MORE THAN JUST SKILL:
MATHEMATICS IDENTITIES, SOCIALIZATION, AND REMEDIATION AMONG AFRICAN AMERICAN UNDERGRADUATES

By

Gregory V. Larnell

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Mathematics Education

2011

ABSTRACT

MORE THAN JUST SKILL: MATHEMATICS IDENTITIES, SOCIALIZATION, AND REMEDIATION AMONG AFRICAN AMERICAN UNDERGRADUATES

By

Gregory V. Larnell

The primary goal of this dissertation is to shed light on a complex and persistent phenomenon in the mathematics education pipeline: disproportionately high student enrollment rates in remedial mathematics courses—particularly among entering, African American college students. As data have indicated throughout the past few decades, African Americans and other students of color have been disproportionately "gate-kept" upon matriculation to four-year universities and relegated to introductory courses that flank the shallowest end of the postsecondary mathematics curriculum. The present, mainly qualitative study was situated in a remedial mathematics course at a large, Midwestern university. Drawing on phenomenology and case study as the main research strategies, I investigated the following questions: (a) What mathematics identities do students construct while enrolled and participating in a remedial mathematics course? (b) How are students engaging academically and with mathematics, in particular? (c) How do students' mathematics identities relate to their engagement?

During a five-month period, extensive classroom observations in the university's lowest-level, "remedial" mathematics course were conducted, with a focus on noting norms, regular activities, and patterns of interaction among the students and instructors. The primary findings are centered on the academic transitions of four, principal "case" participants. To supplement the ethnographic research, I conducted a series of semi-structured interviews with each case study participant to allow students—in their own

voices—to discuss the factors that influenced their mathematics education and learning trajectories during their transitions as first-year university students. Based on narrative analyses of many hours of interview data, I began to evince and advance a central finding: The conventional perspectives are extremely limited explanations, particularly with regard to who the students in remedial mathematics courses are (or tend to be), what supports they have, or how they choose to support their own achievement.

The latter chapters concentrate on the experiences of two students and their negotiation of various socialization forces and processes. Although the primary subject of these conversations with the students was mathematics and the nature of their mathematics experiences, they often discussed the intersecting nature of their various other identities (e.g., as sons or daughters, as first-generation students, as members of working-class families or communities) with their mathematics-specific identities. Most prominently, students openly discussed the racialized nature of their mathematics learning experiences—that is, what it meant to be African American in this particular mathematics-learning context.

The students, I claimed, were also recognizing and negotiating *identity contingencies* in the environment (relating to social psychological research on the topic), in the form of masternarratives about African American participation in mathematics education settings. In the latter chapters, I discuss the empirical evidence and theoretical nature of these constructions and how students negotiated or worked against them. The dissertation closes with a discussion of students' agency (in the form of counternarratives) and implications for future research on the experiences of African American students in mathematics education.

Until lions have their own ‘story tellers,’ tales of a lion hunt will always glorify the hunter.

- Ewe-mina proverb, loosely translated to English

I, as a black writer, must in some way represent you.
Now, you didn’t elect me, and I didn’t ask for it, but here we are.

-James Baldwin

This work is dedicated to the students herein described and for those whom we have yet to teach.

ACKNOWLEDGEMENTS

Neither this dissertation nor the broader odyssey would have been possible to discuss without the inspiration and bountiful support of dear colleagues, friends, and most importantly, my family. Fortunately they are many, and sadly, I cannot name everyone individually. In fact, another volume would be needed to thank them appropriately or express a depth that adequately reflects my debt to them.

I am profoundly grateful for the wonderfully formative interactions with my primary advisors, John (Jack) P. Smith, III, and Glenda T. Lappan, who carefully and thoughtfully guided me through this process, especially during my less-than-resolute moments. In their respective ways, they emboldened my willingness to focus on issues in mathematics education about which I cared most deeply, and they provided tremendous time and resources along the way. Thanks to you both for your open doors, patient listening, and especially from Glenda, your heartening and bond-reinforcing stories.

I also extend a very special thanks to my Center for the Study of Mathematics Curriculum colleagues—coordinating faculty, faculty associates, doctoral fellows, and administrative staff—for providing a rich, welcoming, trans-institutional context and multiple venues through which to learn about the field of mathematics education. Among those involved, I would be deeply remiss if I did not specifically acknowledge Betty Phillips and Judith M. Miller, whose doors were always open and whose kindlinesses were apparent from my earliest days at Michigan State as a visiting McNair scholar; thanks for helping me to always smile from the inside outward (and vice versa, in those needed times).

I also thank the many faculty members and graduate students with and from whom I have been fortunate to learn and gather advice: my committee members (and multiple-course faculty), Anna Sfard and Raven McCrory; course and program faculty, Avner Segall, Dorinda Carter Andrews, Helen Featherstone, Joyce Grant, Sharon Senk, Ralph Putnam, Beth Herbel-Eisenmann, Natasha Speer, and Tien-Yien Li; colleagues and mentors at other institutions, DeJuran Richardson, Judy M. Dozier, Danny B. Martin and Eric (Rico) Gutstein; and fellow graduate students (who number far too many to name).

I also acknowledge the support of my colleagues from the Advancing Diversity through the Alignment of Policies and Practices initiative in the Office of the Provost and the Office for Inclusion and Intercultural Initiatives—particularly, Melissa McDaniels and Paulette Granberry Russell. I appreciate all of the encouragement throughout some very trying transitions and truly hope that I gave to the project and to each of you as much as I so gladly received.

But the greatest credit or gratitude is surely reserved for my family. My parents, Gregory and Brenda Larnell, created access to resources and opportunities by any and all means necessary—even when the means were not really there and in an environment where both excellence and opportunity were unfortunately scarce. And those thanks also extend to my sister, Niccole, for her patient listening and lifelong camaraderie.

Most of all, I acknowledge my wonderful wife and life partner, Twyla. Anyone who knows her must already know that I am truly blessed. We have supported each other unfailingly when nearly every possible circumstance, social force or process, or even person(s) seemed to conspire against our achievement. Only she knows just how challenging this has been for us—two young, ambitious, doctoral students with no

roadmaps—but I hope that she also knows that my appreciation for her and her loving support is profoundly immeasurable. And to our young daughter, Zaria, to whom all of my efforts are now dedicated: I dearly hope that all of the years, hours, and precious moments that were sacrificed for this work, by me and by others, will ultimately bring you great benefit.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

Introduction: Equitable Access to Mathematics, Remediation, and Present Questions

Inequitable access to high-quality mathematics learning opportunities has been a longstanding but slowly growing concern in mathematics education research. As researchers have asserted for decades, the mathematics education enterprise mediates a four-way relationship—between mathematical proficiency (v. NRC, 2001); ingress to courses and careers involving mathematics; full access to broader arrays of personal and collective liberty; and ultimately, "a restructuring of an inequitable and unjust society" (Ladson-Billings, 1997, p. 707; Gutiérrez, 2002, 2007; Martin, 2003; Matthews, 2005; Meyer, 1989; Moses & C. Cobb, 2001; Nasir & P. Cobb, 2007; NCTM, 2000; Schoenfeld, 2002; cf. Secada, 1989a; 1989b; Stinson, 2004). This relationship, reinforced by arguments for national (U.S.) economic needs and competitiveness, has consistently positioned mathematics as a high-status academic subject (Apple, 1992; 1999; Rutherford & Ahlgren, 1990; cf. Secada, 1989a; Usiskin, 2007). A "strong" mathematics education is more important today—for better or worse and for a wider and more diverse pool of prospective learners—than it has ever been.

Given the heightened and widely reified status of mathematics in our societies and modern cultures, students across the United States and around the world are compared and "tracked" based on measured ability to perform on standardized assessments (Oakes, 1990). Mathematics tracking, or the "process whereby students are divided into categories so that they can be assigned in groups to various kinds of classes," has consistently reproduced social inequalities in the distribution of mathematical knowledge

(Oakes, 1985, p. 3). In turn, these inequalities preserve inequities across differences in wealth, gender, and race. According to Schoenfeld (2002), "the data have been clear for decades: poor children and children of color are consistently shortchanged when it comes to mathematics" (p. 13; cf. Nasir & Cobb, 2007). Furthermore:

> Across a broad array of mathematics indicators—careers involving mathematics, graduate and undergraduate degrees in mathematics-related fields, mathematics achievement in school, mathematics course taking and affect—there has been a long and depressing history of documented disparities between men and women (or, boys and girls); between Whites and Asian Americans on one hand and African Americans, Hispanics, and American Indians on the other; and between groups based on socio-economic (SES) differences (Secada, 1989a, p. 24; cf. Ladson-Billings, 1997; Oakes, 1990).

