. She is aware, though the degree to which is uncertain, that she lives in a white supremacist patriarchal society. Harris (1982) described the judgment of Black women in an anti-Black, sexist society in a particular way. She wrote,

> "Called Matriarch, Emasculator, and Hot Momma. Sometimes Sister, Pretty Baby, Auntie, Mammy, and Girl. Called Unwed Mother, Welfare Recipient, and Inner-City Consumer. The Black American woman has had to admit that while nobody knew the troubles she saw, everybody, his brother, and his dog, felt qualified to explain her, even to herself" (p. 4).

Harris does two things here. She both names various controlling images associated with being a Black woman in America, and she points out the notion that Black women lack agency in self-defining. I do not intend for Harris's words to explain Stella's actions during the Diversity Toss activity. However, without knowing what would come next in the activity, Stella chose to discard the cards identifying her as Black and as a girl to release herself from the stigma and judgment associated with being a Black girl. "I put down my race and my gender because that's what

people judge you the most on," Stella stated, and Harris provides us with some reasons Stella

might feel this way as controlling images control precisely, in part, by judging. This statement

harkens back to Harris's main sentiments. First, Stella acknowledged judgment akin to the list of

controlling images Harris shared. Second, Stella acknowledged that this judgment is external.

Controlling Images in the Girls' Talk

The following data were also generated in that same focus group session with all present

except Lysha. During this exchange, the girls invoke the strong Black woman, the matriarch, and

the angry Black woman controlling images.

> Nicole - For me to be a black girl or woman is related to being independent and strong. I
> think society see us as aggressive and angry, like a crutch, just like at the bottom of the
> hierarchy.

> *Marie and Miranda nod in agreement.*

> MC - What do you mean when you say a crutch?

> Nicole - We have to hold everyone else up and just wait for our time to come.

> Miranda - The society part of it made me think of angry Black girl stereotypes as just
> kinda loud and aggressive.

In this excerpt of data, Miranda, Nicole, Larry, and Marie call our attention to several prominent

controlling images and counternarratives. Nicole described Black women as independent and

strong, referencing both the matriarch and strong Black woman. The word "independent"

signifies the matriarch. This image was invoked in the Moynihan Report (1965) with the notion

that the Black community and Black family was largely matriarchal with an abundance of

women-led, single-parent homes where the women did not need a man present. They could lead

a household independently. This narrative has also contributed to what some posit is the

emasculation of the Black male. The report blamed working Black mothers for the conditions of

Black families by neglecting their household and child-rearing duties. It casted them as

unfeminine and neglectful of Black men and children. This so-called neglect of children is said to have been a major contributing factor to school failure. This controlling image, then, is intertwined with the debunked narrative of Black communities as culturally deficient and that they "don't care" about their children's education. In no way do narratives associated with the matriarch controlling image implicate the system in the issue that is Black poverty. Notably, that the Moynihan Report did not only serve to reify the matriarch and the welfare mother, but there were also policy implications that encouraged cuts to state and federal aid that assisted Black mothers raising their children and making ends meet (Collins, 2000; Harris-Perry, 2011). Instead of seeing these women as complex and varied, demonstrating strength as they navigate incredibly adverse conditions, it blamed the matriarch for all that was wrong with the Black family and in Black communities (Collins, 2000).

Nicole's contrasting word choices set up an interesting dichotomy. She celebrated the Black girl or woman as "being independent and strong" while asserting how society casts her as aggressive and angry. This dichotomy established independence as a positive trait, unlike that portrayed in the Moynihan report. This trait has been celebrated by Black women in both academia and popular culture for decades. From poems like Maya Angelou's (1994, 1978) *"Phenomenal Woman"* and *"And Still, I Rise"* to songs that became anthems such as *I'm Every Woman* (Ashford & Simpson, 1978) by Chaka Khan in 1978 and remade by Whitney Houston in 1992 and *Superwoman* (Keys, Perry, & Mostyn, 2008) by Alicia Keys in 2008. Beyonce, perhaps, currently has the most popular Black women's empowerment anthems with nearly one song on every album she has ever released. Songs like *Independent Women* (Knowles et. al, 2000) from her time with Destiny's Child, *Diva* (Knowles, Crawford, & Garrett, 2009), *Run the World* (Knowles et. al, 2011*), Formation* (Knowles et. al, 2016), and *Brown Skin Girl* (Knowles

et. al, 2019) all celebrate and promote the strength and independence of Black women to which

Nicole referred. Perhaps I could argue that Nicole was advancing more of a positive framing of

matriarch from within the Black community. Consider Beyoncé's lyrics from *Run the World*,

> This goes out to all the women getting it in. You on your grind.
>
> To all the men that respect what I do, please accept my shine.
>
> Boy you know you love it, how we're smart enough to make these millions.
>
> Strong enough to bear these children, then get back to business.

This paints a picture of Black women that is contrary to that of the Moynihan report. Instead, she

is honored and respected for her ability to both mother and earn. It is not an either/or, but a

both/and.

The angry Black woman controlling image is related to and not wholly separate from the

emasculating matriarch which Nicole also mentioned and to which Marie and Miranda cosigned.

The angry Black woman is the highly emotional instantiation of the matriarch. Her seemingly

high levels of emotionality are said to have stemmed from the "Black marriage crisis" where

Black women were unwilling to be submissive to their Black male spouses (Harris, 2015). This

emotionality, however, could also materialize or be directed towards whiteness and white

supremacist patriarchy for her position in society. The angry Black woman controlling image is

an attack on the notion of Black women as feminine, as anger is understood as a masculine

performance. This controlling image characterizes Black women as loud, argumentative,

irrationally angry, and verbally abusive. Both Michelle Obama and Maxine Waters, to name a

few, have been inflicted with this label (Harris-Perry, 2011). As Collins (2000) writes that,

instead of concretizing women in oppressive ways, Black women intellectuals "instead portray

African-American mothers as complex individuals who often show tremendous strength under

adverse conditions, or who become beaten down by the incessant demands of providing for their families" (p. 75-76). That is to say, Black women intellectuals demonstrate empathy and resist the dehumanization of Black women by these controlling images. Unfortunately, such narratives are stubborn and persistent, hence their presence in the girls' narratives.

The words that people choose in their narrations are not arbitrary. They index broader familiar narratives and ways of understanding the world. This is what makes Nicole's crutch analogy particularly revealing. A crutch refers to the offering of support or assistance. For many, a crutch is a physical object used to support someone who is lame, weakened, or hurt. However, Nicole's use of the word is not one of a physical object, but of how Black women are used to support, assist, or "hold everyone else up" whereby those needed her are lame, weakened, or hurt, perhaps even including the Black man she is said to emasculate. This puts her in the precarious position of becoming a psychological crutch for those who may become unhealthily dependent on her. Just as with a physical crutch, people can over-rely on a crutch, which not only delays healing or recovery but also delays the independence of the Black woman. All the while, the systems and structures responsible for these disabling conditions continue to churn necessitating even more need for crutches. As Nicole continued, Black women just have to "wait for our time to come." This waiting signifies the Black woman as secure, patient, and forbearing as with the strong Black woman counternarrative.

Malcolm X (1962) famously orated, "The most disrespected person in America is the black woman. The most unprotected person in America is the Black woman. The most neglected person in America is the Black woman." With this belief about the position of the Black woman in American society, Nicole's choice of the word "crutch" is even more striking. It leaves one to try and reconcile how those at the "bottom of the well" (Bell, 1992) or lowest rung on the ladder

can be simultaneously positioned as the ones primarily providing support. When Nicole said,

"hold everyone else up," it is crucial to consider who the "everyone else" is. Is she referring to

Black men, Black children, other Black women? Could she be referring to white men, women,

and children as many Black women did as domestic workers in white homes? Both of these

considerations map directly onto both the strong Black woman and the matriarch. Crutches must

be strong and stable in order to provide the needed support similar to the matriarch (Collins,

2000). Though the Black woman's work should be respected, this image of a crutch signals all

that she is, just as X orated, disrespected, unprotected, and her needs neglected.

     In a continuation of the conversation above, Larry offered a critical nuanced view or

observation. She said,

> "I think adding on to that like being a member of the LGBTQ community, people
>
> expect you to act a certain way because my friend said "sometimes I think you're
>
> confused", you know when I dress feminine because I basically dress masculine all the
>
> time. She'd say, "you don't know what you want to do." I think that is a part of how
>
> society expects Black girls to act in a certain way.

Larry complexified the landscape even more with the introduction of sexuality. It is unclear

whether she foregrounded controlling images of Black girl-ness or queer Black girl-ness. Her

comment is in direct response to Miranda's comment about the angry Black woman stereotype as

indicated by her words, "added on to that." It appears that she did not see her perspective or

version of Black girl-ness as a queer Black girl characterized in the images previously set forth.

One could argue that the aforementioned controlling images exist in stark contrast to notions of

white middle-class femininity, and that they all assume heteronormativity (Collins, 2000). Larry's

comments help us see this heterosexism at play as she illuminated the intersectionality of race,

gender, and sexuality. It highlights the contradictions inherent in holding and trying to understand the controlling images altogether. The images continually play on performances of femininity while also imposing contrasts of the unfeminine and the masculine.

The Strong Black Woman

One of the first questions I asked everyone in the first individual semi-structured interview was "what does it mean to be a Black girl?". The girls' responses varied, but this question proved key to surfacing some controlling images prevalent for them. Marie, an Arts and Humanities major, replied:

"So to be a Black girl just means, I don't want to say it means that I'm going to automatically have more struggles, but it kinda does, and I hate that that's the first thing that I think about, but it's just kind of a reality. I feel like I have these two marks against me. I'm Black and I'm a girl and society, in general, has this view of Black girls not really belonging in a lot of places. Like there's a select few areas we are allowed to be in. For me, it means that I have to carry myself in a certain way. I have to dress myself in a certain way. Talk in a certain way. I have to basically change who I am just so that I can be successful in this world. But at the same time, I have to figure out how to not always hide who I am so that I can break that stigma down. So, it's very...it's a tough line to walk, but I'm going to walk it. There's a strength in being a Black woman. Not necessarily because we automatically struggle, but we're just a strong group of people. We're strong as Black women, and we stand together, and I kinda love that about being a Black girl."

While all responded to this question, Marie's response embodied many of the issues of identifying as a Black girl and the subject positions imposed as controlling images and those that

are either taken up or rejected through the girls' agency. She said, "I have to carry myself in a certain way. I have to dress myself in a certain way. Talk in a certain way." This "certain way" is reminiscent of Larry's earlier comments relating to queerness. What is this "certain way"? Who determines this "certain way"?

Specifically, Marie's narrative included indications of many narratives related to Black women, such as struggle or hardship, as well as strength as characteristics. These reflect the controlling images of Black women as strong, but also introduce the idea of the struggling Black woman emerging from the conditions of Black women's lived reality. Marie connected this identification with struggling as a lived reality with no escape. In essence, it is just a constant toeing of the line to either belong in spaces or to dutifully fight to make a place for herself in those spaces as an example of rejecting the subject position made available to her. Her stating, "I hate that that's the first thing that I think about, but it's just kind of a reality" indicates this.

Partway through the statement, Marie says that she felt compelled to change who she is just to be successful while also trying to stay true to herself and her Black girl-ness. This statement revealed the conundrum that Black girls find themselves in as they perceive that they are limited in their movement through spaces. From a psychological perspective, one could argue that what Marie has put forth is just her perception and not an actual limitation of her ability to move through certain spaces and that this limitation is psychological whether or not it is actually one in social practice. A poststructuralist would reply that whether or not the limitation is real or perceived is beside the point. The discursive formations make the limitation true and real.

