THE INFLUENCE OF MATH AND NATURAL SCIENCE DISCOURSE

ON BLACK WOMEN'S PERFORMANCE, AND RETENTION

IN MATH AND NATURAL SCIENCE

By

Natasha Kanika McClendon

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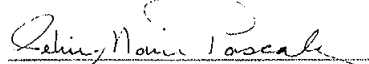
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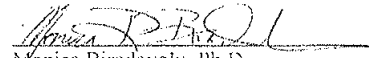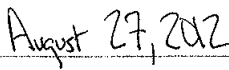the Requirements for the Degree of

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ABSTRACT

This study strives to contribute to the sociological research regarding the experiences of black women in math and science while attending predominately white institutions (PWIs). The goal of this research is to explore the dominant discourses taking place in math and natural science courses through the textual analysis of *Washington Post* newspaper articles and interviews with black women in math or science based majors at PWIs. A textual analysis was conducted using 17 newspaper articles and 8 face-to-face semi-structured interviews. The findings implicated that cultural capital and identity management were strong themes across interviews. In addition, themes of gender essentialism and representation of women and minority students as mutually exclusive surfaced. As a preliminary study, the findings reflect the need for more research on the discourse in math and science and how it informs public discourses on STEM as well as the identities of black women pursuing STEM fields.

ACKNOWLEDGMENTS

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CHAPTER 1

INTRODUCTION

While there has been an abundance of research dedicated to the performance and experiences of children and adolescents of color in math and natural science, there is a still a need for more research as it pertains to their experiences in these subjects at the collegiate level. Moreover, there is little research that delves into how collegiate experiences in math and natural science courses are confounded by the intersection of race and gender. It is the goal of my scholarship to expand the research on the intersection of race and gender by examining the discourses[1] that take place in math and science courses through the experiences of black Women attending a four-year, private, predominately White university.

While attending a small, predominately White women's college in the South for my undergraduate degree, I encountered quite a few black women who, as entering freshman, came in determined to be pre-med or pursue a major in the Math or Natural Science department. However, as those same students matriculated through the required courses for those majors, many of the black women that I knew were beginning to express their difficulty in these classes despite taking AP courses in high school and excelling where they now felt unsure. Due to my involvement in campus diversity initiatives and the campus black student association, I was privy to many of the conversations in which black women who were Math and Natural Science majors divulged their difficulties in their classes, their frustrations with professors and academic networks (tutors, study groups, etc…) and the overall feeling that there was a lack of support and desire for them to succeed on campus. As these same women matriculated through their four-year degree they had to find ways to cope with the challenges they encountered while trying to

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[1]   Discourse in this thesis refers to language-in-use.

complete degrees in their majors. For some of the women this meant participating in a support program for women of color in Math and Natural Science, for some this meant establishing their own networks for studying and tutoring amongst themselves, but for some women it also meant changing their major to a Social Science or Humanities.

In observing the black women I knew having this experience, and as I watched incoming cohorts of black women have similar experiences, I wondered how this experience was affecting their self-concept, as well as their performance and retention in Math and Natural Science programs. I have increasingly been drawn to this issue as a result of my relationships with black women majoring in Math and Natural Science, my experience working in initiatives to improve retention of women of color in those areas of study, and my own struggles in a science-based psychology program.

The goal of my research is to explore the dominant discourses taking place in math and natural science courses. I get at this by examining both interview and newspaper data. In my interview data, I am interested in how black women in math and sciences classes talk about their experiences. In particular I want to explore both hegemonic and counterhegemonic discourses. I also conduct textual analysis of articles in *The Washington Post* about black women in math and science to gain further insight into public discourse on the topic. Due to the lack of diversity that still exists in areas of Science, Technology, Engineering, and Math (STEM) concerning women and minorities, it is important that those disparities are better understood through the continuation of this research.

CHAPTER 2

LITERATURE REVIEW

African American students entering into four-year colleges and universities encounter a myriad of challenges specifically linked to their race. Similarly, women of all racial groups entering as undergraduates experience obstacles based on their gender. Within the existing sociological literature there is not a great deal of research on the intersection of black women's race and gender as it pertains to their experiences in higher education. Furthermore, there is little to no literature on the experiences of black women in math or natural science during their undergraduate careers. This being the case, the literature on the experiences of women in math and natural science attending college and the experiences of black students attending PWIs will be focused on to create a foundation for my research on the experiences of black women in math and natural science at PWIs.

Building Success

It is important to note that psychological and sociological research, describing black students' experiences while attending Historically Black Colleges and Universities (HBCU), demonstrates that black students excel in these programs when provided the opportunity to access higher education and intellectual development in an atmosphere that caters to their needs (Allen, 1992). According to the research, HBCUs are capable of fostering an environment in which the psychological necessities for success such as self-esteem, belonging, and pride in their choice of institution are present (Allen, 1992). Solórzano et. al. (2008) list four aspects of the optimal racial climate for students of color as: including all people of color on campus, a curriculum that recognizes and includes the experiences and history of people of color, programs

that encourage enrollment, retention and matriculation of students of color, and an institutional commitment to diversity. Due to the enormous success rate of HBCUs in producing black graduates, many Predominately White Institutions (PWIs) have attempted to adopt the same practices regarding black students (Guiffrida, 2005).

Chang, Cerna, Han, and Sâenz (2008) found that the science departments of HBCUs rated higher in admission selectivity, were more inclined to recruit an initial pool of eligible students, and then work to create an environment in which they are able to flourish. This practice allowed black students to flourish in the natural science departments because those departments worked to support student success in those courses; they were not trying to weed out potential science majors, which is a common practice for PWIs. For that reason, HBCUs have been known to transform black students who enter their institutions with limited financial resources and minimal college preparation to be successful graduates (Blackwell, 1987 as cited in Allen, 1992).

Conversely, black students attending selective PWIs have the burden of representing their racial group in a way that will not reinforce any negative stereotypes about their intellectual abilities. This burden has been characterized by the phrase "stereotype threat" coined by Claude Steele. Stereotype threat is, "the psychological threat of confirming or being reduced to a negative stereotype" usually within the context of educational performance (Steele, 1997). When faced with this burden it can be difficult for students attending PWIs to perform to the best of their abilities. Often times in order for black students to thrive in PWIs they must overcome feelings of isolation and exclusion by creating their own niche on campus that can support their social and cultural needs (Allen, 1992). In comparison to students attending PWIs, students attending HBCUs experienced greater academic gains and higher college grades, making their experience as a whole, more favorable than that of their counterparts in PWIs (Allen, 1992). Due

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to the continuing disparity in retention in higher education between black and White students, it is imperative that more research is conducted to determine why this disparity continues to exist.

Further, the experiences of black women in Math or Natural Science must be understood from the perspective of intersectionality. Intersectionality is a sociological concept based in the study of oppression that focuses on the impact of prejudice against the multiple identities of a person (Crenshaw, 1991). Studies have shown that as a whole, black women suffer academically as a result of their experiences of discrimination through race as well as gender (Denbo, 2002). Intersectionality has the capacity to work as both an analytical and political framework which can be used to understand and research the lives of black women (Jordan-Zachery, 2007). While intersectionality is helpful in understanding converging identities, Jordan-Zachery reminds scholars that it operates within the context of the marginalized group's lived experience providing political and structural insight into intersectionality as they experience it in their everyday lives (2007).

The literature in Science Education research journals offers a perspective on the experiences of women of color in science that is not found in the Sociology or Higher Education literature. For instance, Carlone and Johnson (2007) created a model of science identity to gain a better understanding of the experiences of women of color in science with the assumption that gender, race and ethnicity affect science identity. The science identity model consisted of three components: a) performance- the ability to perform science related practices; b) recognition- self recognition and recognition by colleagues as a scientist; and c) competence- can understand and use knowledge about science (Carlone & Johnson: 2007). Carlone and Johnson (2007) further illustrate the importance of science identity as cultural production by acknowledging the dominant meanings of "science people" defined by sociohistorical context of science and the

sociopolitical meanings of being associated with being a woman of color. They found that by encouraging the relationship between altruism and science, that has been documented in previous studies, more women of color could be recruited into science related fields as the goal of helping people was a strong part of the science identities of many of the women of color in their study (Carlone & Johnson: 2007).

The recognition that Carlone and Johnson (2007) listed as part of the science identity resurfaces in a study by Johnson (2007). In her study Johnson (2007) found that women of color reported professors as not caring about them because they continually focused on science as a subject that was independent of race, ethnicity or gender. As a result of this construction of science women of color often reported feeling that their individual needs were not addressed and the historical contributions of people of color or women in science went unrecognized as well (Johnson: 2007). This resulted in the perpetuation of the dominant cultural production of scientists as white and male. Since there is a cultural production taking place that defines what it means to be a scientist, Johnson (2007) notes that it is also important to acknowledge that it might be more difficult for some students to navigate what she refers to as decontextualized science.

Women in Math and Natural Science

During Undergrad

Fox, Sonnert and Nikiforova (2009) conducted interviews and site visits to 10 schools with programs for undergraduate women majoring in science and engineering to explore what aspects of these programs are successful in accelerating growth in the percentage of women in science and engineering programs. Through their interviews, Fox et. al. (2009) found that the most

successful support programs for women in STEM fields acknowledged the institutional influences that affect women's growth while employing efforts to increase participation, performance and retention. These programs also focused on promoting visibility and continuing to build relationships and initiatives that promoted dependability within the program, increased external funding and grant writing/research instead of only focusing on generating more of the same programs that already exist (Fox et. al., 2009). This research makes it clear that there is a need for colleges and universities to pay particular attention to how institutionalized sexism operates within science and engineering programs if they want to increase success among women.