By all accounts, equity in mathematics education is a crucial and worthwhile goal. Studying discernable inequities in the pipeline—those instances and places at which disparity is both predictable and chronic (Gutierréz, 2008)—may give us a sense of the depth and significance of the problem. Accordingly, we might ask general questions: How does inequitable access to mathematics affect our students, particularly those who are "consistently shortchanged?" Put differently, how do our students negotiate the mathematics-learning pipeline and their *selves* when faced with constrained access—or when granted access to opportunities that are likely to constrain their potential trajectories?

Statement of the Problem/Phenomenon

The general purpose of this dissertation is to offer an empirical investigation of these questions that bring together the problem of inequitable access to opportunity, mathematics learning, and race and racism. Specifically, I examine the mathematics

learning experiences of African American students who face a "gatekeeping experience,"—that is, a scenario in which success or failure will directly determine whether the student continues in the mathematics pipeline. In the sections and chapters that follow, I carefully describe the background, theory, structure, methods, and results of an empirical study conducted during the 2009-2010 academic year. Centering on the general phenomenon of remediation in mathematics, the study included a cohort of African American students enrolled in one such course at a large, public, postsecondary institution. Using phenomenological case study as a research strategy, I analyze the students' narratives and classroom-level engagement as units of analysis of the "case" under consideration. From this empirical work, I discuss students' mathematics identity work in the setting, the impact of mathematics socialization forces, and implications for the role of identity in future research on equitable access to mathematics.

Phenomenological Context: Mathematics Remediation at Four-Year Universities

> So algebra, once solely in place as the gatekeeper for higher math and the priesthood who gained access to it, now is the gatekeeper for citizenship; and people who don't have it are like the people who couldn't read and write in the industrial age. But because of how access to—the learning of—algebra was organized in the industrial era, its place in society under the old jurisdiction, it has become not a barrier to college entrance, but a barrier to citizenship. That's the importance of algebra that has emerged with the new higher technology. It didn't have to be algebra; that's the decision the mathematical community made over the years (Moses & Cobb, 2001, p. 14).

We now widely recognize that college completion (and hence entrance) is itself a gatekeeper to full citizenship in a society that includes and calls for constant scientific and technological innovation, unique engineering needs, and increasingly complex

mathematical knowledge (cf. Secada, 1989a). According to Moses and Cobb (2001), algebra, in particular, remains a gatekeeper to college and plays a unique role in mediating—or guarding—both the entrances and exits at four-year universities. For many students who successfully negotiate high school—often with three or more years of math courses—the transition to college-level mathematics includes enrollment in a low-level, "developmental" or "remedial" mathematics course. Typically, these courses focus on the basic skills of algebra.

According to the National Center for Education Statistics, 80% of four-year universities include at least one remedial math course in their academic catalogs (Lesik, 2006). Research has also shown that the numbers of students who take remedial courses at universities, particularly in mathematics, have risen sharply in the past 20 years (e.g., Ignash, 1997). Overall, the population of students taking remedial mathematics courses in universities continues to grow (Attewell et al., 2006).

Among this group of students, racial disparities are frequently cited among enrollment patterns (ibid; Grubb, 2001; Stage & Kloosterman, 1995). Again, these data have been clear for decades, according to Attewell and his colleagues (2006): African American and Latina/o students are disproportionately enrolled in remedial mathematics courses at four-year universities (also Kirst, 1998; Stage & Kloosterman, 1995). And because students in remedial courses are more likely to not take advanced courses or leave the university altogether, an increasingly complicated system produces a familiar result: African American and Latino students are, in depressingly large numbers, filtered out of the mathematics pipeline at this stage in their education. And in some cases, the

effects are more extreme: If the student cannot pass the remedial mathematics course, she or he is filtered out of the institution entirely (if not temporarily).

Despite these recent findings, little attention has been given to remedial mathematics courses in research—with very few studies that consider students' experiences in classrooms. According to Grubb (2001), remedial courses in general (i.e., despite content area) are "black boxes" within the higher education research literature. He argues,

> For all the debate over remedial education, there is almost no discussion about what it looks like—what goes on in classrooms, whether it appears to be educative in any sense of the word, whether it stands any chance of bringing students up to "college level"... (p. 5).

Although there are numerous studies of outcomes, placement, and institutional retention as they relate to remedial math courses (among other topics), these studies rarely make use of methods that provide first-person accounts. Studies of national data sets are both necessary and important as documents of broad behaviors, trends, and outcomes, but they do not give an adequate picture of student experience. Noting the absence of more qualitative studies and evaluations of college-level remedial courses, Grubb calls directly for research on classroom-level activity and interaction as one part of a renewed and multifaceted approach to "illuminating" the problems associated with these courses: "Classroom practices in remedial courses must be observed and described.

Otherwise it is difficult to know what might have generated a particular set of outcomes—and therefore what might be changed" (p. vi).[1]

Purpose of the Study and Research Questions

According to Stage and Kloosterman (1995), remedial mathematics courses "serve as 'gate keepers' that effectively filter many students out of careers they might otherwise pursue" (p. 294). For other students, these courses may change their academic trajectories while at the university, prolonging times-to-degree. How does this filtering happen, and what effects does it have on students? Researchers have noted that many students fail these courses, some repeatedly, but how do students' classroom- and school-level experiences relate to these outcomes?

The purpose of this study was to investigate how students' experiences in a remedial mathematics classroom—both general experiences and mathematical experiences—influence their mathematics identities (cf. Martin, 2000). The study was situated in a remedial mathematics course at a large, Midwestern university. Drawing on phenomenology and case study as the main research strategies, I investigated the following questions:

1. What mathematics identities do students construct while enrolled and participating in a remedial mathematics course?
2. How are students engaging academically and with mathematics, in particular?
3. How do students' mathematics identities relate to their engagement?

---

[1] And although classroom practices are not an explicit unit of analysis in the present study, they will be described and figure prominently into the design and context.

The primary focus of the study, expressed in the first research question, is on the sets of mathematics identities that students develop, construct, and tell. In the next chapter, I detail the theoretical perspective on identity that guides my inquiry. The second research question considers how these students engage academically while enrolled in the course, and how they engage with mathematics in- and outside of the course classroom. The third question brings these ideas together and asks how academic engagement and engagement with mathematics influence students' mathematics identities and vice versa. Put differently, what mediates the relationship between mathematics identities and engagement? I explore the first questions through case studies presented in Chapter 4. In Chapters 5 and 6, I address the third research question, both empirically and theoretically.

Goals of the study: A note on research strategy

This study relies primarily on case study as the research strategy. Through fieldwork and interviews conducted over multiple semesters, I documented students' interactions, engagement, community and school biographies, and narratives of mathematics experiences. As such, this study includes a rather particular sample, and I do not intend to generalize empirically (as if statistically). In Chapter 6, however, I do indicate that the study's findings may corroborate an emergent, grounded theory. Beyond this, the study's goal was to contribute to our present understanding of mathematics socialization among African American students transitioning from secondary to postsecondary mathematics.

Why study remedial mathematics courses (at four-year universities)?

> Recently, I heard from a woman who teaches mathematics at the University of Arkansas at Monticello. She told me that about 80 percent of freshman [*sic*] must take remedial math, for which they cannot get college credit. Another person, the head of a center for academic advising for minority students at the University of Kentucky at Louisville, told me that close to 90 percent of entering minority students had to take remedial algebra during their freshman year, for which they did not get credit. A faculty member in experimental physics at Rutgers recently lamented the absence of minority students in his classes. He said, "They're all across campus in the remedial sections" (Moses & Cobb, 2001, p. 11).
>
> The present system measures merit through scores on paper-and-pencil tests. But this measure is fundamentally unfair. In the education setting, it restricts opportunities for many poor and working-class Americans of all colors and genders who could otherwise obtain a better education…In short, it is neither fair nor functional in its distribution of opportunities for admission to higher education…But using the experience of those on the margin to rethink the whole, we may forge a new, progressive vision of…functional diversity and genuinely democratic opportunity (Guinier & Sturm, 2001, pp. 4-5).

Remedial mathematics courses are offered in four-year universities to "provide beginning college students with another chance to learn (or relearn) the mathematics supposedly taught to them in high school" (Lesik, 2006, p. 2).[2] There is considerable variation, however, in the content and policies of these courses across institutions (Bettinger & Long, 2005). In many cases, universities have required mathematics placement examinations for newly enrolled students; students with scores below predetermined levels are then placed into remedial mathematics courses (Jacobson,

[2] Developmental mathematics courses are mainstays in two-year colleges. These two-year college courses are not being considered, however, because their "reason for being" is different from that of four-year institutions' developmental math courses. Their prevalence in two-year institutions has also been well documented (Lazarick, 1997; Lesik, 2006; Rouche & Hurlburt, 1968). In short, developmental mathematics in two-year colleges is offered as a result of the "open door" nature of the colleges—a situation that is different from selective four-year schools (even the minimally selective). For a more extensive discussion of the history of these courses in two-year colleges, see Rouche & Hurlburt, 1968.