For Marie, the options were minimal. She could either identify as a Black girl and reject the subject positions available to her or she could acquiesce or "change" who she is to behave in ways that make her Black girl-ness more acceptable. In this case, "more acceptable" would mean

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to subscribe to performances of white femininity. This was evident in another statement Marie made later in the interview about Black women going to job interviews. She said, "Oh my God, how am I going to style my hair? Who gets to determine what is professional? Is the braid professional? Is a flat twist? Is a fro?". Though braids, flat twists, and afros ("fro") are all hairstyles widely worn by Black girls, the "professional" space is one where there is a clash between these cultural expressions in ways that are favorable for some and not so for others. Marie is capturing discrimination and control that reflects years of anti-Black hair discrimination and control that had become so overwhelming that laws and policies were passed to protect Black women's hair such as the 2019 CROWN (Create a Respectful and Open Workplace for Natural Hair) Act of California and the 2019 NYC Commission on Human Rights Legal Enforcement Guidance on Race Discrimination on the Basis of Hair. This is, yet, another way that Collins (2000) addresses how controlling images permeate standards of beauty and highlights an instance where self-definition and normalized treatment are amplified, making controlling images more visible. Hegemonic in nature, these taken-for-granted controlling images are inescapable (Collins, 2000).

Miranda also embraced the strong Black woman narrative in her interview exclaiming, "oh my gosh, honestly, we are the strongest people, like even my mom and my grandma and all these figures in my life, even myself. Like how intelligent and resilient we are. We are so strong because we deal with all this stuff that people don't even realize, and we're always just trying to be that person in people's lives that is strong". Notice how Miranda connected being strong with having to "deal with all this stuff." She, too, noticed the salient connection between strength amid struggle, which connects directly to Nicole's notion of Black women as a crutch.

Larry invoked the "strong Black woman" and the struggling Black woman, but she also invoked the matriarch. When asked about what it means to be a Black girl, she replied:

"I don't know, strong because you got to like rise above it all. Because my momma, like, she's a single momma, you know, maybe I should say single mom. So you know, she gotta pay the bills, you know, gotta put food on the table and then it's just like, I don't really think about, you know, my daddy because I really don't feel like I have one…So I feel like, you know, you have to be real strong and patient. And then like around white people, you know, you gotta be strong and patient, and you also got to be observant".

Larry described her mother as having to "rise above it all." She goes on to describe the many responsibilities that she had primarily due to her being the solely present parent for her and her little brother. However, as she described the situation, she also invoked the matriarch – as she spoke about how her mother had to do it all in her father's absence (Coates, 2015; Sewell, 2013). The absence of her father was a factor in the struggle that her mother experienced.

The girls often invoked the strong Black woman controlling image both to deal with the hardships of being a Black woman and as a counternarrative to less palatable characterizations. Here, Larry invoked it in an attempt to counter societal hierarchies based on gender, race, and class. The use of the narrative in this way, however, should be examined as the strong Black woman narrative can behave similarly to the "Asians are good at math" narrative (Shah, 2019), denying Black women their claim to the full range of experiences and personhood. This narrative, as widely accepted by many Black women, causes concern about the social and psychological implications of always being strong or with treating strength as a sort of inborn trait specific to Black women. The need to always be strong can have a silencing effect such that Black women refrain from voicing when they need help (Donovan & West, 2015; Harris-Perry,

2011; Stanton, Jerald, Ward, & Avery, 2017). Like the "Asians are good at math narrative," this narrative is elusive as it does not operate from a position of deficiency, but one of surplus, treating the black woman (in this instance) not as subhuman, but as superhuman leaving no room to address the real, material circumstances creating the need for her to be strong in the first place (Harris-Perry, 2011; Shah, 2019).

This notion that identifying as a Black girl is synonymous with struggling was prevalent in other responses as well. Stella, an engineering major, said being a Black girl "means I have to work twice as hard to get anything that I need or that I want." Nicole, in a separate interview, echoed this sentiment, saying that it means "being able to accept the fact that you have to work ten times harder than others to get to where you want to go." Similarly, Tiffany felt like Black girls "would have to do more to be noticed."

Both Stella and Nicole used language consistent with a popular storyline in the Black community. One of the most famous scenes from the hit television show, *Scandal*, created by Shonda Rhimes and starring Kerry Washington, included this narrative. In an October 2013 episode, Rowan Pope, the father of Washington's character Olivia Pope beckons her to recall the mantra he had instilled in her from a very young age that she has "to be twice as good as them to get half of what they have" where it is clear that "them" and "they" are white people. Elsewhere, in *Master of None* (Srubshchik, 2015), a Netflix comedy-drama television series, Catherine, portrayed by Angela Bassett, tells two children that "a minority is a group of people who have to work twice as hard in life to get half as far." Then Catherine turns to the little girl and says, "you're a black woman so that means you gone have to work three times as hard." The narrative is widespread with deep roots so much so that both Barack and Michelle Obama have shared this sentiment in speeches.

This is an example of a racialized narrative that has been amplified as the gendered element is incorporated. Working twice as hard to get half as far is a narrative thought to pertain to all Black youth, boys and girls alike. What is particularly interesting is the additional struggle thought to be inherited by those identifying as Black girls. The issue here is not that Black children have been summoned for decades to work hard and persevere. Instead, it is that hard work without institutional shifts away from anti-Black and misogynoiristic (Bailey & Trudy, 2018) policies and practices will not serve to improve conditions and access to resources. Furthermore, such adages continue to reify the strong Black woman representation as the girls often coupled strength with overcoming struggle.

Curiously, Larry ended her statement by saying "And then like around white people, you know, you gotta be strong and patient, and you also got to be *observant*." The use of the phrase "around white people" and the word "observant" stood out. Why observant, and what controlling image does this word signify? It could mean that one must watch for danger or threat. It could also mean that one must observe others and mimic their actions as not to stand out or draw attention to oneself. From my experience, this call to be observant or keenly aware is related to distrust of whiteness.

My single mother taught us to answer white people's questions with as few details as possible because she feared what they would do with too much information. This applied to teachers, visitors to our home (which often were not white, so if they were something "special" was happening), or someone who "talked white" when we answered the phone. It was my mother's experience that whites lacked nuance for understanding the circumstances of our lived realities. Their attempts to uphold the rules and policies often caused more harm than good. For example, my mother would have probably been characterized as a welfare mother. She was un-

married and did not work outside of the home. We survived on public assistance. Our housing was secured by the Section 8 voucher program through the Department of Housing and Urban Development (HUD). This arrangement came with rules for who could and could not occupy the residence. If my sister was abused by her boyfriend and came to live with us or if my three nieces moved in when my brother was strung out on drugs, this was considered a violation of the HUD rules potentially jeopardizing housing for everyone. Therefore, we were taught at an early age to observe white people and answer their questions about our family with caution.

All considered, Larry's use of the word "observant" most invokes a complex configuration of the matriarch, welfare mother, and the strong Black woman. Larry does not mention whether or not her mother worked outside of the home. She only said she needed to pay bills and put food on the table. What is clear is that these two Black mothers taught their children about whiteness and the detriments associated with whiteness for Black families.

Self-definition, Black Girl Magic, and Social Media

Collins (2000) noted that media heightens the presence and circulation of controlling images of Black women. This increase in visibility was noted previously in the portrayal of the angry Black woman by characters like Sapphire from *Amos 'N Andy* and Cookie from *Empire*. With the rise in social media, the increase in circulation has been multiplied. In an interview, Nicole stated that social media "has a big influence on how a lot of Black girls think they should look or how they should act or who they should be as a person." Additionally, on two separate occasions, Miranda expressed her concerns about the role of social media and its impact on her as a Black girl. She said, "especially in social media when they portray Black women as unintelligent and not being able to stand on our own two feet. Just seeing that breaks my heart." Both of these quotes demonstrate the role of media in the perpetuation of negative controlling

images of Black girls and women. Social media has, however, more recently been used to the counternarrative that is Black Girl Magic.

In the latest effort to self-define, Black women have employed social media to spread the celebratory power of Black Girl Magic. As a counternarrative, it was created to counter the otherwise negative narratives about Black girls and women that circulate via social media to harm and aid in sustaining their oppression (Collins, 2000). This more recent counternarrative emerged in Stella's statement about what it means to be a Black girl. "The good thing about being a Black girl, I would say that people, well not that people envy you, but they would be like she's doing what she needs to do. Look at what she has, that 'Black Girl Magic,'" Stella stated. It is akin to the "strong Black woman" also functioning as a counternarrative to the more deleterious controlling images of the mammy, matriarch, welfare mother, and angry Black woman. Notably, the "girl" is used instead of "woman" which is likely associated with millennial-driven social media as opposed to the older generation.

A social media hashtag is primarily responsible for sustaining the presence of this more recent instantiation of the strong Black woman. It has made its way into academic literature about Black women's lived experiences in the areas of mental health and well-being as well as in education research (Hall, 2017; Morton & Parsons, 2018; Smith, 2016; Walton & Oyewuwo-Gassikia, 2017). #BlackGirlMagic is generally used on social media posts when Black girls or women are recognized in spaces not usually occupied by Black women or as a means to celebrate various accomplishments of Black girls and women. For example, in 2016, *Essence Magazine*, a popular publication established in 1970 that caters to Black women, regularly features the accomplishments of Black girls and women with a "Black Girl Magic" segment of each issue.

Dotson (2013) might argue that this notion of Black Girl Magic is reductive, only celebrating Black girls' and women's accomplishments in white spaces and through the white gaze. Instead, she favors the occupation of a positive, socio-epistemic space is central to Black girls and women's liberation. For some Black girls and women, the use of the Black Girl Magic hastag is not soley for celebrations of accomplishments in white spaces, but is more about being a safe space where "Black girls' and women's experiences are centered, knowable, and legitimated for their own sake" and Black girls and women can exist outside of the white gaze (Gholson, 2016, p. 296).

According to Ladson-Billings (2017), Black Girl Magic is in the everyday, mundane accomplishments of hard-working Black women who put food on the table, keep the bills paid, and maintain their dignity in a society that continually devalues and despises them or renders them invisible. For Ladson-Billings, "magic" is simply insufficient. Strong, smart, brave, resilient, capable are a better collection of adjectives for Black women as they fight on the front lines in social justice efforts despite their circumstances. The portrayal of Black Girl Magic put forth by Ladson-Billings does not differ greatly from that of the strong Black woman. What Stella posited and identified as Black Girl Magic indicated a quality that moved beyond the ordinary into the extraordinary or supernatural. Whether the strong Black woman and Black Girl Magic are equivalent or not is up for debate. What is firm, however, is the existence of and insistence on Black women self-defining. As Collins (2000) states, "by insisting on self-definition, Black women question not only what has been said about African-American women but the credibility and the intentions of those possessing the power to define. When Black women define ourselves, we clearly reject the assumption that those in the positions granting them the authority to interpret our reality are entitled to do so. Regardless of the actual content of

Black women's self-definitions, the act of insisting on Black female self-definition validates Black women's power as human subjects" (p. 114). Self-definition is Black women's way of regaining control of the narrative so that they no longer have to try to find a way to stand up straight in a crooked room. Whether it be the strong Black woman that the girls see in their mothers or the Black Girl Magic they see in themselves, the most important thing is that others embrace these counter narratives charting the way for a more liberatory gendered-racialized discourse to emerge.

Chapter Discussion

This chapter sought to find what controlling images were implicated in Black girls' personal narratives. I establish both the girls' awareness and sense-making around their position in society as Black girls and examine the ways their personal narratives either explicitly or implicitly invoke controlling images. This final section summarizes the key findings, including a discussion of the controlling images and counternarratives that emerged in the girls' talk as well as the relationship between them.