Like the stereotype threat that African American students face because of race, many women in four-year colleges and universities experience stereotype threat due to the comparison of their performances against their male counterparts. Hippel et. al. (2011) explores how stereotype threat influences the communication styles used by women of all racial groups to provide insight on the interpersonal effects of this phenomenon. In comparing the communication styles of all women and men, women are usually characterized by men as less assertive and less competent because their style of establishing rapport and engaging in responsive interactions are not valued equally (Hippel et. al., 2011). This is important to research on the experiences of women in STEM based majors because the difference in communication styles could be one of the issues present in the discourse that takes place between female students and the predominately male faculty in these departments. Hippel et. al. (2011) also found that women were less likely to be affected by stereotype threat when performing positive self-affirmations because they were more likely to focus on their positive attributes.

This study has relevance to the experiences of African American women in Math and Natural Science because self- affirmations may prove helpful in combating the negative effects of the stereotype that white and male students are better in those subjects.

African American Experiences in Undergrad

Solórzano et. al. (2008) list four aspects of the optimal racial climate for African American students as : including all people of color on campus, a curriculum that recognizes and includes the experiences and history of people of color, programs that encourage enrollment, retention and matriculation of students of color, and an institutional commitment to diversity. With the preferred environment in mind it becomes easier to identify what is making the racial climate at certain colleges and universities less welcoming to African American students.

Within the classroom many African American students experience racism through instances such as racial microaggressions, stereotype threat, and racial stereotypes regarding their academic abilities. Solórzano, Ceja, and Yosso (2008) refer to the definition of the psychiatrist Chester Pierce, who defines microaggressions as "subtle, stunning, often automatic, and non-verbal exchanges which are 'put downs' of blacks by offenders," in conjunction with those of other scholars. It is also imperative to include the definition by Davis (1989, as cited in Solórzano et. al., 2008) that characterizes racial microaggressions as "stunning, automatic acts of disregard that stem from unconscious attitudes of white superiority and constitute a verification of black inferiority." Upon exploring the effects of racial microaggressions on African American students, Solórzano et. al. (2008) found that the students experienced feelings of invisibility, low expectations from professors and peers, disbelief and discouragement of their academic abilities, exclusion or underestimation by their peers and assumptions of affirmative action. Experiences

such as these contribute to African American students' feelings that they are living in a separate world than their White counterparts when attending PWIs (Morrison, 2010).

In psychological literature, stereotype threat was first defined by Claude Steele as, "the psychological threat of confirming or being reduced to a negative stereotype," usually within the context of educational performance (Steele, 1997). Conversely, in Sociology, Solórzano's study demonstrates the role of racial stereotypes in creating ideologies such as the culture deficit model which depicts students of color as having inherent deficiencies passed along to them through minority cultural values (1997). This type of thinking was also present in the Solórzano et. al. study on microaggressions which described the tendency for white professors to assume that students of color were less intelligent or less capable based solely on preconceived racial stereotypes (2008). When African American students continually interact with students and faculty who adhere to racial stereotypes, they develop a cultural mistrust defined by Caldwell and Obasi as a response to a history of oppression which leads them to be distrusting of white Americans (2010). Cultural mistrust has the ability to affect students' perceptions of the academic system, and consequently, their performance when they feel that schools are not supportive of their needs or representative of their experiences (Caldwell and Obasi, 2010). While this has been found to be a common experience of students attending PWIs, Caldwell and Obasi found that African American students attending HBCUs reported higher achievement motivation, lower cultural mistrust and higher value of education than African American students attending PWIs (2010). Although African Americans often fair better at HBCUs in regards to their perceptions of supportiveness and the resulting achievement motivation, Lewis and McKissic argue that students attending PWIs can also excel through finding support through participation in black student organizations and the black student community on campus (2010).

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By participating in these organizations the students in the study felt higher self-confidence, a stronger since of self, and a prolonging effect on their retention (Lewis and McKissic, 2010).

CHAPTER 3

CRITICAL RACE THEORY

<u>Foundations of Critical Race Theory</u>

Critical race theory (CRT) developed out of Critical legal studies (CLS) in the 1970s. It begins with the premise that one cannot engage in scholarship with complete objectivity because, "there is no scholarly perch outside the social dynamics of racial power from which merely to observe and analyze" (Delgado, 1995). According to Delgado and Stefanic (2001) there are three approaches to thinking about critical race that divide many critical theorists: Idealists tend to believe that race is a social construction rather than an actual reality and by re-socializing people to change the way they approach race, the negative effects of the current construction can be weakened. Conversely, realists (also known as economic determinists) posit that racism is part of a racially hierarchal system created to establish and assign privilege and power (Delgado and Stefancic 2001). Materialists believe that racism is used as a justification for the exploitation of minority groups and is based on the dominants group's goal to sustain those attitudes and practices that benefit them. Therefore, materialists believe that in order to achieve gains in civil rights, it is necessary to appeal to the converging interests of the majority and minority groups given that racism acts as a means to establish domination over minority groups (Delgado and Stefanic, 2001:17).

Another major theme of CRT noted by Delgado and Stefanic (2001) is Revisionist History which is the practice of re-examining the historical narrative that exists, and bringing the experiences of the minority groups into that narrative. In addition, revisionism dictates that the material aspects of history are explored to determine how the "attitudes follow, explain, and rationalize what is taking place in the material sector" (Delgado and Stefancic 2001).

The third theme presented by Delgado and Stefanic 2001:21) is the critique of liberalism by critical race theory scholars. A major critique of liberalism made by many critical race theorists is that liberals tend to operate under color blindness which makes it more difficult to mitigate those injustices that are not blatantly racist (Delgado and Stefancic 2001). Another popular critique of liberalism by critical race scholars is that the rights that currently exist are interpreted in our society to benefit the majority rather than the minority (Delgado and Stefancic 2001). Even civil rights legislation tends to work within the narrow confines allowed by the majority in that it can be defined so that the original intention of the law is lost. For example, there have been instances in which concepts like affirmative action have been used to benefit the majority more than the minority it was written to empower as in the busing efforts or voucher systems. The last theme presented by Delgado and Stefanic (2001) is structural determinism. This final theme within the context of CRT is the idea that within the structure of our current system it lacks the capacity to address certain aspects of racism.

Critical Race Theory is commonly used by scholars in education to understand the educational experience—particularly for students of color. In her article, "*Just what is critical race theory and what's it doing in a nice field like education?*" Ladson-Billings (1998) connects CRT to education via its relationship to curriculum, instruction, assessment, school funding, and desegregation. According to Ladson-Billings (1998:18), "Critical race theory sees the official school curriculum as a culturally specific artifact designed to maintain a White supremacist master script." The master scripting she refers to is the silencing of minority voices within the curriculum as well as the normalization of Whiteness that occurs creating the master script which is referred to as the truth. As stated by Zamudio et. al. (2011), most CRT scholars would agree

that the purpose of CRT is to challenge those dominant ideologies and remain committed to activism in social justice.

Another one of the roles of CRT in educational research is supporting the development of critical race praxis, which can then be applied in curriculum, policy and pedagogy (Zamudio et. al., 2011). Ladson-Billings describes the connection between the experiences of students of color outside of the classroom as shaping their perspectives and aptitude within the classroom in a study conducted using a CRT framework (2009). Although students' experiences have the capacity to negatively affect their academic performances they can also develop skills that benefit them (Zamudio et. al., 2011). By using CRT, academic scholars are provided with a critical framework from which they can provide evidence for the racism and the resulting disparities in the educational system while also highlighting the often overlooked strengths of students of color (Zamudio et. al., 2011).

Critical Race Theory and My Research

CRT promotes the use of storytelling and narrative to give voice to the discourse on racial justice (Ladson-Billings, 1998). This use of narrative often results in the production of a counter narrative. CRT scholars use counter narratives as a method of exposing a narrative that is contrary to the master narrative (Zamudio, Russell, Rios, and Bridgeman, 2011). The term master narrative is often used in CRT to describe the popular and dominant narrative of truth and reality; which is usually based on a historic narrative that tells the story of the colonizers but excludes the voices of the colonized (Zamudio et. al., 2011). This concept is similar to the imposition of ideal normative grammars in Gramsci's linguistic theory. Master grammar differs from normative grammars in that they are only representative of the ruling or dominant class and

exclusively accessible. For Gramsci, normative grammar much like counter-hegemonic narratives strive to create a production of knowledge that is more inclusive of the experiences of all people rather than just that of the dominant group (Ives, 2004). Counter-hegemonic narratives also tend to follow the same tenets as CRT in that "they challenge the dominant ideology, they have a commitment to social justice and they highlight the centrality of experiential knowledge," according to Solórzano and Yosso (2002).

When used within the context of education, counter-hegemonic narratives can be presented through poetry, speeches, parables or other sources as a way to position them as juxtaposition to the master or hegemonic narrative. CRT scholars claim that by using these counter-hegemonic narratives as alternatives to the existing master narratives, people of color are given an opportunity to tell their story in a way that is both cathartic and empowering (Delgado & Stefancic, 2001). In having the opportunity to tell the story that people of color feel represents their experience, they are able to take part in redefining the existing hegemonic narrative.