2006).[3] According to the National Center for Education Statistics (NCES), remedial mathematics courses are listed in 80 percent of four-year universities' course catalogs (as cited in Lesik, 2006). Nearly 40 percent of all "traditional undergraduates" take *at least one* remedial course in reading, writing, mathematics or some other content area (Attewell et al., 2006, p. 886); this figure has risen considerably from the 22 percent reported by the NCES in 1989 (Ignash, 1997).

Remediation (i.e., remedial education programs) has become a highly controversial, political (and politicized) topic in education (Attewell et al, 2006; Bettinger & Long, 2005; Soliday, 2002). At one end of the continuum, opponents contend that institutions offering these courses have lowered their standards and essentially "dumbed down" their curricula (Attewell et al., 2006, p. 886). At the other end (or close to it), pundits point to the expense of remedial mathematics course offerings at public universities (Bettinger & Long, 2005), some asserting that "[students] are paying twice for education that [they] should have learned in high school" (Hoyt & Sorenson, 1999, p. 2). Combined with the fact that these courses are typically filled with students, are taught by either graduate students or adjunct faculty, and are on the whole, "cheaper per student than regular college coursework," some remedial math courses become financial assets for university mathematics departments (Attewell et al, 2006, p. 889; Redovich, 2003).

Paradoxically, remedial mathematics courses are, in theory, equity-oriented; they are often maintained in order to improve "retention and persistence in higher education" (Ignash, 1997, p. 15). In other words, remedial mathematics courses are meant to

[3] Although the relevance of these tests have come into question in recent years (ibid; Matthews-Lopez, 1998), they are still the prevailing measures by which students are placed into university courses.

"pump" more students—who would otherwise be filtered out—into the postsecondary mathematics pipeline. And when compared to their counterparts in two-year colleges, remedial mathematics courses in four-year universities work to increase the likelihood of graduation (Attewell et al., 2006). In order to achieve this equity, however, these courses impose inequalities that also disadvantage the students that they are meant to help, perhaps inadvertently. Students taking developmental courses—courses that do not fulfill graduation requirements for degree programs—must do so at the expense of an otherwise typical course-load, which could affect (or even undermine) their success (Bassarear, 1986). These courses may also reinforce the latent stigma associated with being a developmental or remedial math student (Hall & Ponton, 2002).

While the debates continue, the facts remain: students who are *routinely* marginalized in the United States (e.g., African American students, poor students, English language learners) are disproportionately enrolled in remedial mathematics courses (Attewell et al., 2006; Stage & Kloosterman, 1995; Kirst, 1998). This fact is often touted as support for remedial mathematics, even though students that do not succeed in these courses are much more likely to drop-out or not take advanced courses (Attewell et al., 2006). Alternatively, some universities opt to simply expel students that do not meet their standards (Bettinger & Long, 2005). In either case, this increasingly complicated equation produces an unfortunately familiar result: underrepresented students are effectively filtered out, and we have no record of their experiences.[4]

[4] In some cases, these students are explicitly filtered out. In many states, developmental courses in reading, writing, and mathematics have been removed from the course offerings at four-year universities (Attewell et al., 2006). Students needing remediation, then, are directed to two-year colleges.

Overview of the Dissertation

As I describe in Chapter 2, the relatively small body of research that considers the participation and achievement of African American students has traditionally focused on group underperformance and comparisons (on standardized assessments) to other racial and ethnic groups. During the past three decades, however, there has been a considerable shift, with a growing number of researchers arguing for a change in perspective. Instead of a focus on failure and underperformance, I observe that researchers have since turned their analytic lenses to classroom and out-of-school mathematics experiences and toward understanding the nature of successful practices.

In the second part of Chapter 2, I detail the theories of identity that support my inquiry. I also highlight the ways in which identity has been employed to dissect the mathematics learning experiences of African American students (Martin, 2000; 2007). Drawing on Sfard's (2010; with Prusak, 2005) notions of identity as a narrative construct (also Nelson, 2003), sociolinguistic tenets of narrative structure (Labov, 2001; Labov & Waletzky, 2003; cf. Juzwik, 2006), and discipline-specific framings of mathematics identity (Boaler & Greeno, 2000; Boaler, 2002; Cobb et al., 2009; Martin, 2000; 2007a; 2007b; Nasir, 2002), I describe a framework for analyzing mathematics identities as narrative.

In Chapter 3, I describe the methods, people, and data involved in this project. During a year-long study, I recruited, observed, and interviewed a small cohort of first-year university students at a large, Midwestern university. I initially contacted 26 students to participate in the study; twenty-one students completed an initial, screening questionnaire. The questionnaire focused on mathematics course background, attitudes

toward mathematics, and students' experiences with the university's mathematics placement exam. All students were enrolled in an enrichment section of the university's lowest-level, non-credit-bearing mathematics course, MTH 1825. For three months during the fall semester, I observed students' class sessions, documenting course-level content and enacted curricular activity, students' interactions, and classroom activities. In all, more than 25 hours of course time were observed.

Along with the research questionnaire, the classroom observations served as a basis for strategically selecting students to participate in a series of interviews. Due to the time-intensive nature of the course experience, I asked only students who reported reasonably strong mathematics backgrounds (B average or better). I also selected a diverse array of students with respect to actual mathematics courses taken in high school and reported attitudes about mathematics. Students were approached in person and/or by e-mail (provided through the questionnaire as an indication of willingness to be contacted). Four students actually participated, and three students completed the full interview protocol. Across the four participating students, more than 16 hours of audio-recorded interviews were conducted. All interviews were transcribed, and narrative analysis techniques were used to code and analyze the resulting data. Field notes and observation charts were sorted and analyzed throughout the study—and as themes emerged from the interview data.

In Chapter 4, I present four, student-centered case studies to address two of the research questions. With a focus on identity and engagement, I examine the students' experiences across multiple levels of socialization: family/community expectations for academic engagement and mathematics learning, institutional/school experiences, and

intrapersonal development of identities specific to mathematics learning and teaching. These students, Cedric, Vanessa, Nicole, and Ruby, represent a wide range of academic backgrounds and institutional histories. All of the students were from urban areas in the Midwest, and through various circumstances, each placed into the university's lowest-level mathematics course.

In Chapter 5, I begin to address the study's third research question, considering the relationship between the identities that students were developing during their course and the ways in which they engaged academically. Through constant comparative analyses across the four cases, I noted the presence of *identity contingencies* (Steele, 2010) that mediated the relationship between who students said they were and how they enacted their selves in mathematics learning contexts. These *master narratives* summarize supposed understandings about how African American students were represented in certain mathematics courses at the university (Martin, 2007b; Nelson, 2003). In each case, these master narratives, though different in form, framed African American learners as deficient and as belonging in the lowest mathematics courses. I also learned that these master narratives were cued for students through different types of situations (Steele, 2010).

In Chapter 6, I present a theoretical version of this argument, reprising the theories on identity and mathematics identity presented in Chapter 2, based on the study's empirical results. I model and define identity contingencies, masternarratives, identity threat, counternarratives and identity repair. I argue that these threatening masternarratives may lead students to question their mathematics identities. More specifically, students undergo a kind of "infiltrated consciousness" (Nelson, 2001), by

replacing portions of their narrative identities with fragments of master narratives. When this identity "damage" occurs (ibid), students either succumb to this threat and alter their mathematics identities or they construct counternarratives—self-stories that resist the threat.

Whether the threat is or is not initially resisted, counternarratives have the potential to intervene as long as the individual is able to produce them (even with assistance). I conclude the chapter by arguing that interventions should aim to help students produce identity-affirming counternarratives. In Chapter 7, I conclude the study by addressing limitations and suggesting implications for future research and for more immediate policy and practice changes in four-year institutions.

CHAPTER TWO

Review of Relevant Literature and Theoretical Framing of the Study

Chapter Overview

This literature review is presented in two parts. First, I review research and commentaries on African American achievement and participation in mathematics, spanning the past three decades. Moreover, I critically synthesize this body of research in relation to the emergence of research and policy documents—in which equity is often positioned as a priority in mathematics education amidst broader policy concerns (e.g., NCTM, 1989; 2000). Later in the chapter, I introduce a central topic for this dissertation study: the emergence of identity (Sfard, 2008; Sfard & Prusak, 2005)—and *mathematics identity*, in particular (Martin, 2000)—as an analytic construct for analyzing students' educational experiences and their mathematics learning experiences (ibid). Furthermore, I discuss how identity has been and is currently being utilized and operationalized in previous studies of African American participation in mathematics, and I present the framework for mathematics identity-as-narrative for the present study.