Only a few of the controlling and counter images from the literature were explicitly or implicitly referenced by the girls' talk in the data: the matriarch, welfare mother, angry Black woman, strong Black woman, and Black Girl Magic. From my analysis, there were no invocations of the mammy or the jezebel. Broadly, the girls' narratives demonstrated the presence of these controlling images about Black girls and women that influence their internal sense of self and the external gaze of others. I argue that a previously undocumented image emerged – the struggling Black woman – and also featured prominently in the girls' talk in connection with their sense-making. Though the struggling Black woman is not explicitly named in academic literature or popular commentary, it is not new. It is merely an instantiation of the

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lived reality of Black women and their position at the bottom of the social hierarchy. This image is coupled with a narrative about how hard the struggling Black woman must work to earn a fraction of what her white counterparts earn. Relatedly, the struggling Black woman is intimately connected to the strong Black woman and Black Girl Magic in fact, that the struggling Black woman seems to lead to the existence of those counter images.

I contemplated designating the struggling Black woman as a controlling image but decided against that designation because the narrative that accompanies the image does not serve to control. It is more explanatory and seeks to more accurately portray Black women's lived realities. It counters more deficit narratives of Black women. Chimamanda Ngozi Adichie (2009) speaks about this notion of "secondly". In *The Danger of a Single Story*, Chimamanda Ngozi Adichie states,

> Power is the ability not just to tell the story of another person, but to make it
>
> the definitive story of that person. The Palestinian poet Mourid Barghouti
>
> writes that if you want to dispossess a people, the simplest way to do it is to tell
>
> their story and to start with, "secondly." Start the story with the arrows of the
>
> Native Americans, and not with the arrival of the British, and you have an
>
> entirely different story. Start the story with the failure of the African state, and
>
> not with the colonial creation of the African state, and you have an entirely
>
> different story.

As it relates to the struggling Black woman, I asked whether her narratives mirrored the story of the Native arrows or that of the British arrival; that of the failure of the African state or that of colonization. I argue that the struggling Black woman's narrative is more a part of the creation of a more complete story than it serves to distort the story. The struggling Black woman correlates

with the strong Black woman and Black Girl Magic in that, they are often mentioned relationally. In my view, the appearance of this new counter image and its relationship to the strong Black woman or Black Girl Magic is the most notable finding.

The struggling Black woman acknowledges the necessity to be strong against imperialist white supremacist capitalist patriarchy or to be strong as something (a crutch) or for someone (Black men and children). I do wonder about the word "struggle". This word could denote being bogged down, overwhelmed, or feeling inadequate to meet the demands of life. This version of struggling requires an acceptance of Black girl humanity and action should be taken to make sure her needs are met and that she has the resources necessary to overcome such struggle. In that way, she grounds the strong Black woman and Black Girl Magic. They exist because she needs them, but changes need to be made so that all three are can be replaced, perhaps, but Black women living out their lives through the fullest manifestation of humanity.

In the next chapter, I turn my attention to controlling images and their appearance in mathematics and STEM learning spaces. The goal of chapter 6 is to identify if the same controlling images from this chapter emerge during mathematics and other STEM learning spaces as well as to examine the interaction between those controlling images and narratives of mathematics learning.

CHAPTER SIX: WHEN CONTROLLING IMAGES AND MATHEMATICS COLLIDE

I began framing this study with an excerpt from *Citizen: An American Lyric* by Claudia Rankin. This chapter chronicles similar experiences by the young Black women in the study, though not tennis, but STEM learning spaces serve as the "sharp white background." The line originated by Zora Neale Hurston (1928), but used by Rankine in *Citizen*, the line "I feel most colored when I am thrown against a sharp white background" offers an appropriate framing for analysis. Narratives of Black girl-ness collides with mathematics learning in ways that elucidate the phenomenal realities of doing mathematics while a Black girl.

In the previous chapter, I argued that, through their personal narratives, the girls expressed an awareness of their position on the lowest rungs of the ladder in American society. Furthermore, they connected this positionality to the controlling images of Black women in non-STEM learning contexts or, as Marie liked to say, "just as a Black girl in the world." There was evidence of both controlling and counter images present in their personal narratives as well as connections between them. There was also evidence the implications for the girls' lives and educational opportunities, broadly. The data in chapter five were reflective (not present time) as the young women recalled experiences from childhood through high school. Across that chapter, racialized-gendered subjectification and controlling images emerged as central to the girls' sense-making of self and Black women as a whole.

This chapter offers two new contributions. First, there are data analyzed that, while still reflective, were generated during the spring 2019 semester; therefore it is no longer a reflection of past experiences, but almost immediate reflections of experiences as they occurred in the girls' current mathematics and STEM learning environments. This type of data is possible by the use of the "Issa Moments" voice notes that allowed access to this phenomenon as it is experienced in

the girls' lives. Secondly, these data are of experiences that all occur in mathematics (or STEM) learning spaces. Though I primarily focused on mathematics with the girls, they often conflated mathematics with other STEM disciplines with similar discourses. It is this second contribution that shifts the data analysis from a sole focus on controlling images to one of the interaction between them with narratives of mathematics learning and doing. As a result, this chapter more closely addresses both research questions: 1) What controlling images are implicated in the personal narratives that Black girls tell about their undergraduate mathematics learning experiences? Moreover, 2) How do these personal narratives about the mathematics learning experiences help us understand the interactions between the controlling images and narratives of mathematics learning for Black girls?

This chapter is organized by previously mentioned controlling images and those that have emerged in the data as being distinct in mathematics or STEM learning spaces. The first discusses the finding that is the struggling Black woman in the mathematics learning context. I discuss the "struggling Black woman" and the various meanings the word struggle connotes in its interaction with mathematics learning narratives. The second finding two new controlling images that emerge in mathematics and STEM learning spaces – the doubting Black girl and the wrong Black girl. These images are continually subjected to marginalization and invisibilization during mathematics and STEM group work.

The Struggle is (un)real: A Reimagination of the Struggling Black girl

Just as in the previous chapter, this theme of struggling continued to be prominent in the girls' narratives with this notion of "struggling" taking on varied meanings as it interacts with mathematics learning narratives. It could refer to low mathematics performance, persevering in

learning content, or resisting marginalization. The goal here is to understand how narratives of mathematics learning shape the meaning of the word "struggling" or "struggle" for Black girls.

Zina's Struggle

During a focus group session, Nicole stated, "I think they had a passion (for STEM). Even with the way they were getting treated, I mean, no one would want to go to work and get treated like that." Nicole is referring to the callous treatment of the women working for NASA and the experiences chronicled in *Hidden Figures*. In other words, the film chronicles the struggles the women experienced. She conveyed struggling as resistance to marginalization the primary image of Black women in STEM. It is not altogether evident that this struggling Black woman is different from that of the previous chapter. However, when one considers mathematics learning narratives, the struggling Black woman takes on a different form. Consider one of Stella's voice notes where she said,

> "So today I just wanted to talk about, not necessarily my own experience, but what I've seen in my class with other Black girls. There's this one girl in my class named Zina (a pseudonym), and she gets confused pretty often. We work in groups sometimes, and I sometimes help her out. But the way that our TA answers questions, it's like he doesn't really help her when she needs help. I understand that he's a TA and all, but he doesn't necessarily help her in the way that she should be helped. I feel like she has to go the extra mile versus anybody else in the class who isn't understanding just like her."

Being good at mathematics means one does not need to ask questions and to ask questions contests belonging in the space. Zina's confusion places her on the deficit side of the binaries in mathematics learning. She is slow instead of fast at grasping the concepts (Horn, 2007). She is a dependent rather than an independent mathematics learner (Mendick, 2005). Stella's language

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conveyed narratives of mathematics learning characterizing Zina as a struggling mathematics learner (Foote, 2008).

However, Stella makes a statement that conveys that there is more to the story. She said, "I feel like she has to go the extra mile versus anybody else in the class who isn't understanding just like her." Initially, Stella mentions that the teaching assistant does not take the time to assist Zina and provide her with what she needs. From my experience, this is typical of a higher-level mathematics course. If a student is having difficulty with the material, teachers often assume that they should have been placed in a lower level course and that it is not their obligation to help them. As Horn (2007) found, mathematics teachers use particular language when discussing "a mismatch of students' perceived abilities and the intended school curriculum" (p. 37). Yet, Stella's voice note goes further. First, she used language consistent with the narratives of the struggling Black woman – "she has to go the extra mile versus anybody else." This is similar to "working twice as hard to get half as much". Stella then qualifies the "anybody else" as those whose understanding is similar to Zina's or others also constituted as struggling mathematics learners. Zina's (in her Black girl body) needs as a mathematics learner are not being met with the vigor as other students with the same level of understanding. This is particularly egregious because students are paying tuition to attend this institution. It appears as if Zina's money is not purchasing the same quality of education.

The notion of what it means to be a struggling mathematics learner – needing to ask for clarification, not answering or understanding as quickly as others, not working and producing mathematical knowledge independent of others – constitutes Zina, in her Black girl body, as a struggling Black woman in this setting. From this, I deduce that struggle has duel meaning for Zina as both a Black girl and a mathematics learner. Her low mathematics performance and

perseverance to learn resulting in her also needing to resist marginalization as a struggling

mathematics learner in a Black girl body. Other scholars have found that there are both

psychological and material consequences for Black girls who learn mathematics in ways that are

inconsistent with these narrow conceptions of what it means to be a good at mathematics

(Campbell, 2012; Copur-Gencturk, Cimpian, Lubienski, & Thacker, 2019; Jones, 2003; Lim,

2008). In this data, it is narratives of mathematics learning that make it possible for Zina to both

struggle with learning mathematics and, consequently, struggle to resist marginalization.

Stella's Struggle

In another voice note, Stella tried, again, to make sense of the notion of struggle and

Black women learning mathematics. She said,

> "I just wanted to talk about how - well we were talking about how we struggle in math as
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> Black women, and I was just thinking about this earlier how I had a quiz that I didn't study
>
> for because usually, I don't have a problem in math. I don't usually need to study for our
>
> quizzes or anything. And today I took this four-question quiz, and I forgot how to do the
>
> problems so that basically cost me the grade on my quiz because I usually feel like I don't
>
> have to do much, but then that just shows me how much extra you do have to do to pass or
>
> to even, like, get by. You can't just slack around and expect to know it."

This is another case of competing narratives about Black women and mathematics learning.

Stella invoked the narrative that those who are good at mathematics do not need to study. This is

a particular kind of gendered and racialized mathematical narrative, being "good at math" – one

that is typically reserved for white and Asian males (Hottinger, 2016; Mendick, 2006; Shah,

2017; 2019; Walkerdine, 1998). Simultaneously, she invoked the struggling Black woman. My

interest lies in the interplay of these two and how mathematics learning and the image of Black women shape one another.

Stella said, "I don't have a problem in math. I don't usually need to study for our quizzes or anything". This statement could be read as both "I'm good at math" or "I got that Black Girl Magic with math." In a previous interview, Stella did describe herself as being "good at math." While Stella challenged the notion that this narrative is reserved for those with a particular identification, she does not challenge the notion that being good at mathematics is innate (Sole, 2019). She endorsed this dominant narrative of mathematics learning. She took up the subject position of being a "math person," believing that her abilities are innate and taking pride in not having to study. She also stated, "that just shows me how much extra you do have to do to pass or to even, like, get by." The "you" in that quote refers to Black girls and women. Interestingly, narratives of the struggling Black woman intersect with Stella's conception of what it means to be good at mathematics. If one is good at mathematics, then they do not have to study, but when one is good at mathematics AND a Black woman, they do.