This practice will prove helpful in answering my research question in that it will provide a foundation for me to critically analyze the discourse taking place among black women and their networks within Math and Natural Science departments in predominately White, private universities. Ladson –Billings points out that "members of minority groups often internalize the stereotypic images that certain elements of society have constructed in order to maintain their power," however, by telling their story, the result is often regarded as not only therapeutic but also enlightening experience for those being subjugated and oppressed.

CHAPTER 4

METHODOLOGY

Qualitative inquiry is the term often used to describe any research in which non-numerical

data is analyzed. Yet qualitative inquiry is more than the use of non-numeric data; it is also an

epistemological position that guides how one makes sense of data. The methods of qualitative

inquiry include interviews, ethnographic fieldwork, case studies, and narrative inquiry to name a

few in comparison to surveys and numerical data sets used in quantitative studies (Schwandt,

2007). In comparison to quantitative research, qualitative methods are usually understood as

aiming to gain a more in depth understanding of the social construction of our world and how we

as people operate within it day-to-day (Outhwaite & Turner, 2007). In addition, qualitative

research also engages the position of the researcher in the topic that they are studying. By

situating themselves in their research the scholar is better able to inform the reader of their

connection to their research and how their perspective may have shaped their research.

Since I used critical race theory as my theoretical framework, I thought that a critical race

methodology would also be helpful in the design of my study. Solórzano and Yosso (2002)

describe a critical race methodology that is informed by critical race theory and applicable to

research in education. The goal of critical race methodology is to use counter-hegemonic

discourses as a tool to combat notions that people of color are deficient while also presenting

data that is grounded in their experiences (Solórzano & Yosso, 2002). Critical race

methodology, as defined by Solórzano and Yosso, does the following five things:

(a) foregrounds race and racism in all aspects of the
research process. However, it also challenges the separate discourses on race,
gender, and class by showing how these three elements intersect to affect the

experiences of students of color; (b) challenges the traditional research paradigms,   texts,
and theories used to explain the experiences of students of color;
(c) offers a liberatory or transformative solution to racial, gender, and class
subordination; and (d) focuses on the racialized, gendered, and classed experiences
of students of color. Furthermore, it views these experiences as
sources of strength and (e) uses the interdisciplinary knowledge base of ethnic
studies, women's studies, sociology, history, humanities, and the law to
better understand the experiences of students of color. (2002: 24)

The components of critical race methodology, as laid out by Solórzano and Yosso are what drew

me toward using this methodology for my research.

As a qualitative researcher doing interviews and media analysis, I was also concerned with

issues of saturation. The concept of theoretical saturation has been used in conjunction with

theoretical sampling in grounded theory. Both theoretical sampling and theoretical saturation

have been regarded as ways to constitute validation while using interviews. Bloor & Wood

(2006:165) define theoretical saturation as "the sampling and data collection until no new

conceptual insights are generated." Similarly, theoretical sampling is the process of amending the

sampling based on the needs of the study by choosing those cases that would be most likely to

provide the most data relevant to the research question (Bloor & Wood, 2006:165). Theoretical

saturation is imperative in interviews research because it is usually determined by the fact that

there is nothing else to be found by continuing the research.

For my data collection of newspaper articles, I used theoretical sampling to find all the

articles that mentioned women and math and science during the time frame of about 12 months[2],

in an effort to find all the cases that fit my research question. Although theoretical sampling is

used to gain saturation I acknowledge that because I only used the database Lexis Nexis, I may

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[2]   The time frame was dictated by the length of the M.A. program which is two years. The second year was
dedicated to the majority of my research which accounts for the time frame of 12 months.

not have reached complete saturation for the *Washington Post* articles. However, using the database that I chose, I attempted to reach saturation. Similar to the interviews I also depended on the use of external audits (described below) in bringing validation to my analysis of newspaper articles.

In my data collection for interviews, I worked to reach saturation by using theoretical sampling in conjunction with convenience sampling and tried to continue interviews until I had explored all the cases that fit my research question. However, I also had to acknowledge the possibility that it might not be possible for me to reach saturation because the population that I was focusing on in my study was too small and after interviewing the entire population there still may not be any consensus or homogenous experiences. The other possible outcome is that I might quickly reach saturation due to the small size of the population, similarities and consistencies in the experiences of participants.

There are many differing views regarding the role of validation in qualitative research and the procedures that can be used to constitute validation. Another term used by qualitative researchers to describe validity is trustworthiness, which Eisner (1991) constructs through credibility using "structural corroboration, consensual validation, and referential adequacy" in exchange for the traditional quantitative-based concepts. In hopes of constructing credibility in my study I used Eisner's (1991) structural corroboration, which is defined as relating different sources of data to either conflate or contradict our interpretations. By doing a thorough research on the current literature I was able to use that evidence to inform my interpretation by linking themes concerning the experiences of black women in Math and Natural Science while attending private PWIs for undergrad.

Given that my research involved interpretation of the discourses that take place in Math and Natural Science courses it was also helpful to employ Angen's (2000) conceptualization of validation as ethical and substantive for interpretive inquiry. Angen (2000: 389) defines the requirements of ethical validation as the ability of the research to engage the "underlying moral assumptions, their political and ethical implications, and the equitable treatment of diverse voices," while also answering questions practically in a way that leads to change and action. Substantive validation is described in terms of understanding; understanding the research, alternative understandings from different sources, and the inclusion of this process during the writing of the study (Angen, 2000). Angen (2000) notes that self-reflection is imperative in this form of validation to ensure that the researcher acting as a "sociohistorical interpreter," is connected to what they are studying and the interpretation they are co-creating. I thought that this form of validation would be essential in helping me to make sure that I reflected on how my part as the researcher contributed to the research I conducted.

Creswell (2007) offers several strategies for validation that include clarifying researchers' bias, member checking, rich thick description, and external audits. These four strategies were very useful options for establishing validation in my study because they are effective but also time and cost efficient for my research. Clarifying my researcher bias is a strategy that connects to Angen's substantive validation in that it requires self-reflection and understanding of those elements that my experiences and point of view bring to the research. Member checking requires that the researcher have the participants of the study critique the researcher's interpretations for validity as well as accuracy (Creswell, 2007). This process is a reasonably simple but very effective way of validating the interpretations that I made using interviews, by allowing me to receive feedback directly from the source of the data. The process of rich, thick description is

describing the details of the study to the extent that any reader can see how the findings in the study can be transferable to other research questions (Creswell, 2007). By making sure that I took the time to extensively describe all the details of my research over the course of my study by keeping a research journal, I was able to include all of those details into the final write up of my research. The last tactic, external audits, entails the auditing of the findings and the process by an outside party to determine if the findings are corroborated by the data (Creswell, 2007). By meeting with my committee regarding my research design and interpretation of the data, I was able to receive an audit to conclude whether my findings are backed by my data.

As noted in Creswell (2007), there are also a number of ways to address reliability qualitatively, one of which is by using quality recording and then transcribing that recording. This method was easily incorporated into my research design as it is a common method used when conducting interviews and examining discourse. In the event that the respondent was uncomfortable with my use of a recorder I was prepared to use what Seale (1999, as cited in Silverman & Marvasti, 2008:271) describes as low-inference descriptors as giving concrete examples of interviewees' responses rather than my summary of their comments. In conjunction with the inclusion of low-inference descriptors, I also had the option of adding the continuers that I used to prompt respondents during interviews as a way to give a more complete account of the interview (Rapley as cited in Silverman & Marvasti, 2007). By using these different strategies I hope to make my study more valid and reliable.

Although I took these measures to strive for validation and reliability, it is also important to note that the goal of my research was to offer a thick description of the population within my research rather than generalizable results as in quantitative research. The intention is to develop research that leads to social theory.

Ethics

Due to the sensitive nature of my research question, it was necessary to withhold details about the study until the completion of the interviews. In addition, I did not want respondents' answers to the interview questions to be primed by telling them that the study would be about race before they participated in the interview. While not telling participants ahead of time that the study would be focusing on race as well as the discourse in their math or natural science courses could be regarded as deception but it is so minimal that it would not cause discomfort to participants. An informed consent form was presented to each student prior to the commencement of the interview process to ensure that they had the opportunity to read a brief description of the study and decide if they wanted to participate.

In regards to risk associated with my study, anonymity and confidentiality were the only risks that I foresaw as possible issues. However, the informed consent form expressed to participants that all information recorded during the interview would be confidential and only available to me and my advising committee. Furthermore, names were not used to identify any of the interviewees; but instead the participants were assigned code names. Keeping the interview recordings and transcriptions confidential also aided in ensuring that the anonymity of the respondents was upheld. Due to the small population of students that met the requirements for my study it was crucial to protect their identities and by taking these preventative measures it was less likely that their privacy or anonymity would be violated.

CHAPTER 5

METHODS

The focus of my thesis is to explore the discourses that take place within Math and Natural Sciences in classrooms as well as public media through analysis of interviews and newspaper articles. In doing this research I hoped to gain insight as to how those discourses affect the experiences of black women in those classrooms and other environments associated with their coursework in math and science. Through the experiences of black women attending predominately white, private universities on the East Coast, I want to explore how the dominant discourses might open and foreclose opportunities for black women and how black women generate counter-discourses that help them to succeed.