Although the participation of African American students has been a prevalent subject of research on education and schooling, its inclusion in mathematics education research has been considerably less established.[5] This is a curious inconsistency,

[5] I will often refer to "mathematics education" or the "mathematics education research community" as something different from communities of educational researchers at large. Both in the United States and internationally, mathematics education has grown into a distinct discipline and enterprise of research agendas (Schoenfeld, 2000), organizations and conferences (e.g., National Council of Teachers of Mathematics, International Congress of Mathematics Education), academic and practitioner-oriented journals, teacher communities, and doctoral programs (Reys, 2000; Reys & Dossey, 2008).

considering the high status of mathematics as a school subject (Lubienski & Gutiérrez, 2008), its continued role as a gatekeeper in school and undergraduate-level mathematics (Kamii, 1990; Moses & Cobb, 2001; Phillips & Lappan, 1998; Usiskin, 2004; Wu, 2001), and the growing gap in measured performance on mathematics assessments between African- and Latino American students and their White and Asian American peers (Lubienski, 2002; 2008; cf. Gutiérrez, 2008).[6] There have also been few attempts to take stock of extant studies in this underpopulated area of research and, as a result, too few chances to gauge learned lessons and needs across studies and time.

Structure of the Chapter

This discussion will be presented chronologically, starting with a brief review of research on African American participation in school mathematics between 1980 and 1990. This decade coincides with the period preceding 1989 publication of the National Council of Teachers of Mathematics' (NCTM) *Curriculum and Evaluation Standards for School Mathematics*.[7] Besides being one of the more influential, national-level education policy documents at the time (Apple 1992; Howe, 1998), the *Standards* (as I will refer to

[6] There is considerable academic diversity within these groups. Therefore, aggregating students by race can be as problematic as it is useful in education research. One such consequence is a "model minority" narrative that silently renders groups of Asian and Asian American students invisible (Lee, 1996).

[7] One could argue that the NCTM is the de facto flagship organization of the U.S. mathematics education enterprise (i.e., research, development, teaching, policy). To extend the nautical metaphor, Lindquist (1993), as the Council's president, once suggested that the NCTM (in reference to the *Standards*) had taken the "helm," saying, "We realized that we could not sail our own ship without direction. We had to chart a new course" (p. 467).

the document hereinafter) initiated another wave of school mathematics reform in the United States (Battista, 1994; Schoenfeld, 2002; Senk & Thompson, 2003).

Unlike previous reform efforts that overlooked equitable access to mathematics for all students, the *Standards* cited equity as the first of six principles for mathematics education, "stressing the fact that all students should learn mathematics, not just the college-bound or (white) males" (Martin, 2003, pp. 8-9). Although this equity principle *necessarily* suffered under a "penumbra of vagueness" (Apple, 1992, p. 413) and has since been challenged in the research literature (see Martin, 2003), the document offered a formal acknowledgement of contemporary concerns for fairness and fair participation in mathematics education for marginalized or subordinated students (e.g., African American students).

After describing the major themes from this period of research, I move to examine the emergent themes from studies on African American participation during and then after the 1990s. Here, I begin to apply the questions listed above to analyze the literature of this period, drawing connections to both the previous period and also to other mile-markers like the publication of the National Research Council's report *Everybody Counts: A report to the nation on the future of mathematics education* (1989), NCTM's (2000) *Principles and Standards for School Mathematics*, and the *No Child Left Behind Act* of 2001 (NCLB).

A note on the dissemination of research

Over the past few decades, the mathematics education research community has enjoyed substantial growth. That growth is manifest, for instance, in the numbers of

doctoral programs across the country (Reys et al., 2007) or of publication outlets specific to mathematics education (Lerman, 2000, p. 21). With the increase in the numbers of researchers, the field's knowledge base has splintered into a collection of several areas committed to particular issues in research, teaching, learning, and thinking. The ongoing development of these specialties has encouraged the emergence of number of special interests groups within the field (e.g., researchers in undergraduate mathematics education; mathematics teacher educators).

Researchers whose scholarship centers on issues of mathematics learning and teaching of African American students have likewise formed informal and formal communities for sharing and disseminating their work (e.g., the Benjamin Banneker Association).[8] Relatively few of these studies and commentaries, however, are published in the main organs of the mathematics education research community (e.g., the *Journal for Research in Mathematics Education* [hereinafter *JRME*] published by the National Council of Teachers of Mathematics).[9] Lubienski and Bowen (2000) broadly examined mathematics education research published between 1982 and 1998 in nearly 50 education research journals. From their findings, the traditional focus of mathematics education research journals has been specific mathematical topics (e.g., integer, algebra). Because articles on African American participation (like research on many other equity-related

[8] But even the Banneker Association, a vibrant and growing community of educators, has sometimes struggled to define its presence in the mathematics education community (Malloy & Brader-Araje, 1997).

[9] Similar to NCTM's standing as the flagship organization in mathematics education, the *JRME* is the leading journal of the mathematics education research community (Williams, 2005; 2006). This emphasizes the idea that the value placed on this journal reinforces and reflects the types of knowledge and ways of knowing that are most valued by the mainstream mathematics education community in the United States.

issues) are "less often focused on a specific mathematical content area," their acceptance into major journals is less frequent (ibid, p. 630).

Contending with the status of various publication outlets has practically subordinated conversations about power, privilege, and difference—particularly as these issues are evidenced in the mathematics learning experiences of African Americans, Latino Americans, and Native Americans—to special issues of journals or occasional "critical" issue sections of books (Martin, 2003, p. 11). The lack of attentiveness to these issues is a contrast to the national conversation about mathematics education in Asian Pacific Rim countries and one that often includes (only high-achieving) Asian and Asian American students in the United States. (cf. Lee, 1996; v. Scheurich & Young, 1997).

This point, that research and commentary on African American students in mathematics is not well circulated, is not now and has never been adduced as a plea for mainstream recognition. As this review will bear out, it is now generally recognized (for better and worse) that African American students are underrepresented in mathematics and that little is known about their school mathematics experiences (or their out-school experiences; Martin, 2000). If we as a research community are serious about the substance of *mathematics for all* or *equity* and not satisfied with shallow slogan systems (Apple, 1992), then rigorous studies that explore the mathematics education of African American students must be identified and circulated widely.[10]

[10] Effective slogan systems, according to Apple (1992), have three defining characteristics and are not necessarily negative (although a shallow one, in my view, can be harmful). A slogan system must be vague enough to be widely acceptable, specific enough to have some immediate value, and must have the "ability to charm" (p. 414; also see Martin, 2003).

Nevertheless, Why African American Students?

As an African American student who thrived in (although only sometimes survived) elementary, secondary, post-secondary and graduate-level mathematics classes while watching many of his African American peers struggle—and seeing fewer of them as the courses became more advanced—this question strikes particularly close to both experience and heart. The answer, for me, is obvious. It may have also been obvious for Ladson-Billings (1997a) who posed the question in an article published in the *JRME* (also Ladson-Billings, 1997b). Although the final version appeared more than 10 years ago, Ladson-Billings cites statistics that are sadly familiar—and yet more disturbing—today (e.g., incarceration rates for African Americans; cf. King, 2006).

It is widely understood the opportunities in education are directly related to societal opportunities and social outcomes. The reverberations from these and other out-of-school circumstances (e.g., family socioeconomic status [SES], community forces) have direct impact on the lives of some African American students—and indirectly for many others. Improvements in the schooling experiences of many African American students are essentially isomorphic to opportunities for improving their "life chances" (Ladson-Billings, 1997a, p. 697). Because mathematics plays such a critical role in the school curriculum and in societal filtering more broadly, the relationship between the school subject and African American students is still significant.

"Coloring the Equation of Mathematics" (1980-1989)

> …Average mathematics achievement may differ by race in part because of average differences in native ability or parental contribution and in part because of what society expects of minorities or the course sequences to which black students have been assigned. (Jones et al., 1984, p. 159).

> This nation can no longer afford insensitive teachers who *blame the victim* for his or her underachievement (Johnson, 1984, p. 152).
>
> Our inability to understand the differences between racial groups in how they participate in and learn mathematics may stem from several questionable assumptions underlying much of the existing research…It is such a dialogue that has been missing in the mathematics community. What we know must not be ignored, but what we might know cannot be denied. It is time to color the equation of mathematics. (Matthews, 1983; 1984, p. 83)

Beginning in the 1980s, the mathematics education of African American students emerged as a "growing concern" in mainstream mathematics education research (Johnson, 1984; Kilpatrick, 1990; Stiff & Harvey, 1988; Strutchens, 1990, p. 16).[11] In February 1981, the NCTM sponsored the Core Conference on Equity in Mathematics, a meeting that officially marked "a new phase of concern and positive action" towards awareness of "the special problems faced by members of minority groups in learning mathematics" (Kilpatrick & Reyes, 1984, p. 8). The conference represented, in part, growing national attention toward general equity issues in mathematics education.