Another viable possibility for Stella would have been to, instead, endorse narratives of mathematics learning and Black girl being that were more compatible. Does what Stella put forth as a rationale, somehow, repudiate Black Girl Magic? For example, most are comfortable with, accepting of, and conflate narratives of the debunked notions of being a "math person" and the innateness of mathematical intelligence. Magic is related to supernatural forces, making something happen that cannot otherwise be explained. Magic in the context of mathematics, one could argue, means having an innate ability that manifests in acing a test without studying. Stella could have put forth Black Girl Magic in conjunction with being a "math person." Instead, she kept the notion of mathematics ability as innate intact while reaching for the struggling Black

woman instead of Black Girl Magic. What would need to happen for Stella to understand that those who are "good at math" are so because they practice the discipline? And what would it take for folks to more readily invoke the strong Black woman or Black Girl Magic instead of other controlling images in mathematics learning spaces?

Overall, this first part of the chapter finds the struggling Black woman featuring prominently in Stella's talk. In keeping with the earlier metaphor, the struggling Black woman has a reserved seat at the table in the mathematics classroom. And when the struggling mathematics learner is also a Black girl, she becomes a struggling Black woman fighting for the recognition and resources she needs to learn mathematics. As it turns out, even when a Black girl considers herself to be good at mathematics, her talk features narratives of the struggling Black woman and of the innateness of mathematics ability. Even when Black Girl Magic narratives are more compatible with being good at mathematics, this image is not invoked. I wonder if she appears when Stella does well on assessments.

No (Black) Girls Allowed: STEM Learning, the Mammy, and the Strong Black Woman

As a reminder, according to Collins (2000), the mammy "symbolizes the dominant group's perceptions of the ideal Black female relationship to elite White male power" (p. 72). She knows her place, is obedient, and has accepted this subordinate position. The mammy even preferred this subordinated position counting herself fortunate to work for her white family (Sewell, 2013). Contrarily, the strong Black woman is the notion of Black women as "motivating, hardworking breadwinners who suppress their emotional needs while anticipating those of others" (Harris-Perry, 2011, p. 184). Both the strong Black woman and Black Girl Magic connote ambition.

The following excerpts of data provoke discussion about the mammy, strong Black woman, and Black Girl Magic in STEM learning spaces. First, I attend to how both Marie and Lysha read the race-gender composition of STEM spaces as well as interactions with the counselors as text– text that reflects the mammy image, knowing her place, and is happy to stay in it without a fuss and that refuses the ambition of the strong Black woman and Black Girl Magic. I then attend to Tiffany's voice note for which mathematics learning practices, such as working problems out at the board, become discursive.

The Mammy and Mathematics Learning

The following exchange took place during a focus group session:

Marie - One of the reasons I never enjoyed STEM is because I felt like there weren't other people like me in those spaces. I almost felt like there was a little sign up that says, "you're not allowed." We weren't really encouraged, like Black girls, to go into this field and that pushed me away from it even more. I think that I didn't go into STEM because of it.

MC - It's interesting that you said there's this invisible sign. Say more about that. What were some of those triggers? What are some of the things that were happening that made you feel like that? What are some of the things that you feel like tell you that Black girls and women don't belong in STEM?

Marie - Like in high school, you could tell that the way that counselors helped you, they would talk to white kids versus Black kids differently. They would recommend more advanced classes, like AP classes, to white kids. And for Black kids, more specifically Black girls, we were just told to stay in our place, like stay in the easy classes. Don't try to set yourself up for success. Just know your role.

Lysha - I think in the movie when she was trying to get into the conference so she could get the data, and they were like "there's no protocol for a woman to be in here." I feel like it's still like that today. Basically, when looking at engineering and stuff, it's basically like just white men in those fields. It's very rare that you see people of color in those types of fields, so you kinda get this thing like, maybe that's not for me. I don't see nobody else doing it, so I don't think it's for me. You get that, though.

Across this exchange, the girls expressed several narratives of who does STEM and who belongs in STEM spaces. They both mention not being encouraged to pursue STEM and Marie

explicitly acknowledged the lack of representation of Black women in STEM as a signifier that they do not belong there. While Marie read the racial and gender composition of the STEM spaces as discursive, Lysha connected "this thing" to a scene from *Hidden Figures*. Marie used particularly strong language likening STEM spaces to those with a "you're not allowed" sign harkening cultural images of a boy's treehouse with a crooked "No Girls Allowed" sign hanging on the door. Though the "you're" in this expression refers to Black girls and women. This invokes the mammy where Black girls should know their place and mathematics learning spaces is not it.
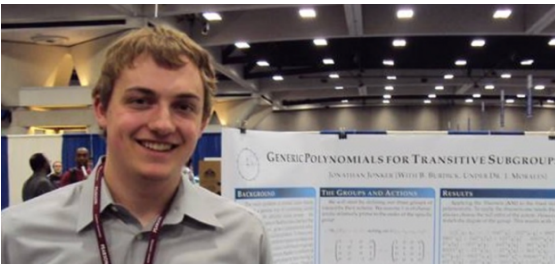
Additionally, the university's undergraduate webpage contains images illustrative of Marie's main point. Consider the series of images that scroll across the main page. Each image (Figure 8 through Figure 15) communicates definite ideas about what undergraduate mathematics learning is like and who does it is at this university. I do not intend to do a full analysis of these images, but only to assert that these images serve the discursive purpose of constructing undergraduate mathematics as a predominately white and Asian male space where white men display knowledge on chalk boards. Notice that in every photo where someone is demonstrating what they know in the front of the room or on the board, it is a white man. Both women and people of color, except for Asian students, are notably absent. There is one photo that includes a Black girl, and she appears on the periphery. If this is the mathematics learning space that Marie and the girls inhabit, it is no wonder they felt that there is an invisible sign. I argue that the signs are highly visible.

Figure 8[2]. Undergraduate mathematic lecture
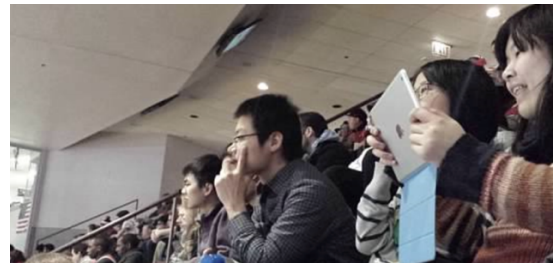

Figure 9. Undergraduate mathematics research

Figure 10. Undergraduate mathematics students

Figure 11. Undergraduate mathematics student gathering

Figure 12. Undergraduate mathematics tutoring center

Figure 13. Undergraduate mathematics classroom

Figure 14. Undergraduate mathematics lecture

Figure 15. Undergraduate mathematics students

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[2] Citation for Figures 8 through 15 MSU Undergraduate Mathematics webpage. (n.d.). Retrieved from http://math.msu.edu/undergraduate/

Lysha further supported this notion of a "No (Black) girls allowed" sign by mentioning the scene in *Hidden Figures* where there was "no protocol" for women to attend the NASA data meeting. For Lysha, this was another indication that Black women did not belong in important STEM spaces. If there is no protocol for attendance, then there was never an intention for their presence. There was no policy, no physical sign, rule, or law stating so. However, the lack of a policy for inclusion communicated one's place as a Black girl in STEM spaces.

Marie's discussion about high school counselors and recommendations is another site for examination. The strong Black woman and Black Girl Magic are controlling images that connote ambition. One interpretation of Marie's narrative is that the counselors, as gatekeepers to advanced STEM, are not deploying controlling images that position Black women as ambitious and, thereby, not actively recommending advanced classes or, worse yet, dissuading Black girls from taking those courses. Narratives of mathematics learning embrace the notion that mathematics courses are sequential and that one cannot be successful in a course unless they have completed a prerequisite. Even more so for advanced mathematics learning and classes reserved for "honors" or "gifted" students, narratives of being a "math person" are elevated. In this way, counselors are not taking up and employing narratives consistent with Black Girl Magic or the strong Black woman, and by doing so, they are also not positioning Black girls as "good at math."

A Black Woman's Place and the Chalkboard

Controlling images of Black women are implicit in the passages of data mentioned above. As previously argued, there are aspects of the mammy image at work to limit Black women's participation and prepare space for Black women's invisibility and exclusion in STEM spaces. Narratives of mathematics as a gatekeeper to STEM success are more pronounced in the

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following voice note from Tiffany as well. The mathematics learning and doing practice of working on a chalkboard also feature prominently. In a voice note, Tiffany said,

"So, things in the movie that I could relate to in my current study now are, I would definitely say are the feeling of a closed mouth. I'll sit in class, like in the movie, she'll sit around, and she knew that she knew the answer, and she knew she had these answers, but she did not want to speak out because she knew she was the only Black woman in the room…She knew she had the answers, but she sort of felt less educated because she wasn't the norm. The white men were the norm…So I feel like relating that to my experience, I wouldn't say it's like a racial gesture that I experience, but I do sometimes feel as though, when I'm in my math classes and my sciences classes, really almost, well I wouldn't say any class, but in math, I do sometimes feel like I have a closed mouth. I do have the answers, but I'll let somebody answer before me because I have this thing where I second guess myself, which is one main reason that I feel as if I don't like math as much if that makes sense. So sometimes I second guess myself. I'll literally have the answer written on my paper, probably before any else has the answer. The instructor will ask if anyone has the answer, and no one will raise their hand. I'd know that I have the answer written on my paper, but I don't want to go up to the board because I don't want to put my right answer on the board, knowing that it's right…I'll even raise my hand and let the teacher check it before I go up to the board, but I'm still very hesitant to go up there. I don't want to say that's a confidence thing because I'm a very confident person…Also, I think that I've had bad experiences with going up to boards, writing on them, and then having to talk about my answer and how I reach my answer. You know that I'd explained that I can do that math just like that, but when it comes to explaining and breaking it

down…I feel like I can relate to Taraji (about Taraji P. Henson, the actress that plays Catherine Johnson in *Hidden Figures*) within the film. She doesn't want to shout out her answers or jump the gun, knowing she knows the answer. I can definitely relate to that. One of my goals is to get to where she's at when she's not afraid to showcase her intelligence and let the people know that I'm a Black female, but my answers shouldn't depict that. You know what I'm saying, so I think that's one of my goals after watching the film. I want to be able to just get up and go to the board even though that might sound foolish because, again, it's like you've been in school for 15 years, and now you're in college, and you don't want to go to the board. That's just foolish."

Tiffany is an incredibly mature young woman. She was poised, exuded confidence, and spoke about the many ways she is proactive in her learning and interactions with others, including professionals in the medical field. That is why it is surprising, even to Tiffany, that she felt silenced and scared to speak out in mathematics class even when she knew her answer was correct. Like the mammy, Tiffany's place is not at the board; perhaps it is in the kitchen (Ernest, Reinholz, & Shah, 2019). In the first interview, she mentioned that she is not a "math person" because, while she could solve mathematics problems, she did not think she could adequately explain her process. She spoke about being able to do mathematics but feeling inadequate when it came to justifying her steps. Tiffany took up a nuanced interpretation of narratives of mathematics learning. "Math people" can both perform computations, yet they speak about what they have done in ways that are above the heads of others. For Tiffany, "math people" can rationally discuss their process.

In voice notes, Tiffany was very intentional about looking for parallels between *Hidden Figures* and her own experiences. She detailed the times when she felt silenced in STEM

learning spaces due to the normalization of STEM spaces as white, masculine spaces despite her

ability and confidence. Tiffany precisely pinpoints mathematics and science classes as spaces

where she felt this way. Just as she was about to expand this feeling to other learning spaces, she

caught herself and doubled down on feeling this way only in STEM learning spaces. The

significance of this practice of going to "the board" to explain one's mathematical processes is

palpable. Notice how prominent this practice is in the series of images from the undergraduate

mathematics webpage. In Figure 8, Figure 11, Figure 12, and Figure 13, people can be seen

explaining mathematics on the board. In every image, it appears that the person explaining

mathematics is a white man. This mathematics learning and doing practice when coupled with

cues about who occupies mathematics spaces has great consequences for Tiffany's position in the

space. As a result, she is positioned, or instead, she located herself with the practice of explaining

mathematics problems on a chalkboard. In this way, she has recognized herself, both

psychologically and emotionally, as a peripheral participant in the production of mathematical

knowledge. The discursive work of those images, the movie, and the practice of doing

mathematics on the chalkboard transforms the experience for Tiffany as a Black girl.