<u>Interviews</u>

I conducted semi-structured interviews because they allowed me to direct the conversation in the direction of my focus and interests but still allow the respondents to express themselves freely within those parameters. I performed all of the interviews face-to-face due to the sensitivity often attributed to issues of race, self-concept and personal performance. Furthermore, face-to-face interviews allowed me to gain greater detail and insight into the responses which was crucial to my research question as I am doing a close reading. This close reading was used to locate some of the deeper meanings associated with the discourse the interviewees took part in while taking Math and Natural Science courses in an environment where they are often the minority by gender, race or both (Gillham, 2000:11).

I created 6 prompts that were used to inquire about the respondents' general experience attending a private PWI, their general experiences in all their courses, their experiences in Math

and Natural Science specifically, their perceptions of their performance in Math and Natural Science courses, the influence of their identity as women of color on their experience as Math and Natural Science majors, and their perceptions of supportiveness from faculty and tutors/teaching assistants.

<u>Sampling</u>

In order to gain the largest sample possible it was necessary to use a combination of sampling methods. Due to the fact that I am focusing on the experiences of black women in specific academic departments it was beneficial to use criterion sampling to make sure that the women that I interviewed were black undergraduate students that were majoring in Math, Natural Science or as Pre-Med while attending the private East Coast PWIs in the study. I used criterion sampling to make sure that there was a degree of continuity among the participants in the sample by ensuring that the participants self-identify as African American or black and that they have completed a Math or Natural Science course before I begin interviewing them. It was also beneficial to use opportunistic and snowball sampling to take advantage of the connections that I made while conducting research and then use them to bring in more participants. Snowball sampling allowed me to take advantage of the connections of participants that I interviewed by asking if there are potential participants that meet the criteria for the study whom they can recommend. In conjunction with snowballing, the use of opportunistic sampling assisted in the diversification of the sample by allowing me to take advantage of opportunities provided through networks of faculty and other students to gain more participants. The final sampling method that I used was theoretical sampling which helped me to hone in on the main themes and trends in order to better select potential respondents as I continued my study. By combining these

sampling methods I was better able to locate potential interviewees who met my population criteria.

Initially, my intention was to use the PWI I currently attend. Upon trying to gather interviews at this PWI I was met with a few obstacles in finding participants. While I was able to locate several gate keepers and discuss possible interviewees I was not able to gain access to the particular students. As a graduate student, who spent limited time on campus it was difficult to build enough trust to get contact information or names of the students that might have been interested in participating in my research. Due to the difficulty that I initially encountered in trying to find potential participants for my research I had to open up the population to include another school. I decided to use another private PWI on the east coast to add to the sample that I initially gathered. I was able to collect seven additional interviews to my sample and complete my sample of eight women.

Upon collecting my interviews in the form of recordings I started the coding process by developing rough transcriptions. The rough transcriptions were summaries of each interview that I used for the analysis in order to save time by not transcribing each entire interview. By transcribing summaries of the interviews I was able to efficiently analyze the trends and eventually themes within my data. I coded the interviews by looking for similarities and differences among the responses of the participants in order to bring out the themes among them. When using exemplars I returned to the interviews to do a complete transcription of the quotes that would be used to illustrate the themes that were identified.

<u>Newspaper Articles</u>

In order to collect my sources I used the LexisNexis Academic search engine used for locating news and magazine articles. I decided to use articles from *The Washington Post* because it is a national paper and is widely cited by other newspapers, both nationally and internationally. To collect my sample I employed theoretical sampling to ensure that my sample met the needs of my research question. Using theoretical sampling, I chose articles that spanned from 2004-2011 with the intention of capturing the most recent discourse on women in math and science. I narrowed my search during that timeline by using variations on the search term "women in math or science" and then focusing on those articles which had the words "women", "math" or "science" in the title or abstract. The last measure I took in creating my data set was to eliminate all editorials and articles that were extraneous such as obituaries, listings or announcements for events such as museum openings. After using these measures to utilize theoretical sampling I had a contained data set of 17 newspaper articles from eight years of reporting (2004-2011).

Once I had collected the articles for my contained data set I coded them by first reading them and noting the individual themes that stood out in each article. In order to identify the themes I looked for repetitions, similarities and differences, and then cut and sort those that fit like themes. Repetitions of patterns were noted to find themes within the data because as Ryan and Bernard (2003) note the more often a concept is repeated the more likely it is that it is a theme. I also noted the differences between the articles in my data set and made note of any exceptions to the patterns that surfaced as I was identifying the themes. I highlighted each instance of the themes in every article and then summarized how each theme was presented in each individual article. After coding and summarizing the themes I chose the articles that best represented the themes that I would be analyzing.

CHAPTER 6

NEWSPAPER ARTICLE ANALYSIS

Upon analyzing *The Washington Post* newspaper articles that referenced either women or math and science two themes surfaced. The first theme was that women and people from racial/ethnic minority groups were written about as if they comprised two mutually exclusive groups in articles about their participation in math and science. The second theme that surfaced was women's abilities in math and science compared to men's in areas such as test scores, behavior and learning environments.

<u>Women and Minorities as Mutually Exclusive</u>

Articles that referenced women and ethnic or racial minorities tended to use terms such as "race" and "ethnicity"; a specific nationality (Chinese, Japanese, Arab, etc…); the ethnic groups "Black" or "African American" and "Hispanic" or "Latino"; or the terms "people/children of color" or "minorities." In hegemonic discourses we know that unmarked categories are used to refer to the dominant group. Therefore I understand the reference to "women" as referring to white women. Within the articles that mentioned these terms the theme of women and minorities as mutually exclusive began to emerge. For those articles that did not exhibit this theme students from ethnic and racial minorities were not mentioned at all. What I found interesting was that many of the articles described the struggles of women or girls and the struggles of African Americans/blacks or Latinos/Hispanics in a way that positioned them as mutually exclusive to women or girls. This was done repeatedly throughout the articles in several different ways. For example, in the article, *"How a self-fulfilling prophecy can drag down performance,"* the author writes a statement comparing the struggles that different students may face in school.

Stereotype threats seem to emerge in large part because certain settings can subtly make particular groups feel out of place: A woman in a math class, a black or Latino man confronted by a vocabulary test, a white man trying to make a basketball team. When confronted by challenges that inevitably arise in these contexts, people threatened by stereotypes get the false message that they ought to be doing something else. (Vedantam 2009)

In this statement, the author positions the identities of a woman, a black or Latino man and a white man as isolated or distinct identities. As a result the article elides the presence, arguably the very *possibility*, of black or Latino women in a math class. Throughout this article, references describe students who may be struggling in math or science but they either describe them according to their ethnicity, race or gender (women). By identifying students as belonging only to one of these three criteria, they exclude the experiences, perspectives, and needs of minority women from the discourse. This is especially evident by the fact that women, black or Latino men and white men are specifically named in this way. In listing these categories so specifically the author leaves no space for women of color to exist in this discourse. Further analysis also shows that the author is presuming that women in math or science do not need to be named because they are white. This assumption leads us back to the critique, in CRT, that in instances of privilege those aspects that are not named are assumed to belong to the dominant group.

Consider also an exemplar from the article, "Girls Deserve Better Educators; Laurie Snow Turner of Herndon submitted this column about what she termed 'the so-called gender gap in education'." Turner tells stories from her experiences as a woman with a daughter who is excelling in math and science explaining what she thinks about the way boys and girls are treated in math and science and how to improve the current climate to better support young girls. In the following excerpt the author, Laurie Snow Turner argues that educators and parents should learn from their kids' example and not acknowledge the distinctions between different groups of people:

But all of this crowing was canceled out by his comments about girls and minorities. My daughter and her friends rolled their eyes, as teenage girls do so well, shook their heads and said, "He just doesn't get it." And they are right. He and many other educators in today's schools really don't get it when it comes to these important issues. When we teach our children to notice the distinctions between different groups of people, we teach them to believe the distinctions matter. When we even allude to differences based on race, gender or any other distinction, we teach our children to believe that they should act differently because of them. When it comes to basic civil rights, our children are far more sophisticated than we tend to believe. Our educators would be well-advised to follow their lead. The less they clump students together in special groups, the further our children will advance in their real-life education. (Turner 2004)

However, in looking at the way students are again referred to as either girls or minorities it may be better that distinctions between groups of people are made. By identifying the children as only "girls and minorities" there seems to be an assumption being made that the students can't possibly be girls and minorities at the same time. Furthermore, the author goes on to declare that by acknowledging distinctions children are being taught that distinctions matter and "when we allude to differences based on race, gender or any other distinction, we teach children to believe they should act differently because of them." I found this argument to be contradictory based on the fact that although it may have been unbeknownst to the author, they have already made those distinctions based on race and gender. By not acknowledging that these distinctions are being made could be more damaging because it could result color blindness. As referenced by Zamudio et. al., (2011) the acceptance of color blindness presupposes that whiteness is the standard that all other cultures are judged against. Moreover, the author is positioning herself in a place of privilege by assuming that all of the children in her daughter's school do not see color because her white daughter does not see color. As a white parent she has the privilege of choosing to not to make those distinctions that indeed exist and are reinforced daily for students of color.