Concerns were raised, however, that those issues had "been raised only to be submerged under the rubric of excellence for *all*, or have been transformed into other issues" (Secada & Meyer, 1989, p. 1; e.g., enlightened self-interest, Secada, 1989a). Although a small and scattered collection of published research literature around African American mathematics students can be found throughout the latter half of the twentieth century (e.g., Means, 1959; cf. Johnson, 1984; Ortiz-Franco, 1981), a growing disquiet about equity facilitated a new wave of published studies on African American

[11] Matthews (1984b) suggests than the year, 1975, appears to have marked the beginning of research in this area. As Matthews goes on to suggest, "much research on women and mathematics was well under way, and questions were beginning to be raised about the participation of minority women in mathematics" (p. 84).

participation in mathematics. One major theme of this collection of studies has been called a "classical" perspective on equity in mathematics education (Secada, 1995). This perspective, albeit helpful in mapping broad trends, established a narrative in mathematics education research that centered the *under*-representation and *under*-achievement of African American students compared to White students.

One tangible and lasting product of the Core Conference on Equity in Mathematics was a special issue, "Minorities in Mathematics," published in the March 1984 issue of the *JRME*. In it, there were two articles whose focus was on African American participation in school mathematics: "Blacks in Mathematics: A Status Report" (Johnson, 1984) and "Monitoring the Mathematics Achievement of Black Students" (Jones et al., 1984). Taken together, the articles provide an important and impressive snapshot of (research on) African American participation through the early 1980s. Johnson's review discusses trends in mathematics participation and achievement, as well as the factors related to both for African Americans. Jones and his colleagues analyzed results from the 1973 and 1978 administrations of the National Assessment of Educational Progress and present findings related to African Americans.

Citing mathematics enrollment data from the National Longitudinal Study of the High School Class of 1972 (NLS-72), Johnson (1984) affirmed that African American students were essentially "being cut off" from the post-secondary mathematics pipeline (p. 146). African American students surveyed as part of the NLS-72 took fewer semesters of high school mathematics than White students. That fact, according to the article, would suggest that they were less prepared in terms of prerequisites for university-level

mathematics.[12] According to the 1978 NAEP, more African American students took high school algebra and geometry courses between 1977 and 1980 than in previous years but still lagged behind their White peers. Similar figures were also available through the 1981 High School and Beyond study.

Along with participation, Johnson also focused his review on the mathematics achievement of African American students, providing revealing new evidence of continued disparities between African American and White students. According to NAEP results from 1978, African American 9-, 13-, and 17-year-old students either gained or held steady in most categories in mathematics compared to the 1973 administration. From analyses of the 1982 NAEP results in mathematics, however, Johnson reported that at age 17, 58% of African American test-takers were included in the bottom quartile of scores; White test-takers comprised 18%. At an age at which many former high school students enter colleges and universities across the nation, these results again suggest that African American students were less prepared than White students. In other words, African American students were "disproportionately represented among the poorest performers" (p. 149).

Examining the results of the 1973 and 1978 administrations of the National Assessment of Education Progress (NAEP) in mathematics, Jones and his colleagues (1984) also documented a wide range of disparities in achievement for Black and White students. Many of those differences were not immediately apparent. They found that the gains among Africans American students' mathematics scores on the NAEP were on

[12] Unfortunately, this statistic has not changed, more than 35 years later. Even worse, African American students with the *same* mathematics background as White students are still more likely to enroll in remedial mathematics courses at the post-secondary level (Attewell et al., 2006).

level with gains in reading, social studies, and science. Other researchers cited rising incomes among African American families, federal education programs, and motivational changes as potential factors for these improvements.

Analyzing data from a special mathematics addendum to the 1975-76 National Assessment of Citizenship/Social Studies, no significant differences were found between mean scores for female and male test-takers at age 13. Within each sex, however, there were "highly significant" differences by race (p. 158). By age 17, there were significant differences in mean scores by sex and by race. The gap between African American and White students had grown, particularly as students got older. At age 13, the mean difference of 17.2 percentage points between African American and White students was nearly 1.1 times the within-group standard deviation; by age 17, that difference had grown to 25.2 percentage points (nearly 1.4 times the within-group standard deviation; p. 158).

In their study, Jones and his colleagues sought to identify factors that could explain these gaps in achievement. Were the differences attributable to school-level characteristics (e.g., region, community type)? Or could they be predicted from individual background characteristics like students' parental education, high school grade point average, or even the number of books in the home (p. 160)?

Among individual characteristics, the best predictor of mathematics achievement score for 17-year-old students was the number of high school algebra and geometry courses taken. Similar findings for 13-year-old students are not reported here (v. Jones et al., 1982). Grade point average and other individual background variables were also strong predictive indicators. Among school-level predictors, however, the average

number of books in the homes of students was the most prominent predictor of high mathematics achievement; lesser predictors were mean grade point average, school-level parental occupation, and parental education. In other words, home influences were strong predictors of whole-school mathematics achievement for 17-year-olds while mathematics background (and not race, per say) was a strong factor from analyses of individual differences.

As Johnson claimed, however, African American students participate in mathematics courses at lower rates than White students. Jones and his colleagues also substantiated this. As the average mathematics score increased, so did the percentage of White test-takers. The percentage of African American test-takers, however, decreased. For instance, 32% of White 17-year-old students took 3 high school algebra and geometry courses and scored above 80% correct on the assessment. Thirteen percent of African American students were in the same category.

Jones and his colleagues were also able to show that the racial composition of schools was also a strong component in the determination of mathematics achievement. As the percentage of White students in the school rose, so did the average number of mathematics courses taken across the school. In schools where there were no White students, the average number of mathematics courses taken by 17-year-old African American students was 1.3. In schools with White student populations between 90 and 100%, the average rose to 1.8.

These findings suggest that increases in African American participation in mathematics courses would encourage higher levels of achievement. They are also consistent with disparities documented in the Johnson (1984) review. Johnson suggests

that there are many factors that could help explain why African American students were less likely to take mathematics courses (e.g., the absence of role models, lack of parental involvement, and the lack of productive disposition toward mathematics). But few studies of the period were able to substantiate particular factors that related to African American underparticipation and underachievement in mathematics. These studies did, however, initiate a wave of research on what would soon be known as the "achievement gap" in mathematics education.

Moving beyond Deficits amidst the Standards *movement (1990-2000)*

> Explanations for poor mathematics performance of African Americans abound. (Fullilove & Treisman, 1990)

In the 1970s and 1980s, researchers exposed hidden disparities in achievement on the NAEP, or the "nation's report card," between African American and White students (Lee, 2002, p. 3). Underrepresentation and underachievement in mathematics continued to characterize research around African American students after the NCTM *Curriculum and Evaluation Standards for School Mathematics*.[13] Building on previous studies, many scholars began to focus on factors that contributed to student underachievement and underrepresentation. These studies, however, were limited in number. Published empirical studies concerning African American students' achievement appeared during this decade as compared to the previous one (Lee, 2002); even fewer were specific to mathematics.

---

[13] In 1991 and 1995, the NCTM published two policy document to supplement the reach of the 1989 *Standards*, the *Professional Standards for Teaching Mathematics* and *Assessment Standards for School Mathematics*, respectively. Unlike the 1989 *Standards*, neither the *Professional Standards* nor the *Assessment Standards* documents explicitly addressed issues of equity or those of African American students or teachers.

A second (albeit less-detailed) report on the status of research on African American participation was published in the inaugural issue of *The Mathematics Educator*, in the summer of 1990: "Underachievement and Underrepresentation of Black Students in Mathematics: A Categorized List of References" (Strutchens, 1990). The studies in Strutchens' report were divided into several categories: achievement, affect, cognitive style, equity vs. equality, multicultural education, and "nature versus nurture" (ibid; cf. Matthews, 1984; Powell, 1990; Rech, 1994; Wilson et al., 1994). Although the article itself did not elaborate these factors, the list was a strong indication of the new directions of research in mathematics education for African American students.

In 1997, the Banneker Association, with support from the NCTM, hosted a leadership conference entitled, "Challenges in the Mathematics Education of African American Children." The proceedings were published from presentations and discussions on teaching and learning, policy, and professional development relating to the mathematics education of African American students. Ladson-Billings' (1997b) keynote address, "It Doesn't Add Up," appeared in the proceedings and was later published in the *JRME* (Ladson-Billings, 1997a).

During the 1990s, only two articles that directly address issues of teaching and learning for African American students have since appeared in the *JRME*. Ladson-Billings' (1997a) article was one, and an empirical study conducted by Malloy and Jones (1998) was the other. In their study, Malloy and Jones investigate how African American students solve problems in school mathematics, with particular attention given to culture and success. While "unsuccessful" student strategies were documented, the authors also focused on students' success and how that success was achieved in the context of

mathematical problem solving. Their attentiveness to the varied problem-solving methods and abilities that African American children employed or exhibited was different from many other articles in which the participants' results were not disaggregated *within* racial groupings.

The Malloy and Jones study marked an imminent change in how African American participation in mathematics was framed and studied. The prevailing narrative positioned the underachievement of African American students as a central analytical focus for research in the field. According to Ladson-Billings (1997a), "certainly enough literature documents [*sic*] the mathematics failure of African American students. What is lacking is the documentation of *successful practice of mathematics for African American students*" (p. 706, emphasis added). A new body of study was needed in the field—as a counterpoint to explaining underachievement.