I was particularly struck by one line toward the end of the voice note where Tiffany

stated, "let the people know that I'm a Black female, but my answers shouldn't depict that." Here,

Tiffany is challenging the positioning of Black women in mathematics spaces. The discursive

linking of race and gender with mathematics knowledge was explicit, and she pushed back on

that messaging. It is an attempt at self-definition and of the struggling Black woman making it

evident that her production of mathematical knowledge should not be indicative of her race or

gender. In mathematics learning spaces, one should not be positioned either positively or

negatively based on race and gender but based on their ability and participation in the space. She

no longer accepts being silenced, reduced, or made invisible in mathematics space where white masculinity is the norm. When reasoning and logic are gendered (Hottinger, 2016, Mendick, 2005) and innate intelligence is racialized (Leonardo, 2002), what space does this leave for a Black girl to position herself or be positioned as good at math or a mathematics doer?

In this section, the mammy is invoked and Black girls knowing their place features prominently yet again. Though the mammy is invoked in the girls' talk, this time it is linked to practices that signal Black girl positioning in mathematics learning. Black girls learn their place through class student composition, scheduling sessions with school counselors, the university's undergraduate mathematics website, and the practice of explaining one's mathematical understanding at the board.

Thus far, the mammy and the struggling Black woman have debuted as we have delved into several aspects of mathematics learning. We have been in the classroom as a whole with Zina, Tiffany, and Marie. We have been in the counseling office choosing mathematics classes with Miranda, and we have taken assessments with Stella. Though there were several opportunities or openings for the strong Black woman or Black Girl Magic to emerge, sadly, they did not. The final section of the chapter focuses on mathematics learning in group work where we will see which controlling images surface.

Group Work as a Discursive Practice in STEM Learning

According to Ellis (2014), cooperative learning in the form of group work is a significant educational innovation. There has been a recognizable shift in mathematics teaching practices from individually oriented lecture and note-taking towards cooperative learning and group work (Esmonde, 2009; Jurow, 2005; Langer-Osuna, 2011). This is particularly popular in recitation sections generally conducted by a teaching assistant (TA). This participation structure, however,

is ripe for positioning and being positioned. The storylines that emerge from group work encompass student actions, mediation of subject positions, and patterns of engagement by which students interpret one another's actions, mediating students' positional identities (Langer-Osuna, 2011; Wortham, 2006). It is in the context of group work that the girls were marginalized or made invisible. By marginalization, I contend that the Black girls' contributions were treated as insignificant, or she was gaslit in such a way that seeds of doubt were planted about the significance of her mathematical contributions. Group work in STEM learning very much functioned as another crooked room for which Black girls struggled to stand up straight.

Group Work and the Strong STEM Learner

Consider Stella's statement from our first individual interview:

"I've been treated unfairly mostly based on my gender, even recently in my Physics class. It's all group work. It's me, another girl who's white, and another boy who's white. We would be working on our project, and I'll say something. And he would be like, "oh well, I don't know." And then when we call our TA over, he'll say the exact same thing I just said, and I would be like "I just told you that." And he would just like keep downplaying every single thing I say…And in my EGR class, that's why I was saying it's because I'm a girl because we have group projects in our EGR class. Both of the girls are Black, me and another girl. One boy is Black, and another boy is white. Every time me and her say something, and it works, he - the Black boy - would be like, "no, I don't think so. I don't think it's gonna work"…Oh, even today in my - we have a project we have to program a robot for my EGR class, and while we're programming our robot, the one boy in my group was like, "well, maybe it's not working because our numbers are wrong. What did you change in the numbers? I think they're wrong". He kept trying to tell me that I was

wrong. I mean, we're all putting in a team effort, and it's trial and error, trial and error. He was just being annoying and I'd try to just ignore it and just try to get the work done because that's all the really matters."

In two separate instances and STEM contexts (Physics and Engineering class), group work used as a STEM teaching practice becomes the site for marginalization for Stella. In group work, group members must come to a consensus on a set answer (another discursive mathematics learning practice). This occurs by either reaching consensus or by trusting (or resigning to) the person in the group positioned as having the most mathematical knowledge at that moment. In both episodes, Stella is not positioned as such. Instead, she is constituted as the wrong Black girl. In one instance, not even a cosign from the TA can elevate Stella's status in the group. She was still just wrong yet persists as the struggling Black woman putting her head down and just trying "to get the work done."

Group work also provides the context for the illumination of interesting and unclear relationships between race and gender. In the previous section, Tiffany commented that what she was experiencing was "not a racial gesture." Stella also highlighted gendered narratives as the source of her subjectivation. It is evident that women are positioned in a particular way in mathematics, yet Black women are in a different position especially when one considers that not even the TA could elevate Stella's Black girl status in the group.

Additionally, some may think that diversity in group composition can act as a shield for group members. However, this is not always the case. Those who share the same racialized identification can still perpetuate discourses of white male math superiority. Black boys and men can perpetuate negative gendered-racialized narratives of Black girls and women. Consider the cases of Brianna and Kofi (Langer-Osuna 2011) or the scene in *Hidden Figures* when Catherine

met the man who was to become her husband (played by Mahershala Ali) for the first time. People are positioned through discourses, not other people.

Group Work and the Strong Mathematics Learner

Nicole had a similar experience to Stella, though in the context of mathematics learning. She shared,

> "In our groups, it seemed like everyone was having a difficult time. And I kinda knew the information. So, I was in a group with three white kids and, I don't know, I kinda felt, like, reluctant to, you know like, say my answers even though I knew they were right. But when I said the answers people were like, I don't know; I feel like they were trying to double-check it even though I understood the concept. But yeah, I didn't know how to feel about that. I knew I had the answers right and knew the concept, but it's like when I said it, they were doubtful about it. And then even me, myself, was doubtful about it. I was like "Man, is this right?", just you know, like questioning myself."

This is a particularly interesting example because the three white students in the group were positioned as the ones who were struggling while Nicole felt secure in her conceptual understanding. Even still, this was not enough to protect her from being positioned as incompetent. This manifested in Nicole being reluctant to share her answers while the others questioned whether or not she was correct. Initially, I identified this narrative as being consistent with the mammy. Nicole was "reluctant" to share her answer as if she did not have the right to do so in that space. Yet, by the end of the segment, it appeared to me that the mammy gave way to another previously undocumented image that may be unique to STEM spaces – the doubting Black girl. One could argue that traces of the doubting Black girl were present in the previous section as Tiffany hesitated to share her work at the board.

Group Work and the Struggling Mathematics Learner

Both Stella and Nicole were strong mathematics students and were able to navigate these episodes slightly differently from the way that someone like Zina might have been able to. Miranda's experience illustrates this. Throughout the semester, Miranda often spoke about struggling to learn the concepts in her mathematics class. In one voice note, she said,

> "I actually have been having a little bit of trouble in (math) class…It's been difficult between my classmates and me, we do have these things called base groups. It's me and two other girls, and that's supposed to be kinda like a support group in the class, so if we have any questions, we can ask each other, or if we do work together, we have to ask each other. But I have been noticing in these base groups, it's kinda like the two other girls are more paired up, and I'm kinda just left on the side. Like if I have a question, they'll acknowledge that I have one, but they don't turn to me for help with anything. It kinda gives off that, like, I don't know how I would describe it, but I feel more isolated in the group, and it's kinda like the feeling that I'm not capable of answering the question as well as them."

Later, I asked Miranda about her experiences during our focus group sessions, and she responded, "I like the focus group sessions because, a lot of times, I'm the only Black person in my math class, like the one out of thirty or forty kids. So it's nice to sit down with other folks that look like me and maybe share a similar experience." Initially, this voice note was identified because of Miranda's mention of gender (grouped with girls). However, her response to my question during the final interview indicated that what she had experienced was also racialized. In this case, group work produced the conditions for Black girls to feel invisible. She admitted that they would acknowledge her if she has a question, but that is where the cooperative learning

ended. There is the insinuation that this is a racialized experience and, as she is the only Black student in the class, even a restructuring of base groups offered no reprieve. Simultaneously, she also felt unsupported by her instructor and, as a result, unprepared for her upcoming exam. Though Miranda did not mention race, gender, class, or any other social identity markers in other voice notes, she continued to convey feelings of helplessness while trying to be resourceful and actively seeking the support that she needed in the course.

Something different happens here with a Black girl struggling mathematics learner that is different from what happens in the instance with Zina. Perhaps the element of group work and what it means to work cooperatively is responsible for the difference. In this instance, Miranda is constituted as a struggling mathematics learner, but she is not merely marginalized. She has to struggle against being made invisible. Now, Miranda is not saying that she does not feel like she belongs in this mathematics learning space (the mammy). She is saying she does not feel seen there. Miranda does not mention the race of the other two girls in her group. Often, when race is not indicated, the default is white. No matter their race, this personal narrative reveals how the Black girl struggling mathematics learner turns struggling Black woman, but it is not marginalization, but erasure she must struggle against and her isolation had a deleterious effect on how she perceived her role as a producer of mathematical knowledge.

Challenge as the Great Equalizer

In this final episode, Stella introduced the curriculum and difficulty of the task as discursive and transformative for her experience. In a voice note, Stella said,

"The other day I was in Physics and the same boy that usually tries to correct my math and all this other stuff, he actually laid off this one day so. I think it was more because we were both challenged by the problem that we had, and the other girl in our group was not

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there, so it was just me and him. Our TA helped us a little bit, but he was easier to work

with this day. I don't know what it was. It could have been because the other girl wasn't

there or not. I'm not sure. But he was easier to work with this time. We had our exam last

Wednesday. Before, I thought it was because I was Black or because I was a Black girl

that he feels like he needs to check my work, but now I don't know because during the

exam, it was timed, and I felt like he wasn't as rude about us checking. It was about like,

"Oh, okay, I'm doing the numbers, so could you run them too to make sure that I'm right."

It was more like teamwork this time."

All of the previous discursive agents remain stable in this episode – controlling images, group

work, and other narratives of STEM learning. However, two things were different. First, both

Stella and her partner were challenged by or struggling with the task. Secondly, they were not in

a group but worked together as partners. As a result, Stella was positioned very differently as her

partner "laid off" and was "easier to work with." She was neither marginalized nor made

invisible. She was not a struggling mathematics learner, struggling Black woman, or mammy.

Here, if only for a moment, she was simply mathematics learner. Though this is but one instance,

it begs the question as to whether there is something about the nature and difficulty of the task

and the group composition (partners) that made being constituted by negative controlling images

to a halt, though, regrettably, the strong Black woman and Black Girl Magic still have yet to

appear.

Chapter Discussion

This chapter demonstrated that controlling images about Black girls that already circulate

outside mathematics and other STEM learning spaces both slightly morph and exert an even

stronger downward pressure. This pressure effects Black girls' opportunities to learn

mathematics and be fully human as those images interact with narratives related to mathematics and STEM teaching and learning. One strategy that I used to demonstrate this is to examine the data for both what controlling images were present as well as which were absent. We saw the struggling Black girl and the mammy while also being introduced to the doubting Black girl and the wrong Black girl. At the while, the strong Black woman and Black Girl Magic which featured so extensively in chapter five never materialized.