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The theme of referring to women in math or science and minorities as mutually exclusive was also evidenced through the lack of any reference to race or ethnicity and explicit naming of whiteness when referencing women or girls. In the article, "More women are feeling at ease in science labs," the author positions women or girls in math or science as white by identifying the women in the "all-women's lab" as white in quotes given in the article.

> "That lab was a refuge between classes. I loved being there," says Allred, now a second-year doctoral student in the Yale University chemistry department and one of a new generation of young women who are helping change the face of the so-called STEM fields - science, technology, engineering and math. Though she was happy to help blaze the path for them, Harbron says she didn't set out to create an all-women's lab. It happened naturally. Students such as Allred sought her out because they liked her informal, lively teaching style. "I don't want to become a female ghetto of overachieving white girls," Harbron jokes, referring to the general makeup of her lab these days. Then she asks more seriously: "But am I just perpetuating the model that's gotten us where we are?" (Irvine 2011)

The professor, Harbron, who is quoted in the article jokes that she doesn't want to become the "female ghetto of overachieving white girls," which refers to the women that frequented her lab. The author explains that Harbron is talking about the "general makeup of her lab these days." This description of the makeup of her lab gives the impression that there may be other people besides the majority of white women that attend the lab. The fact that these students are not explicitly referenced reinforces the theme that students of color are possibly not being recognized. Although there is no way of knowing who the unidentified students are it is evident that they are not seen as important to the telling of this story. By identifying the women as "white," Harbron positions all the women that used the lab and that are changing "the face of the so-called STEM fields" as white women.

For those articles that did mention an ethnic group of women other than white, such as Japanese or Chinese, (31 July 2005, Lally; 30 Jan. 2005, Valian) they developed that descriptor

as a nationality rather than a race or ethnic group that could qualify them as a minority. This was

accomplished by establishing the "minority" group through identifying blacks or Latinos as

belonging to that group. An example of this is shown in the article, "How a Self-Fulfilling

Stereotype Can Drag Down Performance*"*, in which the author describes stereotype threat:

> Dozens of field experiments have found that reminding African Americans and Latinos
> about their race before administering academic tests, or telling them that the tests are
> measures of innate intelligence, can hurt their performance compared with minorities
> who were not reminded about race and not told that the results reflect inherent ability.
> (Vedantam 2009)

Here it is evident that the use of the term "minority" is being defined as those students who are

African American or Latino as the writer lists the ethnic groups out in the beginning of the

sentence then later refers to them using the blanket term "minority." Another important point is

that the author is discussing the effects of stereotype as they pertain to African Americans and

Latinos but does not describe how it may affect other racial or ethnic minorities such as Asian or

Native American students. This exclusion reinforces their use of the term minority to describe

African American and Latino students exclusively.

An important consequence of the style of reporting in this first theme is that the

association of whiteness and women is naturalized and the presence and value of women of color

is erased. Articles that did not report women and students of color as mutually exclusive from

women either did not mention women at all or did not mention ethnic/racial minorities at all.

Two articles described the experiences of white women in math and science without the mention

of any students from other ethnic or racial backgrounds. The last article referred to education

legislation and its effects on minorities but did not mention women.

<u>W omen's Abilities are Compared to Men</u>

Articles that characterized differences between women and men pursuing math and science related fields were more likely to write about gender situating the attributes as oppositional to one another. In all of the articles is a use of language that discursively constructs "the opposite sex" which perpetuates and maintains the gender/sex binary. The comparisons covered issues such as the different behavioral patterns of women and men in math or science, the different environments that women and men in math and science do well in and differences in test scores. Although the majority of the articles compared women in math or science to men in some way, many of the articles differed in the way they compared men to women. The example of comparisons between women and men in math or science that is consistent across the most articles is that of women as more social, altruistic or collaborative and men as more conflict-oriented, individual and money driven. However, this sub-theme only exists across five of the fifteen articles that compare men and women's experiences in math or science.

For example, the article, "Raise Your Hand if You're a Woman in Science…," is one example of how women in math or science are compared to men based on their behavior and their approach to pursuing STEM oriented fields.

> The result of the experiment by Heilman and colleagues is typical of other research: Both men and women give men the benefit of the competence doubt. Why do we do this? Because we're like Summers: We have conceptions -- what psychologists call "gender schemas" -- of what it means to be male or female. We tend to see males as capable of independent action, as doing things for a reason and as getting down to the business at hand. We tend to see females as nurturing, communal and expressive. So which person, man or woman, seems a better fit for the job of assistant VP in an aircraft company? One guess. You can expect similar results in other male-dominated fields -- such as the sciences. (Valian 2005)

Within this article women and men's behavior and approach to math are positioned as oppositional to each other. Where women are "nurturing, communal and expressive," men are

viewed as "capable of independent action, as doing things for a reason and getting down to the business at hand." The issue with this portrayal of women is that it puts men in a position of power by depicting them as more competent and a "better fit" for the jobs in math and science while devaluing the traits attributed to women. By juxtaposing the attributes of women against those of men, they are giving the impression that men are taking advantage of the system of meritocracy by "getting down to business" while women are socializing. As the author writes, this is a perpetuation of the already existing "gender schemas" of how men and women perform gender which, when brought into the workplace can influence the perceptions of how women will perform in male dominated fields.

Another example of this comparison of women with men in math and science is evident in the descriptions of the differences in what types of courses men and women take, their behavior and how it guides their choices. It is posited that women are attracted to different courses than men because they align with their "personal interests, personality [and] levels of exposure at younger ages to stereotypical signals sent by adults" (Strauss 2005).

> Although all Thomas Jefferson students are required to take computer science, the more advanced elective courses are heavily populated with boys, as are advanced physics, engineering and math, teachers and students say; biology and chemistry classes are more attractive to girls, as are the humanities. Students, teachers and administrators attribute class enrollment to factors including personal interests and personality, levels of exposure at younger ages and the subtle -- and not so subtle -- stereotypical signals sent by adults. Boys, for example, are more often exposed to computers and blocks at an earlier age than girls -- perhaps because they like them more, perhaps not -- and thus come early to engineering, a subject that requires early interest for proper sequential course enrollment, teachers said. Girls are usually more social -- something Jan Taylor, an engineer turned school counselor at Thomas Jefferson, believes is "hard-wired" -- and physics and math are commonly seen as more individual pursuits. Biology, on the other hand, is usually seen as more collaborative, students said. Boys, Dell said, are more generally programmed for conflict, and part of scientific endeavor is to challenge conventional wisdom with an

argument. And boys don't mind being wrong as much as girls, both boys and girls said. (Strauss 2005)

In this exemplar, the writer is once again essentializing gender by attributing the differences in the course populations to the gender traits of girls vs. boys. While the differences in the class enrollment are seemingly attributed to a myriad of factors such as personality, personal interests and levels of exposure to stereotypical signals, all of these defer to gender differences to make sense of these factors. For example, although personality is not defined explicitly by gender identity, the article goes on to describe women as "hard-wired" to be social, which accounts for their lower enrollment in courses such as physics or math because they are seen as independent pursuits. This becomes even more interesting when the gender of the engineer-turned- school counselor is explored. The counselor, Jan Taylor, who seems to be a woman, exhibits an acceptance of the same gendered stereotypes that have made it difficult to pursue math heavy majors such as engineering. Ironically, it may be the perpetuation of gender stereotypes by administrators like the counselors that influence girls to choose biology or chemistry over physics and math.

The article goes on to describe how boys are "programmed for conflict," making them more likely to question "conventional wisdom." This serves as another example of how gender is essentialized to make boys seem naturally better at science than girls. However, this could be another instance in which subtle and not so subtle "stereotypical signals sent by adults" are more likely to blame than natural traits. Girls, more often than boys, are discouraged from being confrontational despite what their personality may reflect. Given the social expectation that little girls are to be polite and amiable rather than argumentative it is most likely socialization that accounts for women caring more about being wrong or questioning conventional knowledge.

In this exemplar is another instance of how girls and boys are situated as having oppositional approaches to science based on gendered traits.

> Girls of all ages like math and science to be useful and relevant to their everyday lives. A college course on how to take apart a computer and put it back together attracted 300 male students and no young women -- until the announcement describing the course changed, to say that the computers they worked on would later be given to needy schools. Then the women signed up. (McNees 2004)

This article illustrates an instance in which making science and applied subject increases the appeal to both women and minority students. Like many of the preceding articles, this author still relies on the same essentializing discourse as the previous exemplars in that it still defers to describing women and men as having mutually exclusive traits that determine their involvement and pursuit of math and science. The author continues to essentialiaze gender in the way that he writes about the men who enrolled in the computer course as being less concerned with math or science being " useful and relevant to their everyday lives," though they have no definitive way of knowing if that is the case. As women and minority students are often subjugated within our society, they may be more drawn to those sciences that would allow them to make an impact on their communities by using science in an applied context.

Summary

As evidenced by the patterns that developed from my analysis of these *Washington Post* articles, there is a limited scope of what is included in the public media discourse on math and science. The patterns of women and men's traits as oppositional to each other in math and science and the description of women and racial or ethnic minorities as mutually exclusive both have consequences for how not only women of color, but all women and people of color are represented in the public discourse. By writing about women and men in math and science, using

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essentialized gender attributes, it gives the impression that there is little that can be done to close the gap between women and men in math and science because there are natural attributes that make on gender better suited to pursue these fields. When public media depicts women this way it releases institutions that may systematically perpetuate these patterns from any culpability in rectifying the retention and achievement gaps between men and women in STEM fields.