The study of African American participation during this period also expanded from the school (grades K-12) mathematics context to include undergraduate mathematics education ("grades" 13-16). One exemplary and often-cited article published during this period was a study of African American undergraduate mathematics students at the University of California-Berkeley (Fullilove & Treisman, 1990). This landmark study investigated and identified factors that support high achievement among African American students. Treisman's work, more generally, was focused on promoting excellence within groups instead of parity across groups. The premise of the study, however, was based on the fact that African American students were not succeeding at rates comparable to their White and Asian American peers. Asian

American students were clearly defying the stereotype that non-Whites could not succeed in mathematics; Why was this not true for African American students?

In the late 1970s, Uri Treisman and his colleagues at the University of California at Berkeley (of Berkeley, hereafter) created the Mathematics Workshop, a then-small effort with a unique focus. The program sought to create new solutions to counter the narratives of underachievement and underrepresentation of racial minority groups in mathematics. The Mathematics Workshop was different than other equity-oriented programs on at least two dimensions. First, the program was designed to encourage African American students to pursue mathematics as a professional career. Its focus was on excellence, not remediation. A second feature of the Mathematics Workshop was its focus on mathematics. Similar programs were often focused on content-generic study techniques and other skills, where the Mathematics Workshop was specifically focused on mathematics and mathematical problem solving.

Now widely known as the Emerging Scholars Program (ESP), the Mathematics Workshop represented the idea that all students with sufficient training could become proficient mathematics thinkers and doers. In the early work that supported the project's development, Treisman sought explanations for why African American and Latino American students performed so poorly in calculus courses at Berkeley. In a groundbreaking study conducted during the 1975-76 academic year, Treisman noted that African American students in these courses did not suffer from natural intellectual deficiencies, inherent cultural disadvantages, or other common notions of deficiency (Asera, 2001, p. 11; Fullilove & Treisman, 1990). What Treisman found was that these very models (and their constructions of culture on predominantly White campuses)

created environments that isolated African American students. In contract, Chinese American students in the study managed to succeed by forming study groups outside of the course; it is not clear if this strategy was a response to feelings of isolation similar to those attributed to African American students. Average hours of study time were determined along with qualitative assessments of students' interactions.

Studies that measure the impact of Emerging Scholars Programs have consistently found that program achieves its objectives, helping students to make substantial gains in achievement in their calculus courses. In their assessment of the program at Berkeley, Fullilove and Treisman (1990) found that participating African American students significantly outperformed non-participating students. These positive results also translated to degree completion; program participants were more likely to achieve than their counterparts.

In a different study, Bonsangue (1994) measured the impact of the Emerging Scholars Program at California Polytechnic State University, Pomona (Cal-Poly). Despite the different setting and local context, Bonsangue found similar results. Based on the original Mathematics Workshop model, ESP at Cal-Poly helped African American students succeed in calculus courses. African American participants outperformed other students that did not participate in the program, regardless of racial background. Students also reported that ESP was crucial to success in calculus at Cal-Poly.

Like these, other studies have reported considerable gains for African American calculus students at other sites (Alexander, et al., 1997; Millar, 1996; Moreno et al., 1999). From these studies and other commentaries, there are several common themes. First, mathematics is central in the development and structure of these programs.

Mathematics is also a central subject in most related articles; documenting students' actual solution strategies and ways of doing mathematics, however, are not usually emphasized. Group work is also heavily emphasized as a key in-school practice, but research on students' out-of-school mathematical practices or activities outside of school is also not usually included. What we do have, however, is a proven program that has positively impacted many African American students across the country.

Mathematics Success and Failure Among African American Youth: Research on African American participation in mathematics education in the National Standards Era (*2000-2010*)

> While underachievement and limited persistence in mathematics among African Americans have received attention from researchers, I contend that the juxtaposition of African American status, underachievement, and marginal participation within the existing literature has unwittingly served to create a *masternarrative* that has continued to dominate discussions and orient research on African Americans and mathematics (Martin, 2007b, p. 149).
>
> It will become very apparent that our approach to mathematics education and mathematics literacy among African Americans is in stark contrast to analyses that focus on testing outcomes and analyze so-called achievement gaps in ways that, we claim, contribute to the reification of *racial* differences in mathematical ability and construction and acceptance of racial hierarchy of mathematical ability (Martin & McGee, 2009, pp. 210-211).

The "achievement gap" between African American and White students in mathematics has been the focus of research involving African American students for many decades (Gutiérrez, 2008). In the late 1980s, various factor analyses followed, and the collection of research became replete with studies of and commentaries on underachievement and underparticipation (Gutiérrez, 2008; Ladson-Billings, 1997; Martin, 2007a). Research on African American students in the current decade has

marked a new direction that started in the late 1990s (cf. Ladson-Billings, 1997a,b). Citing the lack of counterbalance as motivation, a number of researchers have shifted to studies on high-achieving African American mathematics students (e.g., Berry, 2005), the nature of their mathematical experiences (Martin, 2000; 2007a; 2007b; Martin & McGee, 2009), parental and community influences (Jackson & Remillard, 2005; Martin, 2000), and the out-of-school mathematical practices of African Americans (e.g., Nasir, 2007).

The number of studies on African American participation in mathematics education has grown considerably since the publication of the NCTM *Principles and Standards* (2000) and will probably expand more following the implementation of the *No Child Left Behind Act* (NCLB) of 2001. For the first time, school districts are required to disaggregate reports on the percentages of students meeting state standards by race, sex, socioeconomic status, and migrant status. With this new data, new measures of African American participation and achievement will likely issue from research.

For researchers whose work attempts to re-center the discussion of African American student participation and achievement in mathematics, a central critique has focused on the ways in which African Americans are traditionally framed as mathematics learners. Limited persistence, underperformance, and failure have long been the subjects and results of research on African American students. These deficit-centric depictions, when consistently associated with African American status, may "unwittingly serve to create a *masternarrative* that has continued to dominate discussions and orient research on African Americans and mathematics" (Martin, 2007b, p. 149, original emphasis). Others have referred to this as a "deficit paradigm" or a (big-"D") "discourse of

deprivation," constructed and maintained by the prevalence of studies that emphasize insufficiency (Ladson-Billings, 2000, p. 206; cf. Gee, 2001).

Despite the pressure, a number of works have been published in mainstream scholarship and gained national attention. One of the more seminal of these is Moses and Cobb's (2001) writing about the Algebra Project and the Young People's Project, two related grassroots movements organized to promote algebra and general mathematics learning amongst young African American students.[14] In their work, Moses and Cobb frame mathematics for African American students as a "civil right" and algebra, particularly, as a gatekeeper to full participation in the mathematics education pipeline (p. 16).

The Algebra Project was founded to promote mathematics and science for middle school students in Cambridge, Massachusetts; it has since expanded to other urban and rural areas of the country. The underlying philosophy of the program is that success in middle school algebra will not only enable access to advanced high school-level mathematics courses, but that a lack of access to mathematics is tantamount to impeding access to civil rights. The ultimate, practical goal is for students to be fully prepared for mathematics coursework at the post-secondary level (Moses, et al., 1989). The Project was comprehensive; it included new curricula, teacher professional development and parental and community involvement.

Moses, who founded the Project in 1982, was a former mathematics teacher who had even deeper in the grassroots organizations of the Civil Rights Movement. Merging

[14] The Algebra Project is included in this period because of the 2001 publication of the book detailing the work. The Algebra Project itself is much older and was nationally visible before 2000, but it gained broader recognition in the mathematics education community after 2001.

these two elements in his past and his own children's mathematics education, Moses began by leading sections in his children's high schools for "high ability" seventh grade students (ibid, p. 427). With some success, Moses and colleagues, including Mary Lou Mehrling, a mathematics teacher in Moses' daughter's school, broadened the scope of the early program.

The Algebra Project and its offshoot, The Young People's Project, introduced new ideas of the role of mathematics in the lives of students. Moses and Cobb (2001) claimed that mathematics was a tool of liberation for young African American students. The Young People's Project has a particular "beauty" in that it is a student-initiated counterspace purposed to affirm the mathematical identities of African American students (Moses & Cobb, 2001, p. 17; c.f. Carter, 2008; Martin, 2000). In these spaces, students were encouraged to use algebra to explore issues and problems in social studies, language and creative arts, and the sciences.

Identity, African American students, and Mathematics

> Most likely, it is the coming together of individual student characteristics, societal influences, and schooling opportunities that is most relevant to understanding and improving the participation of underrepresented groups. Some analysts have proposed that both schooling opportunities and students' responses to schooling are influenced by the current social milieu that holds particular norms and expectations about different groups of students. If this is the case, schools' definition of individual differences and decisions about what opportunity should be provided to different students may be influenced by societal as well as educational factors (Oakes, 1990b, pp. 200-202).
>
> To understand how their mathematical experiences were internalized at a psychological level, I focused on the construction of mathematics identities…The development of particular kinds of mathematics identities reflects how mathematics socialization experiences are interpreted and internalized to shape people's beliefs about mathematics and themselves

as doers of mathematics (Martin, 2007b, pp. 206-207).