I organized the chapter into three primary sections. The first highlighted the multiple interpretations of the word struggle or struggling and dealt with the relationship between the struggling Black woman and the struggling mathematics learner narratives. The primary findings are that the struggling Black woman exists in mathematics classroom and could be, but not is not necessarily, paired with the Black girl struggling mathematics learner. When the two are paired, she struggles to be recognized and provided a quality mathematics learning experience. Absent the struggling mathematics learner, a Black girl who is good at mathematics takes up the struggling Black woman image in lieu of Black Girl Magic to characterize her experience.

In the second section, we see narratives of the mammy interacting with narratives of mathematics learning such as practices like sharing one's mathematical knowledge at the chalkboard, the race and gender critical mass cues in both the classroom and on the undergraduate mathematics webpage, and guidance counselor advice serve as discursive agents telling Black girls to stay in their place.

In the final section of this chapter, group work served as a site for the struggling Black woman to struggle both against marginalization, in Stella's case, and also against being made invisible, in Miranda's case. Two new controlling image of the Black girls also emerged from this data, that of the wrong and the doubting Black girls. It is only when the task was sufficiently

challenging and when there were not groups, but partners, that Stella was able to experience mathematics learning free of negative controlling images.

One familiar with the gender in mathematics literature could posit that the wrong Black girl and the doubting Black girl are simply the wrong *girl* and the doubting *girl*, sans race (Ganley & Lubienski, 2016; Lundeberg, Fox, & Punćcohaŕ, 1994). In other words, could those newly emerged controlling images be gendered narratives as opposed to gendered-racialized narratives? Likewise, one could ask whether the wrong Black girl and the doubting Black girl are simply the wrong non-Asian person of color or the doubting non-Asian person of color, sans gender, as "doubt" and being "wrong" are also experienced by many non-Asians of color in STEM (McGee & Martin, 2011; Shah, 2017). I argue that this singular, as opposed to intersectional, thinking is a form of erasure that regularly happens as the literature constantly subsumes the experiences of Black girls and women in that of all women or that of all people of color. The findings that are the wrong Black girl and the doubting Black girl are, indeed, gendered – racialized. Asking if these controlling images are simply gendered or simply racialized places Black girls and women in the shoes of Anna Julia Cooper who, while traveling in the south, found herself in a position where she needed to choose between two bathrooms, one with a sign that read "'FOR LADIES' and another which read 'FOR COLORED PEOPLE' (Cooper 1892, p. 95). Which door are Black girls supposed to walk through? Does either fully encompass all that she is and the way that she experiences the world at the intersection of race and gender?

The doubting Black girl and the wrong Black girl are no less racialized than the experiences of the white and Black women working at NASA in *Hidden Figures*. Consider the departure of Black feminists from the broader feminist movements or the gender pay gap which,

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for example, is not just gendered, but also gendered-racialized. In the same way, these controlling images emerged from the language in Black girls' stories and are, indeed, gendered-racialized. To consider anything other would be to deny Black girls and women of who they quintessentially are and how they experience the world in qualitatively different ways. As Kimberlé Crenshaw (1997) warns "treating different things the same can generate as much an inequality as treating the same things differently" (p. 285). Though the experience of Black girls learning mathematics may be similar to that of other women, the experiences are not the same and we must resist such reductions to avoid perpetuating inequality, marginalization, and erasure.

CHAPTER SEVEN: DISCUSSION, FUTURE RESEARCH, AND CONCLUDING REMARKS

"I am no longer accepting the things I cannot change. I am changing the things I cannot accept."
– Dr. Angela Davis

While chapter five helped us understand more about controlling images such as the matriarch, mammy, and the angry Black woman alongside counter images such as the strong Black woman, Black Girl Magic and the struggling Black woman as it relates to the lives of Black girls, only the mammy and the struggling Black woman proved relevant in relation to narratives of mathematics learning. Those controlling images were interlaced with narratives of mathematics and STEM learning in ways that primarily resulted in the Black girls either being marginalized or made invisible in mathematics and STEM learning spaces. This chapter discusses what this study's findings mean in relation to the mathematics education literature, the usefulness or limitations of engaging controlling images as a frame for analysis when studying Black girls in mathematics, and implications of mathematics learning practices, namely, going to the board and group work. I conclude with the limitations of the study and implications for future research.

Synthesis of Findings

This study began with a focus on two research questions. In this section, I will provide a sense of how this study has addressed these questions before addressing how the study is related to the extant literature, conceptual framing, and practice. As a reminder, I asked:

RQ1. What controlling images are implicated in the personal narratives that Black girls tell about their undergraduate mathematics learning experiences?	RQ2. How do these personal narratives about the mathematics learning experiences help us understand the interactions between the controlling images and narratives of mathematics learning for Black girls?

Several controlling and counter images from the academic literature were explicitly or implicitly referenced in the girls' talk. In chapter five, I argue that there is evidence of the matriarch, welfare mother, angry Black woman, strong Black woman, and Black Girl Magic as well as a previously undocumented image, struggling Black woman, present in their personal narratives. This new image, the struggling Black woman, is a counter image with narratives that support the need for the strong Black woman and Black Girl Magic. All of the images reflect both internal and external gazes on Black girls and women as they live out their lived. Though several controlling images were implicated in the daily lives of Black girls, only a few were implicated in their talk about their mathematics and STEM learning experiences. Of the original controlling images put forth by Collins (2000), only likenesses to the mammy arose in the data in the form of knowing one's place. In conjunction with narratives of mathematics learning and practices, the struggling Black woman, doubting Black girl, and wrong Black girl emerged as prominent. Not once for the mathematics and STEM learning experiences shared did the girls invoke the strong Black woman or Black Girl Magic as they had in chapter five. Any mentions of those counter images were through my role as analyst wondering why those narratives were not invoked when opportunities existed for such. I remain curious about how or why this is the case given that the girls obviously reached for these narratives for meaning making in their lives as Black girls.

The invocation of the struggling Black woman and the emergence of the doubting Black girl or the wrong Black girl are both significant. They arise in conjunction with mathematics learning narratives and teaching and learning practices. First, the conception of what it means to struggle in mathematics bares likeness to Mendick's (2005) list of oppositional binaries. Mendick listed several oppositional and interrelated binaries found in narratives of mathematics

learning such as: maths people/non-maths, people, ordered and rule-based/creative and emotional, numbers/words, fast/slow, independent/dependent, and naturally able/hardworking among others. I would add to this list the binary that is right/wrong as many think of this as a staple outcome when solving mathematics problems. Mendick argues that this list is also gendered with valued position in mathematics as is more masculine and the lesser valued is feminine. Walkerdine's (1990) work supports this claim noting the discursive production of femininity "as antithetical to masculine rationality to such an extent that femininity is equated with poor performances, even when the girl or woman in question is performing well" (p. 134). This point, layered with anti-Black sentiments of limited intelligence, provide the context for the emergence of the wrong or doubting Black girl in mathematics and STEM learning contexts both with detrimental consequences for her learning. Aside from these narratives of mathematics learning, several practices play a role in the emergence of these new images. Critical mass cues, academic counseling sessions, explaining mathematics problems at the board, and participation in group work were all sites for Black girl marginalization or rendering her invisible.

Controlling Images and Extant Mathematics Literature

This section discusses how the findings of this study inform current literature on the mathematics learning experiences of Black girls. I first discuss one aspect of the study, namely the mathematics courses the girls were enrolled in, could prove to be an additional site for future research. I then discuss and extension of what Gholson (2016) and Bullock, 2018) put forth as the invisibility or figure hiding of Black girls in mathematics education literature. This is followed by an associated discussion of the limited consideration of Black girl excellence in mathematics and STEM learning spaces through the unavailability of counternarratives.

Connection Between Course Enrollment and Narrative of Mathematics Learning

Both Stella and Tiffany were STEM majors while the other girls were not. Additionally, the girls were enrolled in various levels of mathematics from Quantitative Literacy through to Calculus 1. Though narratives of mathematics are relatively stable, there could, most certainly, be differences in the salience of particular narratives across various contexts. Both Shah & Leonardo (2017) and Larnell (2016) discuss the importance of mathematics learning course types as it relates to the racialized narratives present. For instance, Larnell (2016) found that critical mass cues signaled racial composition of a non-credit bearing remedial mathematics course offered at this same university influenced the narratives that his participants told simultaneously shaping their mathematics identities. Therefore, there is evidence to suggest that the narratives that Black girls tell about their position in mathematics classes could be linked to the level of mathematics class they are taking. This is a site for future research for a deeper understanding of the phenomenon.

Invisibility as a Kind of Representation

Bullock (2018) argues for the use of an intersectional analytic lens in critical mathematics education research. She asserts that, without it, we participate in figure hiding – "a metaphor representing the invisibility of those marginalized" which would include Black girls and women (p. 123). Gholson (2016) makes a similar argument asserting that "Black girls and women lurk in the proverbial shadows of inquiry in mathematics education and become visible only briefly to illuminate the status of Black boys and men or White girls and women" (p. 298). They are rendered invisible in their service as a referent group in gap-gazing (Gutiérrez, 2013) literature or are hidden because researchers embrace the myth that Black girls and women are doing well. Gholson explicitly states that "Blacks girls and women are constructed in mathematics for the

purpose of becoming invisible" (p. 295) and to make them visible we must confront white feminism and Black patriarchy.

In an attempt to honor the pleas of Bullock and Gholson and to unhide Black girls and women in mathematics education research, I designed this study employing Black Feminist Thought and avoiding using Black girls as a referent group, but to center their experiences and voices. The findings suggest that, within mathematics and STEM learning practices, there are other forms of invisibility at play for Black girls. Group work in STEM learning spaces are ripe with opportunity for this to take place. The wrong Black girl or the doubting Black girl were forced to the edges of relevance in group work (Tiffany and Stella) whereas the struggling Black girl mathematics learner (Zina and Miranda) was dismissed and rendered invisible in group work as a mathematics learning practice.

Invisibility of Counter Images and Counternarratives

Where were the strong Black woman and Black Girl Magic in mathematics and other STEM learning spaces? Though Black girls occupied these spaces, these images were largely absent in their narratives. The strong Black woman and Black Girl Magic images signify confidence, self-assuredness and certainty which would seem align well with STEM and particularly mathematics as a bastion of certainty. However, the problem is that STEM spaces are configured historically for white men (and more recently for Asian men), which means that the confidence and self-assuredness in that specific setting gets reserved for them, and specifically appropriated from Black women. This made controlling images like the strong Black woman and Black Girl Magic less available to Black women in STEM as the dominant discourses of STEM are organized in ways that make it less possible for those controlling images to get taken up by both Black women and others.

Langer-Osuna (2011) is an instance where confidence, self-assuredness and certainty purchased little for Brianna in her Algebra cooperative learning group. As was mentioned earlier in the literature review, Brianna's confidence and self-assuredness did not purchase more access to mathematics learning in her cooperative group. Instead, she was deemed "bossy", demoted as the group leader, replaced by Kofi, and relegated to secretarial duties in the group. Similarly, as previously mentioned, Gholson (2016) also noted the tension between confident Black girls defending their mathematical ideas and the reservation of these traits as masculine. Examining and shifting this dynamic, making the strong Black woman and Black Girl Magic available subject positions in mathematics and STEM learning spaces could prove critical in shifting this storyline.