In addition to the essentializing of gender traits, writing about women and minorities as mutually exclusive can have repercussions for both women and students of color. One of the most glaring aspects was the lack of representation of any black or Latino women in math or science in the articles. In some cases women from Asian countries were written about but not as American women in math and science. This was particularly problematic because that implies women of color in America are not choosing to pursue majors in STEM when in fact, they are and may be being overlooked in public media as well as in the classroom. As shown by Carlone & Jackson (2007), it is important for women of color in math and science to be recognized as scientist by themselves and others not only on a personal level but also in a sociopolitical and sociohistorical respect. If girls who are interested in going into math or science are not accepted as being math or "science people" by their peers and superiors and cannot find examples of women like them in public media they may be less likely to see themselves as scientists or mathematicians.

CHAPTER 7

INTERVIEW ANALYSIS

In this section I will analyze each theme and the variations within them. Two topics that were present in all of the interviews were the concepts of identity management and cultural capital. These topics developed out of themes regarding the students' perceptions of support within their math and science departments as it pertained to their classes, faculty and staff support and their experiences within bridge programs as they entered into their freshman year.

Identity Management

Women used strategies for identity management[3] regularly in their classes, and in interactions with faculty, staff and students. In my interviews this appeared in a very particular way as black women talked about their academic experiences in primarily white schools. For example, across my interviews while students began to describe their experiences in their math and science programs and its resources by at first praising the programs, they ended by criticizing them. For example the women talked about the many resources available to them and acknowledged the school's reputation, the credentials of the faculty and the initiatives to diversify and retain students of color in math and science programs at their respective colleges and universities. However, despite their declarations of these resources as helpful, many of the women went on to describe how they were hesitant to use the resources such as office hours or tutoring as they began taking courses for their math and science majors. Consider an exemplar of this pattern that occurred in my interview with Annette, asophomore majoring in math:

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[3]   Identity management is used here in reference to Carlone & Johnson's (2007) "science identity" and is applied to the construction and maintenance of Black women in both math and science. The three components of this concept are a) performance, b) recognition, and c) competence.

NM: And what made you want to be a math major?

Annette: Um, I decided last year that I would like to be a math teacher and so I looked up all of the requirements and you can teach math with a bachelors in mathematics. And I was going through other majors and was like hmmm none of those really appeal to me. And then, I mean I've always been good at math but I was like ugh I could never be a math major but then I've been taking math every year, even though I dropped Calc 2 my second semester, I decided that math was the right major for me.

NM: Um, can you tell me about your experience here as a student…in general?

Annette: Um…I have really hard classes in my opinion. But I guess there are some hard and some easy depending on what you like to take. I've found that-the majority of the classes have been hard but I deal with them I guess. Um, there are a lot of places to go if you need help, and um you know….office hours and such but I found in my experience I didn't really utilize the help that they have. I guess I should so I'm starting to use it more and that has really helped me.

NM: Why do you think that you didn't utilize it before?

Annette: um, well in high school I found that, you know, you really tried to do stuff on your own, they would tell you like, you know they don't encourage group work as much as they do in college so it's really hard to adjust to getting help with it. Like in high school I found that I could do a lot of stuff by myself, you don't really need…I didn't really need that much help in high school but here it was really hard to come to terms with the fact that I needed help. I needed to uh go to the math learning center and go to the teacher and all that stuff. Then it's also like hard cause you think, this is a stupid question like you know, um what I'm asking.

In this excerpt Annette spoke about all of the helpful resources that existed within their bridge programs and math department. The excerpt begins with Annette talking about the reasons that she decided to become a math major. Although she has taken many math courses in high school and college and she says that she has "always been good at math," she mentions feeling like "ugh I could never be a math major." Here it seems possible that Annette contradicts herself by doubting her ability to become a math major —which could be related to the difficulty that she has experienced in the courses rather than her actual skills in math. However Annette did go on

to become a math major. I believe a stronger understanding of this must be grounded to an analysis of "the kind of person" whom Annette believes can be a math major and "the kind of person" she perceives herself to be. Being talented in math is not enough for becoming a major—one must be a certain kind of person. It is unclear from the excerpt what those expectations are for Annette but this is clearly consistent with news articles about math and science. Indeed women of color were completely absent from the fields in those articles.

Annette goes on to say that, "there are a lot of places to go if you need help," however, she continues to say that she "didn't really utilize the help" which is interesting since she is acknowledging that there are resources in place such as office hours but she has chosen not to use them until recently. The way that Annette describes these resources gives the impression that they are not a source of support for her, but rather for other students. Even as she continues to describe her experience with these resources she says that she has begun to use them recently because she "guess[es] she should" but not because she thinks that they are actually resources that are of use to her. With regard to her hesitancy to "utilize" resources on campus Annette talks about wanting to do things on her own as she did in high school and the adjustment that she had to make in order to admit that she needed help. She also says, like many of the other students, that she was concerned about asking questions that would be considered stupid by professors or tutors. While many students may face insecurities about being perceived as stupid, for black women in math and science programs at predominantly white institutions, the risks are much higher. These women have to simultaneously deal with the challenges that arise as a math or science major while also dealing with obstacles that arise due to their ethnic/racial identity. The concern of being perceived as stupid or asking stupid questions may lead black women like Annette to avoid using resources within their departments because they do not see it as a support

but rather admittance displayed for all to see that they are unable to understand the course material. It is also possible that stereotype threat could be the reason that black women, like Annette, are not using resources within the math and science departments.

Notably, the women also initially spoke about their initial feelings of being welcomed within their programs. Many of the women related their initial experiences of support to their involvement in their institution's bridge program. In the following excerpt Sharon a sophomore, and pre-med major, describes her initial feelings regarding the support on campus:

NM: Tell me about your experience as a student [here]?

Sharon: So far I felt welcomed, in the beginning, which I started out with the step program so it gave me a leg up on my studies and like all the research resources around campus. It was cool when I started and I feel like this school was kinda like my high school, very rigorous academics. It's hard it wasn't as easy as I thought it would be. Um, should I talk about my first year?

NM: yeah

Sharon: Um first year I felt like I did stand out because I'm black. I'm in a lot of situations where basically I'm the only black person. They try to make you feel like you don't fit in.

NM: Are you like the only black person in some of your classes?

Sharon: Um maybe like one or two other people.

NM: so do you think that the step program really helped you to get acclimated to the campus and pointing out people who could help you?

Sharon: yeah, cause they like basically took us to every single department, introduced us to people, handed out business cards, email addresses and all that and it made me feel like it wasn't as stressful and I wasn't taking classes yet.

As Sharon talks about her first year she links her initial experience on campus with her involvement in her institution's bridge program. She also is sure to note that she felt this way "in

the beginning" which shows that this level of welcome and support that she first felt has somehow changed. When Sharon talks about her experience on campus she situates herself as a black person that "stand[s] out" from everyone else on campus rather than as a student or as a woman. This talk also carries into how she situates herself in the classroom as she talks about being one of the two or three black people in her classes. What is interesting about her classification of herself as one of a few black people in her classes is that she seems to be recognizing the presence of stereotype threat on her and the other few students to avoid fulfilling any negative stereotypes about their ethnic group. It's possible that Sharon may have felt less welcomed in her classes as a result of the stereotype threat that existed in her classes as she describes them as "trying to make you feel like you don't fit in." What is unclear is if Sharon actually "felt welcomed in the beginning" or if that was another instance of her attempting to be even handed in describing her experience. Sharon talks about herself not fitting in so it may be possible that she did not want to further distance herself by not acknowledging the efforts of the bridge program. While Sharon describes her experience in the bridge program as helping her to get acclimated to campus her talk about the bridge program places any support specifically on her first year. She does not talk about it as a support that has continued as she has moved into her second year as a pre-med student.

<div align="center">Cultural Capital</div>

Cultural capital [4]was the second topic that surfaced in the interviews regarding students' experiences as math and science majors. Within the interviews cultural capital surfaced in the

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[4]   Cultural capital as is used here is Bourdieu's concept of cultural capital defined as non-monetary capital that can be used to achieve social mobility.

form of family's education and a cultural understanding of science and math. Students that had this cultural capital had different perceptions and expectations of faculty support and the bridge program. There were two themes that developed out of this topic. The first theme that centered on cultural capital was related to students' experience in their schools' bridge programs. Women with less cultural capital were more likely to rely on the bridge programs for academic support throughout their experience. The second theme that developed was regarding students' expectations of faculty. Students coming into the program with less cultural capital had lower expectations of faculty when it came to providing academic support.

Students with less cultural capital were found to be more likely to rely on the bridge programs for academic support throughout their majors. The bridge programs at both PWIs introduced students to Math and Science faculty on campus during the summer and also offered opportunities to take courses before the start of the fall semester. This could explain why the women relate their experiences in the bridges programs to the initial supportiveness they felt upon arriving on campus. Women entering with more cultural capital, as a result college educated family members, did not talk about their experience of support as declining after the first year. Of particular note here is that women who described their initial experiences as very supportive but had less cultural capital, also talked about this support faltering as they moved out of the bridge programs and into their majors. Consider this exemplar:

> Erica: So those who are not excelling kinda get dusted under the rug, and I feel like those people need the most help because they don't understand. And I feel like that's what the science department kinda does. The students who understand get all A's and you know, they're doing research with the professors, they're you know, their relationship with the professor is a lot stronger than those who are not understanding information, and those who maybe are failing out of the class or just overall have a lower grade in the course.