An emergent theme amongst this recent collection of studies and articles is a focus on the identity development of African American mathematics students and, specifically, the intersection of the racial/cultural and mathematics-specific identities (e.g., Martin, 2000, 2007b; McGee, 2008; Nasir, 2007; Stinson, 2006). Among these studies, an implicit goal is to replace the deficit-laden perspectives that have long pervaded the field with more nuanced view—and one that positions students' voices as critical to understanding their contextualized experiences.

Martin's work also expands the research base to include African American adult students in community colleges, often documenting the relationship between their struggles for mathematical literacy and their children's mathematics experiences in schools. Martin (2000; 2007b) argues that mathematics learning and participation can be conceptualized as "racialized forms of experience," meaning that our identities as racialized persons become salient when doing mathematics (Martin, 2007b, p. 198). The goal of his research, then, is to explore the ways in which African American (adult) students respond as parents to their children's mathematics experiences infusing their "mathematical beliefs, experiences, and advocacy practices and parents of color" (p. 1999).

Jackson and Remillard (2005) also explore the roles of African American parents—mothers, in this case—in their children's mathematical learning experiences. Responding to policy calls for more parental involvement (e.g., *NCLB*), Jackson and Remillard challenge the common assumption that low-income, African American parents are impediments in their children's mathematics education. They pose two questions:

"How do African American mothers in a low-income neighborhood conceptualize their roles in their children's education?" And "what are the challenges they face in enacting these roles" (pp. 52-53)?

Interviewing most the ten mothers and grandmothers in their homes, Jackson and Remillard combined data from these interviews with data obtained from observations conducted inside the homes. The women in the study varied in age and level of education, from 26-years-old with a bachelor's degree in psychology to 48-year-old with a bachelor's degree in mathematics, to 49-year-old and less than a high-school education. In all cases, however, the mothers had high aspirations for their children, invariably expecting them to graduate from high school and college. These caregivers and parents also wanted their children to have opportunities to which they did not have access, hoping that their children would gain "independence," a notion similar to mathematics liberation (p. 60).

Martin's (2000, 2007b) research includes data from more than 100 African American students, parents, teachers and community members. Using grounded theory, Martin (2000; 2007b) developed a multi-level theoretical framework to explore what he calls "mathematics socialization," or the collection of experiences that "facilitate, legitimize, or inhibit meaningful participation in mathematics" (p. 206). Martin found that many parents clearly centralize race and racism in their struggle for mathematics literacy. These parents also position their struggle against the deficit paradigm of African American inferiority in mathematics. Another finding from Martin's work is the agency enacted by these African American parents in their children's mathematics education. Although the literature is replete with claims that African American parents are not

directly involved in their children's education—particularly African American parents in single-parent households—Martin found that the parents in his study were heavily involved with their children, helping with homework, resituating mathematics in local contexts, and setting high expectations for their children's engagement with mathematics.

Stinson (2004, 2006) also conducted studies among African American students with a dual focus on identity and achievement. His work focuses on the mathematics learning experiences of African American male adolescents and explores the sociocultural ramifications of the "discourse of deficiency" that pervades extant commentaries on the mathematics learning of African American students writ large. In his dissertation study, Stinson analyzed case studies with four African American men; he examined the enacted role of agency in their mathematics learning experiences—i.e., their abilities to "accommodate, resist, or reconfigure the available sociocultural discourses that surround African American males in order for them to effectively negotiate these discourses in their pursuit of success. Like Martin found in his studies of African American adults, Stinson found that the African American men in his dissertation study had "acquired robust mathematics identities" (p. i). Stinson argued that the men's mathematics identities were derivations of a broader process—byproducts of negotiating societal discourses about African Americans that circulate in the broader societal context.

Nasir's (2007) work expands the base even further to examine African American mathematics participation in out-of-school contexts (e.g., basketball, dominoes) and among school students as well as adults not in school. Nasir's research moves away from race and racial categories and instead views everyday mathematical practices as ways of unpacking culture by exploring its expressions. Understanding cultural practices that

include mathematics and understanding mathematics as a culturally situated practice, she argues, may allow researchers to begin to understand the uneven distribution of mathematics achievement across and within racial groups.

In the case of dominoes, Nasir analyzed the decisions that players make in the course of a game, how players negotiate the complex game play, and the goals that players associated with the activity. *Practice-linked* goals were those associated with the game play but may not have been mathematical in nature. In dominoes, blocking the opportunities of opponents to score, negotiating one's play with a partner, and sustaining a certain level of play were all explicit goals of the players. *Mathematical goals* "arise in the context of activity, when mathematical operations become a normal and required part of the cultural practice" (p. 225). Calculating scores, anticipating opponents' outcomes, and mentally computing and making choices all involved strategic, mathematically-oriented goals. As Nasir tracked the dominoes players, she found that their goals were fluid; they were not only concerned with becoming better, but specific mathematical goals were altered as their play became more sophisticated.

Mathematics Identity-as-Narrative: Toward an Analytic Framework

> The second possible site for collaboration concerns the identities that students are developing as they participate in classroom mathematical activities. A collaboration with this focus would encompass students' interests and motivations (i.e., so-called affective factors) as well as their decision of whether to continue to study mathematics… [Identity] is also important with respect to equity in students' access to significant mathematical ideas, an issue of great significance given the role of mathematics as a gatekeeper to future educational and economic opportunities…Although this gatekeeper role is typically framed in terms of students' cognitive abilities (or the assumed lack thereof), mathematics as it is realized in the classroom also appears to function as a powerful filter in terms of identity (Cobb, 2004, p. 333).

As I have discussed throughout the first part of this chapter, research in mathematics education concerning the learning experiences of African American students—their participation and achievement, in particular—is a slowly growing cross-section of the field. While some have noted the marginal position of this literature (Lubienski & Bowen, 2000; Martin, 2003; Stinson, 2006), it has quickly evolved throughout the past few decades to encompass a broader array of perspectives. Accordingly, researchers have shifted an implicit focus on outcomes (e.g., underachievement) to a more complex picture—one that necessarily includes the nature of schooling experiences and successful participation among African American students.

Given this broader direction, the purpose of the second part of this chapter is to focus on the primary unit of analysis: identity and, particularly, its role in the study of African American students' engagement with mathematics. I begin by discussing my use of Martin's (2000) analytic framework for mathematics identity and mathematics socialization. To extend Martin's framing of identity, I operationalize mathematics identity as a strictly narrative construct—that is, as a product of intra- and interpersonal discourse (Bamberg, 2004, 2010; Hammack, 2008; Juzwik, 2006; Martin, 2000, 2006; cf. Nelson, 2001; Sfard, 2008; Sfard & Prusak, 2005; Stinson, 2004; Williams et al., 2008). In particular, I define mathematics identity as a set of reifying, endorsing, and signifying narrative fragments that indicate an individual's sense of the importance of mathematics, strategies (Sfard & Prusak, 2005; cf. Martin, 2007; Nelson, 2001). Finally, I deepen this view of mathematics identity-as-narrative by making explicit what is meant by narrative from a sociolinguistic perspective (Labov, 2001; Labov, 1972; Labov & Waletsky, 2003;

cf. Juzwik, 2006). To conclude the chapter, I present the resulting analytic framework.

Mathematics Identity and Socialization Frameworks and Themes

According to Martin (2000),

> *Mathematics identity* refers to the dispositions and deeply held beliefs that individuals develop, within their overall self-concept, about their ability to participate and perform effectively in mathematical contexts and to use mathematics to change the conditions of their lives. A mathematics identity encompasses a person's self-understanding of himself of herself in the context of doing mathematics (i.e., usually a choice between a competent performer who is able to do mathematics or an incompetent person unable to do mathematics, but often flowing back and forth). It also encompasses how others "construct" us in relation to mathematics. As a result, a mathematics identity is expressed in its narrative form as a negotiated self, the results of our own assertions and the sometimes-contested external ascriptions of others. The development of particular kinds of mathematics identities reflects how mathematics socialization experiences are interpreted and internalized to shape people's beliefs about mathematics and themselves as doers of mathematics (pp. 206-207).

Martin situates this definition of mathematics identity at the base of his multi-level framework for conceptualizing and analyzing mathematics socialization processes. Mathematics identities, individual and collective, are shaped within various contexts—sociohistorical, community, school, and intrapersonal. At each of these levels, Martin argues and evinces throughout his study, a number of factors impact one's experiences and the construction of identities (Table 2.1). Influenced by these factors, mathematics identities cluster around six central themes: (1) the importance of mathematics; (2) the capacity to perform in mathematics contexts; and the (3) motivation, (4) opportunities, (5) constraints, and (6) strategies to participate in mathematics contexts.