Leonard and Martin (2013) beckons the mathematics education research community to attend to the brilliance of Black children in mathematics. Similarly, I would beckon us (researchers, teachers, peers) to realize the brilliance of Black girls in mathematics learning spaces instead of always positioning them as deficit. One potential reason for this could be associated with the nature of counternarratives. Collins reminds us that "Black women's lives are a series of negotiations that aim to reconcile the contradictions separating our own internally defined images of self as African-American women with our objectification as the Other" (p. 99). Therefore, counternarratives are prominent and prevalent in Black women's narratives about themselves as individuals, but not as societal narratives of Black women in general. When a group self-defines those definitions are not automatically embraced by the masses especially in a society where anti-Black sexism ideologies are predominant. Though the Black girls embrace the counter images and counternarratives when talking about themselves, others do not readily recognize and employ such narratives. This begs the question of what it takes for a

counternarrative to be taken up as a viable, widely embraced narrative. One way for this to happen is by taking stances like that of Leonard and Martin (2013) to actively promote the narrative.

Another approach would be to create safe mathematics and STEM learning spaces for Black girls. Collins (2000) believes these safe spaces as a necessary condition for Black women's resistance. Consider Nasir's (2012) recommendation for making relational, ideational, and material resources available for the successful development of Black students' academic identities. Though she does not advocate for segregation, per se, she does argue that this successful development was possible for Black students in segregated schools in ways that they are not in integrated spaces. Nasir references the history of African American education and the tension inherent in the "kinds of people education was preparing African-Americans to be" versus creating educational opportunity worthy of African Americans, the kind of education they deserved (p. 146). What was most important from Nasir's findings was that Black students attending school in all Black settings felt that the adults created spaces where they had access to both positive racialized and academic identities. It is possible, then, that creating spaces for Black girls and women in STEM could have a similar effect. At the very least, we should consider classroom grouping practices during group work and allow more Black girls to be grouped together instead of prioritizing heterogeneity. Consider what happened when Stella and Zina were grouped together. Stella did her best to help Zina and allow her to be seen in a way that she otherwise was not.

Black Feminist Thought and Expanding Controlling Images

The controlling images put forth by Collins (2000) result from intersecting oppressions of race, class, gender, and sexuality, but for sexuality the default is always heteronormative. This

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frame makes an entire group of Black women invisible. Larry's contribution in this study was powerful in helping me realize that. Throughout her interviews and our focus group sessions, she would bring issues of sexuality to the forefront causing us to collective to consider how we may have been inadvertently giving rise to narrow conceptions of Black girl-ness.

Gholson and Martin (2019) are the first to address Black girl performances of femininity and masculinity as it intersects with her mathematics learning. They discuss blackgirl face as a racialized gendered performance of "cool pose" (Majors & Bilson, 1992) as it is performed by Cameryn, a middle school aged Black girl. Gholson and Martin hope to expand the conversation around how blackgirl face might be used by Cameryn "to counter the social vulnerabilities created by intersectional forms of racialized, gendered, and class-based oppression" in the context of mathematics learning (p. 391). What does a performance of blackgirl face purchase Cameryn? Could it provide her with access to other narratives of mathematics learning associated with masculinities? Is that the goal? Is this equitable or just? A myriad of questions arises when notions of masculinity and femininity as performances are considered. Because of Larry's contribution, I have begun to question the limitations of controlling images as a frame and its role in the potential to make the experiences of queer Black girls invisible in this and future studies. Instead of considering the controlling images in contrast to notions of white, middle-class femininity, we should broaden our scope and consider narratives of white, heterosexual, cisgender, middle-class femininity because Black women are not a monolith.

Controlling Images and Mathematics Learning Practices

In this section, I consider this study's implications for mathematics learning. The first is a consideration for the re-framing of what it means to struggle during mathematics learning. As we saw in the data, the struggling mathematics learner subject position paved the way for the

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struggling Black woman for Black girls in ways that were not possible for other learners. To borrow from McDermott, the struggling mathematics learner acquires a certain percentage of mathematics students. For Black girls, this acquisition is even more detrimental as she struggles against gendered-racialized marginalization. Perhaps this reframing of what it means to struggle in mathematics could serve to reduce or eliminate those occurrences. Secondly, I briefly address how this study contributes to the conversations around the pedagogical practices of group work in STEM learning settings.

Productive Struggle as a Tool for Improving Mathematics Learning for Black Girls

Warshauer (2015) and others have attempted to reframe what it means to struggle during mathematics learning by shifting the narrative of struggle from one where there is something wrong with the learner to one where there is something problematic about the narrative. A shift from struggling as a sign of a deficient learner to one of productive struggle would be welcomed by the field. When both Zina and Miranda were constituted as struggling mathematics learners in their Black girl bodies, they were made invisible and essentially ignored in by their group members and the TA. Warshauer landed on the notion of productive struggle and others (i.e. Lynch, Hung & Lewis, 2018; Zeybek, 2016) have taken up this conception of struggle and examined how it might be promoted through task differentiation with middle-school mathematics learners and at the university level with pre-service mathematics teachers. This work, however, is seemingly situated in the cognitive domain of mathematics education research without a critical examination of students' social identities and sociocultural and sociopolitical contexts. Perhaps, with future consideration and expansion of frames and methodologies, this work could prove promising for interrupting the connection between the narratives about Black girls and about mathematics is it relates to struggle.

Shifting Group Work as a Site for Harm to One of Promise

Regardless as to whether or not the girls were constituted by strong or struggling subject positions as mathematics learners, group work settings were prominent cites for marginalization and being made invisible. Rosser (1998) stated, "if the dynamics of race and gender are understood and used effectively, group work may enhance the learning for all students, especially women and men of color. Even more important, if these dynamics are ignored or misunderstood, group work may actually inhibit or detract from learning" (p. 83). Rosser goes on to consider how those dynamics such as group size, group roles, ability, assessment and number of other factors must be considered when using group work for instruction in undergraduate STEM courses. The National Council of Teachers of Mathematics (NCTM) and several mathematics education scholars concerned with equity in mathematics education have employed complex instruction (Cohen, Lotan, Scarloss, & Arellano, 1999) as a means for creating meaningful group work experiences that aim to minimize harm and promote growth for student learning (Boaler, 2006; Featherstone et al., 2011; Horne, 2012). However, much of this work has been done in the K-12 context or in other collegiate disciplines (Colbeck, Campbell, & Bjorklund, 2000; Shimazoe & Aldrich, 2010).

Complex instruction considers factors relative to roles for both the instructor and the students. It addresses the nature of the task and asserts that the best tasks are open-ended and inherently uncertain in nature yet are organized around central disciplinary themes or ideas. Complex instruction also strongly considers student status based on perceived smartness or intellectual ability and seeks to interrupt those statuses through a multiple ability treatment which engages learners of different abilities in the act of problem solving. This treatment challenge notions of what it means to be smart and can help to interrupt status problems. One other

consideration is the assigning competence to low status students in groups. A public statement of competence by the teacher helps to elevate low status students contrary to what we saw in how the TA treated Zina in her mathematics class. This is not a fix-all, however. Consider the data where the TA was called over for help in Stella's group or when the instructor checked Tiffany's work. Though these were both public affirmations and validations of their ability, Stella was still positioned by her group as wrong and Tiffany remained doubtful in going to the board to explain her answer. Complex instruction may be a place to start, but research employing critical methodologies would be useful in helping to understand how to create spaces of promise in mathematics learning for Black girls.

Overall, there is no one answer to interrupting the effects of controlling images on the mathematics learning experiences. Any approach must be multifaceted considering both theory, research, policies, and practice. These manifold approaches must also consider both consideration for ideologies that support misrepresentation of Black girls in mathematics learning spaces as well as the availability more material resources to support and sustain learning spaces dedicated to the promotion and edification of Black girls' mathematics (and STEM) learning. Only then, will we begin to address the wheel of misogynoir that has been churning for centuries.

Affordances and Limitations of the Study

One affordance of this dissertation research is the methodological approach employed and how it made capturing gendered-racialized moments in "real-time" more possible. The use of the Issa moment audio logs utilizing WhatsApp voice notes made it possible for data to be

generated around these ideas via the girls' personal narratives in ways that had not previously been practiced in research. For example, when Stella left her Physics class one day, I could hear the excitement in her voice as she recorded her voice note about how she had been treated in her group. Though I did not include this as part of the analysis, emotions such as excitement, frustration, anger, and joy could all be a part of analyzing future data collected in this way for even more insight into what these experiences hold for Black girls. The voice notes uniquely complimented individual interview and focus group data culminated in a body of rich data capturing the phenomenon.

While this study supported powerful insights into the mathematics learning experiences of Black girls attending a PWI, there are also limitations. The first limitation is analytical in nature and concerns the issue that is explicit versus implicit references to race, gender, class, and controlling images. The second limitation is that the study is limited in size and scope.

This dissertation privileges explicit invocations of controlling images in the girls' personal narratives. This is not to say that there are no instances where implicit invocations are captured, but they are much less prevalent in the data. For example, as I initially parsed the data, I only included passages that explicitly referenced social identity markers such as race, gender, class, sexual orientation. The second pass through the data separated passages as to whether or not they referenced events that took place in a mathematics (or STEM) learning space. These two analytical moves both privilege explicit references. There may have been times when the girls were speaking about social identities in more coded ways. Perhaps they mentioned students in urban schools which could have been code for race and/or class, but since they used the word "urban" to describe their fellow students or the school setting, this data would not have been considered for analysis.

Secondly, this study is limited in size and scope. It is also a new area of research as none have employed Black Feminist Thought and controlling images to understand Black girls' mathematics learning experiences in quite this way. Questions remain about what these mathematics learning experiences may look like for girls at other levels of undergraduate mathematics study or in other learning contexts such as community colleges, HBCUs, liberal arts schools, and other postsecondary institutions and whether or not this could be captured in their personal narratives. There was also no consideration for whether the girls were mathematics or STEM majors. Similarly, the data were only collected over the course of one semester which adds to the limiting scope.

Implications for Future Research

The findings from this study investigating how controlling images are at work in mathematics learning spaces for Black girls has led me to consider two paths for future research. The first path was illuminated in the girls' narratives. The data privileged in this study referenced gendered-racialized narratives, however there are times in the data where the girls shifted back and forth between solely gendered or racialized narratives as well. The mechanisms for this practice are not altogether apparent. In what contexts is gender privileged? When is race privileged? And how are these contexts distinct from those where both gendered-racialized narratives emerge in the girls' talk? These are all inquiries that, when investigated, will help a great deal in our understanding of just how narratives of various social identities intersection with learning in mathematics and STEM.

The second path emerged from a preliminary analysis I performed on the data in chapter six regarding group work. I was curious about connections between the way Black girls were positioned, the way the group members were positioned, and the outcome of the interaction for

the Black girls' mathematics or STEM learning. I have performed a brief analysis, but fully realize that the results are speculative and arise from very limited data. With the addition of more observed social interactions either by being physically present or through video recordings of mathematics group work sessions, I could come to understand even more about the constitution and learning experiences of Black girls in mathematics and STEM learning spaces.

Concluding Remarks

To conclude, I would like to consider the words of self-defined "black, lesbian, mother, warrior, poet," Audre Lorde (Kay, 2017). She stated, "the master's tools will never dismantle the master's house. They may allow us temporarily to beat him at his own game, but they will never enable us to bring about genuine change" (Lorde, 1984, p. 112). Demands for educational equity and justice for Black girls, particularly in mathematics and STEM, should advocate for equal access to material resources. However, as we can see from this study, while material resources are important, full recognition in spaces is part and parcel for equal access to learning. This study employed Black Feminist Thought and Black women's self-definition through counter images and narratives, hardly the master's tools, to help us understand the role of controlling images in the mathematical learning lives of Black girls. As Collins (2000) reminds us, with a thrust to control the narrative, making these counter images and narratives the dominant narratives, a critical mass with changed consciousness could prove to be pivotal for fostering Black women's collective empowerment in mathematics learning spaces. It is my hope and life's work to continue to work towards this changed consciousness and help be a part of this change.