> NM: Do you feel like there is any kind of support for them, for students not doing well in the courses?

Erica: I feel like they're trying. The GEMS program, um, which is a great program and they're trying, uh, but um a lot of support teams that are here, on campus they're run by administration or faculty and so, what they might think coming from this level could be completely different than a student who's going through it herself. So it can give these programs and support systems you know, to target with this, and to help with this but in reality this student is like, her issues are completely different from what the program is offering. Um, like the GEMS program is a lovely program and I, I love it. I've been in it since my freshman year but, it tends to gear everything towards the freshman and so like once you past that stage of being a freshman, there's no support, um, uh, I mean there's support but there's not as much, so yeah.

In the above excerpt Erica talked about the lack of support from faculty that exists for students "who are not excelling" but need help the most. When Erica spoke about students "not excelling" she did not speak about them as if they were less capable, less competent than other students or even as doing poorly, but rather as students who were not doing as well as the top performing students in that class. This is an interesting point because that would also mean that if the only students that the professors acknowledge are those who are excelling, then the majority of the students are receiving little attention from faculty, which may be acting as an impediment to their ability to excel. Erica's interview gives a clear sense that faculty reward excellence rather than help students who struggle. She describes the professors as giving more attention to those students that do the best in the course which results in them having stronger relationships with them and greater access to research opportunities.

When Erica talks about the support available for students that are not doing well in their science courses, she mentions the bridge program called GEMS. Here she is associating the bridge program with only those students who are underperforming as she does not mention tutors, learning centers or fellow students as "support". This could mean that this program is more supportive of students of color than the other resources or that black women who need

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support feel more comfortable with a group of students, faculty and staff of color. For many of the women there was concern about how they were perceived by students and faculty that weren't people of color and expressed feeling more comfort studying with or getting help from people that they identified with. While the GEMS program does seem to offer support from staff, faculty and students of color to the students in the program Erica says that this support "tends to gear everything towards the freshman," so it doesn't continue to work as a resource for students past their first year. She attributes part of this waning support to the disconnect that exists between the administration or faculty and the students on what the programs target

Although all the women related their initial perceptions of supportiveness to the bridge program, the women with more cultural capital did not talk about a decrease in support within the bridge programs. The women who were exceptions to this pattern were a first-year student with little experience in science coursework and a sophomore who had taken transfer classes at another institution in the area. Like the other women interviewed, both of these women described their entry into Math and Science as very supportive but they did not have the same opinions about the faltering support as they progressed. Joana, a first year explained that she had only completed one full semester of classes so she was not separated from the bridge program as the other students were. Faith, who took transfer courses during the summer at another college, stated that her experience taking transfer courses had influenced her perspective on the supportiveness present at her home school. In addition, she seemed to have different expectations of faculty and the bridge program which influenced her assessment of its effectiveness. Here Faith describes her experience with campus support and resources:

NM: Ok so um, what year are you and what's your major?

Faith: I'm class of 2014 but I'm doing the dual degree, biology and nursing, and now a minor in public health so I am told that I will graduate 2015.

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NM: Ok. And can you tell me about your experience at [your school] in general?

Faith: well I've been to um, as of last summer, like I've had the opportunity to, you know, study at another campus and I really appreciated everything at [this school] because number one, like you do have people that care. People that are always asking you hi, can I help you, how are you doing or whatever. But like at another campus, at Perimeter it's like what do you want, like ok whatever. So nobody cares for you, you're on your own. But here it's very nurturing, and you kind of need that kind of community especially when you're in the sciences cause its very stressful and if you don't have like anyone supporting you then it becomes very, very difficult so I really appreciate all the staff here. And I'm also a part of GEMS which is generating excellence in math and science and with that community like we meet um, once every other Thursday and we talk about what's going on, we talk about how to tackle our finals. And it's been like, I think GEMS has been going on for a while now so it's different generations of uh math and science majors and we just like inform each other oh the best way to tackle that is to you know put in these many hours or like group studies are you know, really beneficial and then you have like the advisors that like um, keep you aware of internships, you know job opportunities or whatever. So it's a very supportive community, and I really like it and I'm happy to be a science major, well I guess, yeah a science major. So I'm really happy and I'm excited to complete this degree and see what's out there.

Faith's experience as a transfer student over the summer and her cultural capital she carries from her family has shaped her perceptions of the support on campus. Unlike the other women interviewed, Faith sees her college as supportive because they "care for you" and create a "nurturing" environment rather than help her when she is struggling with course work. What is interesting to note is that her expectation of the campus community is that it helps to provide camaraderie and community for students, "especially when you're in the sciences cause it's very stressful and if you don't have like anyone supporting you then it becomes very, very difficult." She acknowledges that the sciences are difficult but where she differs from the other women is in her understanding that social and academic support work simultaneously to make students successful.

Faith describes her experience in the bridge program on her campus and the services that it provides as creating a sense of community for students of color. Like other resources on campus she talks about the bridge program with the expectation of it acting as a social support for students in math and science rather than as an academic form of support. However, she does talk about how within this social setting students or staff and faculty can advise students about how to tackle their finals; they can participate in group studies and have access to news about new opportunities or internships. It seems that her expectations of the campus resources have been mitigated by her cultural capital in that she has higher expectations of faculty in regards to academic support because she came to college with an understanding of how a good relationship between student and faculty can promote success in math and science. In addition, because she regards the bridge program as social support and not the only form of support on campus she can better utilize the resources that are offered.

Students coming into the program with less cultural capital had lower expectations of faculty in regards to academic support. The women seemed not to expect faculty to act as a resource and tended to either look outside of their department or to other resources on campus such as the bridge programs. In this exemplar, Bianca, a senior neuroscience major describes her experience with faculty support.

> NM: Can you tell me about your experience as a student at [here] in general?
>
> Bianca: Um overall I'd say that I've had a pretty good experience [here] being a science major. However, I see professors who don't necessarily encourage much participation in the sciences but then I feel like at times they do that's like any university or college. But um, overall I'd say that I'm enjoying my time [here] and I feel like it's really preparing me for the field that I'm going into.
>
> NM: Out of your professors who you say don't really encourage you, what do they do?

Bianca: It's more of a, I'll tell you an example, they may give more resources and more attention to other students than helping all the students who are science majors. You have professors who, like, really try to help you.

NM: So do you feel like there is some sort of bias in the way that they handle your academics? Do you have any specific examples you can think of?

Bianca: Um, not really, nothing comes to the top of my head.

NM: if you compare like, the ones who do encourage you and the ones who don't what would be the main difference?

Bianca: Like in their teaching styles?

NM: Anything

Bianca: I think the ones that don't care, they don't really um, encourage you to do other than like the bare minimum I guess. So if you come to them with a problem and you're not really sure how to answer it or you want to elaborate on it more they'll just be like "oh no its fine, it's ok, you can just do that. I'm not grading it harshly anyway." So other teachers who actually encourage you to learn and get the concepts of what you're doing they, like, challenge you better. Like they give you more information to read or direct you to other resources, stuff like that.

Bianca discusses her experience at her school in a way that acknowledges that the school she attends has offered her a good education but also impediments to her progress as a science major. She acknowledges the aspects of her experience that have been helpful before discussing the parts of her experience that that have been problematic. By doing so she demonstrates her apparent willingness to be fair or "even handed" and thus lessens the possibility that she will be discounted as the stereotypical angry black woman. By describing the faculty as "the ones that don't care," or the ones that don't "encourage you to do more than the bare minimum" it becomes clear that Bianca has low expectations of faculty in regards to the amount of support they are willing to provide to her. What is interesting to note is that she continues to say, "but

then I feel like at times they do, that's like any university or college," which shows that she does not have the expectation that professors will be helpful and feels that is normal. Her expectation seems to be that either the faculty in the science department is not a source of support and that professors outside of it will offer the support she needs or that she has to look for support outside of the faculty.

In this excerpt Bianca also gives an example of how her science professors encourage or discourage women who want to major in the sciences. Bianca talks about herself as someone who wants to learn because she wants to do "more than the bare minimum," but also as someone who has not received needed faculty support as they instead tell students "I'm not grading it harshly anyway." This type of response from professors may also contribute to Bianca's lowered expectations of faculty as these types of responses might give her the impression that they also have lower expectations of her.

Of the women interviewed there was only one student that did not have lower expectations of faculty as a source of academic support in math and science. Due to the cultural capital that Faith had inherited from her family who had a history in working in math and science she had higher expectations of faculty to perform the role of an academic resource. She talks about the necessity of developing and maintaining relationships with faculty outside of class in order to succeed within class:

> NM: So um, can you tell me about the professors here? Can you tell me about like your relationships with them, in your science classes?
>
> Faith: Um, well most of my professors like I still say hi or you know I still have that, cuz I know that most students, maybe it's just me but with most students it's like ok I'm done with that professor, like it's gone. But with me like I'm always visiting my professors like whenever I see them I'm just like hi like we build a conversation, you know. On a very more personal, it's a much more personal versus like um teacher and you know student and that's about it. So when the semester's done, it's done. But for me

I kinda carry on this relationship because you know they become like a mentor to me. Like I, like I've been here my whole life but many of my like family members like… American education. So they don't really understand SATS like we don't have that back at home. We have other things so it's like, here its more private if you pass or fail, there it's like so and so you didn't pass, oh, you didn't pass. It's more like, people like are much more serious, like when it comes to education I feel like people back home, they're like on the grind you know. It's a competition like everybody wants to be on top and its valued more. Here it's like oh I'm done with this professor, I'm done with this teacher, you know that's a wrap, I'm good. But I know back home like my Dad he still talks to his professor, and this guy is like 50 almost, 50-something. I'm not sure I lost track after a while. But like, he still like, he still keeps in contact. Like it's a community, so I kinda carried on like the kind of relationships my parents carry. They never forget anyone. You know once you meet someone you just know them for life. So I carry that trend where it's um like if I ever have a problem like recommendation or whatever my professors are always there for me. Cause I you know made myself open to them. Like they're, they're like parents…

Faith talks about her relationships with her professors as a personal one that continues even after her course with them has ended. The way Faith describes faculty as "mentors," or "like parents" it becomes evident that her expectations of them are very high. Faith talks about her culture and how it has influenced her to build long lasting relationships with faculty members. For Faith, the cultural capital that she harnesses is drawn from her parents' experiences with their professors and a cultural respect for educators. She talks about her father's relationship with his former professor and her decision to "carry that trend" with her into her interactions with faculty at her college. Unlike the women who entered into math and science majors without cultural capital, Faith has an understanding of the benefits that result from building a personal relationship with faculty which leads her to have much higher expectations of faculty in regards to academic support. Faith's talk about students who do not continue to develop relationships with faculty after the semester describes them as if they might be less motivated. She starts to compare students in school with the people in Somalia, her country of origin, saying that "people like are

much more serious, like when it comes to education." She goes on to talk about how competitive it is "back home" as if that is one of the reasons why students develop relationships with their professors. It is evident here that while she acknowledges that there are cultural differences she sees students in Somalia as more driven. However, when she talks about her father's relationship with his professor and her wanting to "carry that trend" she is again referring to this knowledge as cultural capital.

Summary

The interviews presented two major topics regarding black women's experiences in math and science at PWIs. The first topic that emerged was identity management which all of the women dealt with in their interactions with students, faculty and staff in their math and science departments. The first of the themes that evolved from this topic was that of students trying to maintain an even-handed assessment of their respective programs and schools even though they were hesitant to use them. The women seemed to find it important to continue to maintain or manage their identities as hard working and amiable students rather jeopardize their reputations as hardworking and amiable students. As the literature suggests, many of the women were conscious of their race when interacting with faculty, staff and students and did not want to fulfill any stereotypes that would depict them as less capable than their peers. In addition, this manifested in the way that the women perceived the support associated with their school's bridge programs. All of the women described the initial support that they experienced as being tied to the bridge program which consequently, led women with less cultural capital to be less likely to depend on faculty for support as seen in the second topic that emerged.

The topic of cultural capital produced two additional themes that related to student perceptions of faculty support. Women with less cultural capital were more likely to depend on the bridge program for continued academic support and were also more likely to have lower expectations of faculty in regards to academic support in math and science. The importance of cultural capital is reflected in theory and literature. Theory in education often focuses on what type of cultural students are bringing to their course and how it can be applied. While the women in this study may have had other forms of cultural capital that they used it became evident that having a working knowledge of how higher education, STEM fields and faculty-students relations worked were imperative to developing those relationships and connections that are necessary to excel in math and science majors. This notion was reinforced in the way that the women talked about students who worked closely with faculty having greater research, internship opportunities and mentoring.

CHAPTER 8

DISCUSSION

Analyzing both newspaper articles and interviews was useful in helping to illustrate the

different ways that discourse is used to communicate messages about what scientists and

mathematicians are, whether on a personal or institutional level. The interviews presented this

discourse as subtle and nuanced interpretations of language used in math and science courses by

professors or fellow students. Conversely, newspaper articles conveyed this message through the

lack of representation of black women in the discourse of women in math and science. The

analyses of newspaper articles drew out the importance of how not only newspapers but media

such as textbooks or other educational tools may also influence the women's acceptance of

themselves as mathematicians or scientists. Likewise, the analyses of interviews helped to bring

meaning to the conflation of black women's gender and racial or ethnic identities often used in

the newspaper articles. Using these two forms of analysis in conjunction with each other

conveyed the possible connection between public media and the way that students interpreted

the discourse that they experienced while pursuing a math or science related major.

Critical race theory contributed to my analysis in informing my understanding of how the

experiences of students outside of the classroom influence their perspectives and aptitude within

the classroom (Ladson-Billings 1998). Knowing that experiences inside the classroom alsoshape

the perceptions of students pushed me to explore the different aspects of math and science that

shape the perception and performances of black women majoring in these subjects. CRT also

contributed in to my analysis in informing me of the way counter-hegemonic discourses develop

among marginalized students. My research contributes to CRT by continuing to build on the

existing theory regarding how every aspect of the educational experience, in this case discourse, shapes the way students navigate the academic terrain.

Use of textual analysis allowed me to gain deeper insight into what the interviewees were saying when they talked about their experiences in math and science. While ordinary interview analysis would allow me to analyze the way students talk about experiences, it lacks the capacity to explore the meaning behind the words of the discourse in the way that textual analysis does. In using textual analysis, I was better able to analyze how they were using the language to say more than what was presented through their words at face value. My hope is that by using textual analysis I can contribute to the sparse existing sociological literature regarding the experiences of black women in math and science and their retention or lack thereof in these fields. Of the literature that has been written there is not very much that explores how the use of language within STEM fields contributes to the low numbers of black women represented.

<div align="center">Conclusion</div>

Due to the time constraints of the Masters of Arts timeline, there were some weaknesses that may be reflected in my research that include a strict timeline to complete the data collection, difficulty in contacting black women at PWIs, and partial transcription of interviews due to time and monetary constraints. Given that the M.A. program has a timeline of 2 years for full time students, I had very little time to build connections with undergraduate students on campus and gain access to black women in math and science. Although I was able to make contact with several gatekeepers it was difficult to gain access to the potential participants. In addition to the difficulties in data collection, due to the time constraints I was unable to transcribe my interviews in full. In order to overcome this obstacle I opted for a system in which I alternated between

listening to interviews repeatedly and using a rough transcription that summarized the main points of each interview. However, for the exemplars used, I fully transcribed the quotes. This system proved to be a helpful and time conscious compromise to fully transcribing the interviews.

As a preliminary study, this research was able to explore the discourse used within math and science taken by black women attending PWIs. As there is a sparse amount of sociological literature on this subject my intention is to make a contribution to the existing literature that can be expounded upon in the future. Through the use of thick description, in-depth interviews and a strong textual analysis my hopes are that this research can spur the expansion of sociological research on the lack of representation and retention of black women in STEM relate majors. In addition, by exploring the discourse through public media as well as one-on-one interviews, this study explores the different forums in which discourses on women in math and science can develop and how they affect women of color who want to pursue these fields.

There is a definite need to continue this area of research within the all disciplines but especially sociology. There has been limited research published on black students in math and science and even less that explores how the intersection of race and gender affects retention in STEM fields. In the future more sociological research can focus on how the lack of representation in public media such newspapers, television or textbooks perpetuate the concept of science as independent of race, class or gender (Johnson 2007). As the literature has shown it is imperative that women as well as students of color be able to see themselves in the positions that they are working towards through the presence of models that they can relate to in those roles (Fox et. al, 2009). For this reason it is imperative that there be more research to investigate the extent to which this lack of representation influences black women and their ability to see

themselves as mathematicians and scientists. There is also a need for additional research on how language used within science and math classrooms and environments influences student's experiences and consequently their retention. By gaining a better understanding of the part that language plays in black women's experiences in this context it may become clearer how to improve these experiences in the future.

During the course of my research new scholarship was published by the sociologist, Maya A. Beasley, entitled "Opting Out: Losing the Potential of America's Young black Elite." In the book she discusses the scarcity of black students from elite colleges in science, technology, engineering and math (STEM) fields and the part that those institutions play in that disparity. She found that black students were more likely to follow the status quo and gravitate toward professions geared towards "service-oriented, racialized jobs including counselors, education administrators, preschool and kindergarten teachers and community and social service specialists." Beasley claims that university's actions have influenced the decisions that black students make by allowing them to self-segregate in regards to their living facilities and programming, not retaining students in STEM fields, not hiring and retaining more faculty and staff of color. This research illustrated how imperative it is that we continue to research the disparities in STEM fields as their affects reach far beyond the classroom.

SEMI-STRUCTURED INTERVIEW GUIDE

Topic	Prompts
Experience at PWI	• Tell me about your experience as a student at AU? • Do you think that being a person of color has affected your experiences as a student at AU?
Experience majoring in science	• What made you decide to pursue a major in science? • Tell me about your experience as a science major here? • Do you think that being a person of color has affected your experiences as a science major? • Have there been any obstacles or opportunities? • Have your experiences affected your perception of science?
Supportiveness	• Tell me about your relationship with faculty and students in the science department? • How do you feel about the resources available here for you as a science major?

Other points

Science identity – competence, knowledge & recognition

Supportiveness

Altruism

Discourse in class-asking/answering questions, office hours, lab

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