APPENDICES

Appendix A: Initial interview protocol and information sheet

Information Sheet:

Name_____ Age_____

Institution_____

Hometown_____

High school attended_____

Anticipated Major_____

Last math class taken in high school_____

Math class enrolled in for Fall semester_____ Grade received_____

Math class enrolled in for Spring semester_____

How did you find out about this study? _____

Interview protocol:

Question 1: Tell me a little about yourself.

Question 2: Describe yourself as a student? What classes/subjects do you like or have you enjoyed throughout your schooling?

Question 3: Where do you see yourself in 5 or 10 years?

Question 4: When I say the word "math" what comes to mind?

Question 5: Do you think math is useful? Necessary? If so, how or why?

Question 6: If comfortable, please tell me a story about a high school math learning experience. It could be about experiences with a teacher, other students, taking an assessment, or a time when you felt either successful as a math learner.

Question 7: Have you ever been treated unfairly because of your race and/or gender? What did you do or say? Would you act differently in the future?

Question 8: Have you seen someone else treated unfairly because of their race and/or gender? What did you do or say? Would you act differently in the future?

Appendix B: First focus group meeting protocol

Introductions/ice breaker:
MC: Thank you for joining me. My name is Missy Cosby and I am a graduate student in educational psychology and educational technology. We will talk a little more about why we are here, but let's first introduce ourselves and break the ice. But first, I must tell you that this session is being both video and audio recorded for research purposes. I will do everything in my power to keep your identity concealed. A copy of the video will be saved on a password protected computer that only I have the password to. We'll go around and have every state their name, institution/school, hometown, math class enrolled in, a desired superpower. I'll go first. My name is Missy. I am a graduate student at Michigan State University, I am originally from Flint, Michigan but I have lived in the greater Lansing area since 1995. I'm not enrolled in a math class right now, but I do teach high school math part time at Okemos High School and if I could have any superpower it would be teleportation because I spend too much time in the car driving myself and family around. Would anyone like to go next?

Take turns going around the group until everyone has had the opportunity to share.

Question 1: You watched the movie Hidden Figures in preparation for this meeting. Had you seen it before? How many times?

Question 4: Is this movie about math in any way? If so, how?

Question 5: What parts of the movie do you remember most and why?

Question 6: What messages did you pick up on from the movie? It can be about women, black women, black men, white men, math, school, or a combination of any of these.

Question 7: Do you see yourself and your life so far reflected in the lives of these women in any way?

Question 8: What part of the movie could you relate to most and why?

Question 9: Are there practices, policies, or procedures that we currently do in schools or math classrooms that remind you of the movie?

Give an overview of the project and directions for audio log creation:
MC: Thank you for taking the time to join me for this focus group session and showing interest in my study. The data that I will collect will be used to satisfy the requirements for a PhD in educational psychology and educational technology. As you know, I am interested in the mathematics learning experiences of Black girls and women, specifically in the ways that they feel in those learning spaces. We talked about the movie Hidden Figures as a conversational stimulus and for examples about messages one could be aware of. Throughout the semester, you'll be picking up on both direct and indirect messages about math, what it means to do math, who does math well, who doesn't, and your feelings of belonging. You might have already received some of these messages as a high school math student. These messages may deal with race and gender but could also just be about learning and doing math. As you go throughout the semester, whenever you encounter one of those experiences, I would like you to use your

smartphone and WhatsApp to record a voice note telling me about the experience that you had, who was a part of that experience, how it made you feel, what your reaction was, and anything else you think I should know. I will be the only one to listen to the messages and you will each choose a pseudonym so that you cannot be identified. Any questions?

Make sure that everyone has access to a smartphone, WhatsApp, and voice notes.
MC: If you choose to continue throughout the semester, your commitment will be to record and send me at least one voice note each week, participate in a mid-semester focus group check-in meeting, and sit down with me for a one-on-one debrief interview at the end of the semester. Those who complete all portions of the study will receive at least $50 on an Amazon gift card. I will send reminders on WhatsApp each week so that you do not forget to send the voice note. Also, if you ever have any questions, feel free to contact
me through email or WhatsApp. Any questions?

As a preparatory exercise, I re-watched *Hidden Figures*. During this exercise, I identified the following potential topics to discuss during the focus group. I can introduce topics, as needed, if the group is having a difficult time generating topics.

1. Black people often recognized and celebrated the brilliance of other Black folks. (Catherine Goble's early school experience, church scene)
2. White men's disbelief that Black women had the ability to do rigorous mathematics (police officer, men in office)
3. STEM spaces belong to White men.

4. White women look down on Black women even when they have the same position in the workplace.

5. A Black woman could not possibly be better at mathematics than a White man. (When Catherine is assigned to check the work of others in her office)

6. Dealing with the patriarchy of Black men who also doubted that Black women could do rigorous mathematics.

7. Resourcefulness of the Black women to do their jobs in the face of adversity (IBM library incident, black marker and holding paper up to the light, making case to the judge to attend White school)

8. Persistence in the STEM space depended on having a strong network of other Black women persisting in the space.

9. The use of the terms "gentlemen" and telling the staff to "call their wives" when they have to work late.

10. Work not good unless it was validated by a White man.

11. Was Catherine capable of a different kind of mathematical thinking than the other computers? More analytical? Conceptual? Is some mathematical thinking valued more than others? If so, by who?

Appendix C: Second focus group protocol

Question 1: How is everyone doing? How has the semester been going for you so far?

Question 2: How has the project been going for you? What has gone well and what has been difficult for you?

Make a quick announcement about the quality of the audio logs received:

- Audio quality, speaking clearly, rate of talking, content of the messages (revisit prompts). Are participants including enough detail and including how they responded to the experience?

Question 3: Would anyone like to share a story about one of the audio logs you sent during the first few weeks? (allow time to share).

MC: I'd anticipated that you would be sharing a variety of stories with me and that some of them would revolve around the messages in this table (share screen if via Zoom). Has anyone had an experience where one of these messages was directly or implicitly received? Would you mind sharing with the group? If not, please considering sharing the story with me in your next audio log.

Question 4: Is there anything more that we could add to these lists (see Table 3)? If so, what and why do you think we should add it?

Question 5: Are there any other questions before we head into our final weeks of audio log creation and submission?

Appendix D: Second focus group slides

Figure 16. Slides for Focus Group Session

Appendix E: Final individual interview protocol

MC: I would like to personally thank you for participating in this research study. Sharing your math learning experiences could help to improve the experiences of Black young women in the future. This session will last approximately one hour and will be audio recorded. This first question may feel a bit difficult to answer, but please know that there is not a "correct" answer. I am really just interested in your thoughts.

Question 1: What does being a "Black girl" mean to you?

Question 2: What has this experience been like for you?

Question 3: How was this semester of math learning similar to previous math learning experiences? How was it different?

Question 4: What was most impactful moment of the semester?

Question 5: Did you talk with anyone about your math experiences this semester? If so, who? What did you talk about?

Question 6: What were your interactions with other study participants?

Question 7: What was your biggest take-away from the focus group sessions?

Question 8: Do you believe your experiences as a Black woman taking mathematics classes differs from the experiences of Latinx women, Asian women, or White women? If so, how?

Question 9: Are you apart of any special programs on campus such as the Honors college, Lyman Briggs, Drew, etc? If so, how did being a part of this program impact your learning experience?

Question 10: Do you have any more math courses to take? How has this semester shaped your thoughts about future math learning?

Question 11: Where do you see yourself in the next five years or so? How will math or any STEM fields play major role in your future?

Additional questions about specific narratives may be asked to help gain more context or a more recent update. If necessary, we might listen back at an audio log or two depending on individual participants.

Question 12: Is there anything else that you'd like to me to know?

Appendix F: IRB Approval

MICHIGAN STATE
U N I V E R S I T Y

EXEMPT DETERMINATION

November 1, 2018

To: Niral A Shah

Re: **MSU Study ID:** STUDY00001613
        Principal Investigator: Niral A Shah
        Category: Exempt 2
        Exempt Determination Date: 11/1/2018

Title: SPEAKING TRUTH TO POWER: A CRITICAL NARRATIVE ANALYSIS OF
BLACK WOMEN UNDERGRADUATES' MATHEMATICS LEARNING
EXPERIENCES

This study has been determined to be exempt under 45 CFR 46.101(b) 2.

Principal Investigator (PI) Responsibilities: The PI assumes the responsibilities
for the protection of human subjects in this study as outlined in Human Research
Protection Program (HRPP) Manual Section 8-1, Exemptions.

Continuing Review: Exempt studies do not need to be renewed.

Modifications: In general, investigators are not required to submit changes to the
Michigan State University (MSU) Institutional Review Board (IRB) once a research
study is designated as exempt as long as those changes do not affect the exempt
category or criteria for exempt determination (changing from exempt status to
expedited or full review, changing exempt category) or that may substantially
change the focus of the research study such as a change in hypothesis or study
design. See HRPP Manual Section 8-1, Exemptions, for examples. If the study is
modified to add additional sites for the research, please note that you may not
begin the research at those sites until you receive the appropriate
approvals/permissions from the sites.

Change in Funding: If new external funding is obtained for an active study that had
been determined exempt, a new initial IRB submission will be required, with limited
exceptions.

Reportable Events: If issues should arise during the conduct of the research, such
as unanticipated problems that may involve risks to subjects or others, or any
problem that may increase the risk to the human subjects and change the category
of review, notify the IRB office promptly. Any complaints from participants that may
change the level of review from exempt to expedited or full review must be reported
to the IRB. Please report new information through the study's workspace and
contact the IRB office with any urgent events. Please visit the Human Research

**Office of
Regulatory
Affairs**
Human Research
Protection Program

4000 Collins Road
Suite 136
Lansing, MI 48910

517-355-2180
Fax: 517-432-4503
Email: irb@msu.edu
www.hrpp.msu.edu

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Protection Program (HRPP) website to obtain more information, including reporting timelines.

Personnel Changes: After determination of the exempt status, the PI is responsible for maintaining records of personnel changes and appropriate training. The PI is not required to notify the IRB of personnel changes on exempt research. However, he or she may wish to submit personnel changes to the IRB for recordkeeping purposes (e.g. communication with the Graduate School) and may submit such requests by submitting a Modification request. If there is a change in PI, the new PI must confirm acceptance of the PI Assurance form and the previous PI must submit the Supplemental Form to Change the Principal Investigator with the Modification request (available at hrpp.msu.edu).

Closure: Investigators are not required to notify the IRB when the research study can be closed. However, the PI can choose to notify the IRB when the study can be closed and is especially recommended when the PI leaves the university. Closure indicates that research activities with human subjects are no longer ongoing and have stopped. This means there is no further interaction or intervention with human subjects and/or no further analysis of identifiable private information.

For More Information: See HRPP Manual, including Section 8-1, Exemptions (available at hrpp.msu.edu).

Contact Information: If we can be of further assistance or if you have questions, please contact us at 517-355-2180 or via email at IRB@msu.edu. Please visit hrpp.msu.edu to access the HRPP Manual, templates, etc.

Exemption Category. Please see the appropriate research category below from 45 CFR 46.101(b) for full regulatory text. [123]

Exempt 1. Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

Exempt 2. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.

Exempt 3. Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if:
(i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) require(s) without exception that the

confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

Exempt 4. Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

Exempt 5. Research and demonstration projects which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

Exempt 6. Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

[1]Exempt categories (1), (2), (3), (4), and (5) cannot be applied to activities that are FDA-regulated.
[2] Exemptions do not apply to research involving prisoners.
[3] Exempt 2 for research involving survey or interview procedures or observation of public behavior does not apply to research with children, except for research involving observations of public behavior when the investigator(s) do not participate in the activities being observed.

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