Table 2.1. Martin's (2000) Multi-level Framework for Analyzing Mathematics Socialization and Identity among African-Americans: Key Themes.

Mathematics Socialization Level	Mathematics Socialization Factors
Sociohistorical	• Differential treatment in mathematics-related contexts
Community/Family	• Beliefs about African-American status and differential treatment in educational and socioeconomic contexts • Beliefs about mathematics abilities and motivation to learn mathematics • Relationships with school officials and teachers • Math-dependent socioeconomic and education goals • Expectations for children and educational strategies
School/Institutional	• Institutional agency and school-based support systems • Teachers' curricular goals and content decisions • Teachers' beliefs about student abilities and motivation to learn • Teachers' beliefs about African-American parents and communities • Student culture and achievement norms • Classroom negotiation of mathematical and social norms
Intrapersonal	• Personal identities and goals • Perceptions of school climate, peers, and teachers • Beliefs about mathematics abilities and motivation to learn • Beliefs about the instrumental importance of mathematics knowledge • Beliefs about differential treatment from peers

These themes form the basis of the framework employed in this study, as well as the data collection methods described in Chapter 3. To address the questions presented in the previous chapter, I used the mathematics socialization framework to guide and structure the semi-structured interviews conducted with student participants and, more

abstractly, to inform course-level observations. These themes were also used in the data analysis phase of the study, to code transcript data at a top level.

While Martin's framework provides the broad themes used to differentiate levels of mathematics socialization as the impact the formation (and information) of mathematics identities, it does not specify a method that differentiates identities from other kinds of narrative constructions. In other words, the analyses of mathematics identities in an individual's narratives would require a way to structurally associate mathematics identities with narrative considerations of identity. In the following section, I explain the next level of the mathematics identity framework—i.e., an analytic frame for examining identities as narrative. When taken together, they form the framing of mathematics identity-*as*-*narrative*, a bricolage that pairs socialization and identity themes with discursive methods for dissecting a "certain kind" of intrapersonal and social construction.

Operationalizing Mathematics Identity-as-Narrative

According to Sfard and Prusak (2005), identities are minimally composed of three narrative components, or "fragments": reifying, endorsable, significant statements (cf. Nelson, 2001; Sfard, 2008). By *reifying*, the identity must say something about the subject as a certain or distinctive kind of person. Moreover, a reifying narrative fragment is a label and is applied to specific persons of groups; for instance, "I am a mathematics education researcher." Often times, this declaration is explicit, but it is sometimes the case that one tells who she is without clearly labeling herself. Therefore, a narrative can be an identity without an explicitly declarative part—that is, without a reifying clause or

fragment. Of course, these identities are less than ideal; they lend themselves to claims of insufficient information. An identity of this kind, however, must have both endorsable and significant parts.

An identity is endorsable if it "faithfully reflects the state of affairs" for the narrative's author (Sfard & Prusak, 2005, p. 16). In other words, an identity reflects the state of affairs if it *correlates to an action* in which the teller involves herself within a particular context (cf. Nelson, 2001). If the state of affairs is "being a mathematics student," for instance, an individual may faithfully reflect—or endorse—it by engaging in certain actions, like studying or actively participating in a mathematics classroom.

Action, however, is not enough. The individual must also *signify* the state of affairs. In other the words, the storyteller must have and display a reason to care about what happens. She must be tied to the state of affairs such that "any change in the it is likely to affect the storyteller's feelings about the identified person" (Sfard & Prusak, 2005, p. 16). The storyteller, therefore, must be connected to the story in a way that matters in determining who she is as a certain kind of person and how she engages contexts in which she finds herself.

With these three components, an identity takes shape as a narrative construct. For the purposes of empirical study, however, this construct must also be rendered as a unit of empirical analysis (Juzwik, 2006). That is, how does one look at a narrative and decide where the parts are? As Juzwik suggests in response to Sfard and Prusak, research that takes up identity-as-narrative must also articulate what is meant by "narrative."

For the purposes of this study, I define narrative minimally as the conjunction of two causally linked clauses (Labov, 1972; Labov & Waletzky, 1967, 2003). Furthermore,

these minimal narratives have parts that can be linked to Sfard and Prusak's three features of identity. Minimal narratives may be composed of an abstract/orientation, complicating action, evaluation, resolution, and/or coda (Labov & Waletzky, 2003). The three identity features (reify, endorse, signify) may be expressed through any of these narrative part-categories. However, a significant narrative fragment must be included in a narrative's *evaluation*, following Linde's (1993) assertion that narrative "is a presentation of the self, and the evaluation component in particular establishes the kind of self that is presented." (as cited in Juzwik, 2006, p. 16). A complete version of the framework is depicted in Figure 2.2.

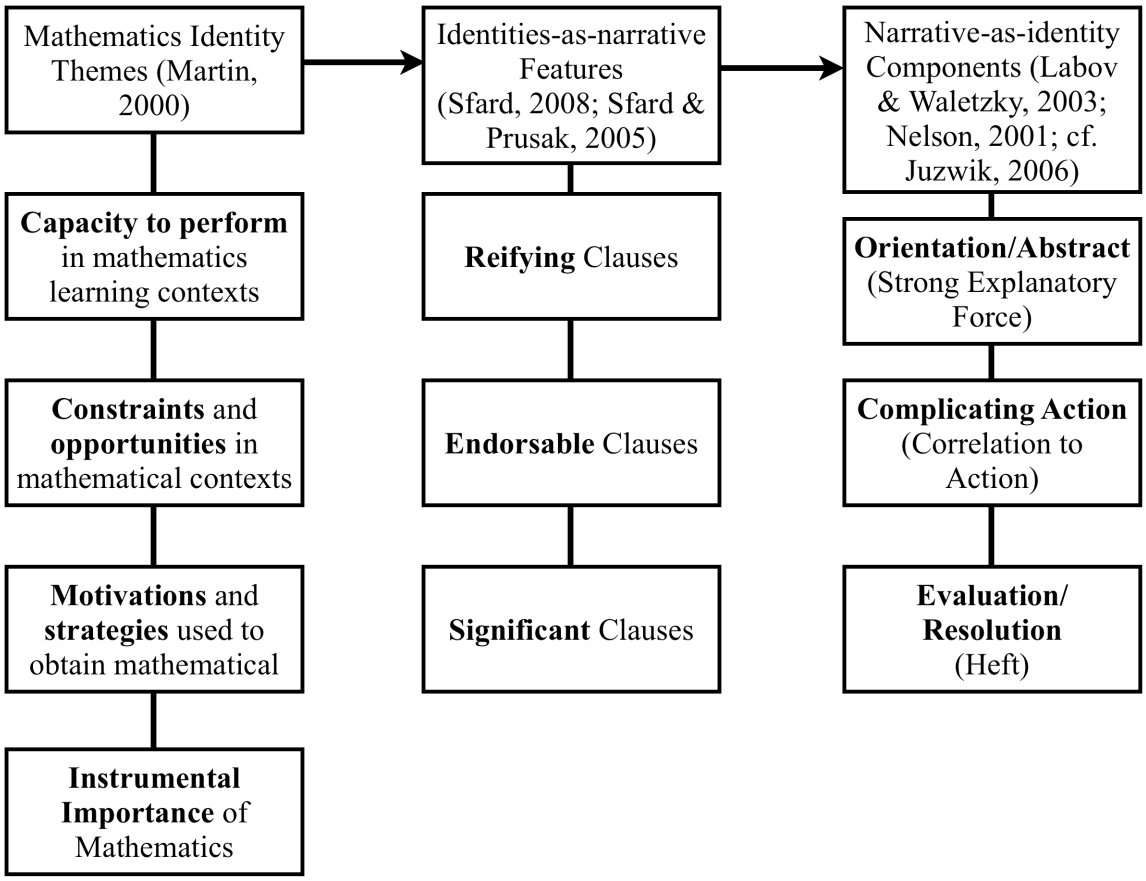

Figure 2.2. Mathematics Identity-as-Narrative Framework

CHAPTER THREE

Research Design, Setting, Participants, And Methods

Chapter Overview

In the two previous chapters, I provided rationale and context for examining students' mathematics learning experiences in a particular kind of phenomenological context: remedial mathematics courses at four-year universities. In Chapter 1, I connected these arguments to a broader, growing body of research studies, commentaries, and policy documents that invoke and position equity as a central concern for mathematics education research. I juxtapose this concern against another, the growing numbers of students who enroll in remedial mathematics courses each year in four-year universities.

Remedial mathematics courses are (or should be), I argue, an equity-oriented concern for mathematics educators. These courses, on one hand, are positioned to catalyze transitions to general mathematics requirements—thereby acting as a conduit to ease college access for all students—and, possibly, postsecondary study in mathematics. On the other hand, remedial mathematics courses have been found to play a very different role in positioning students, acting as a gatekeeper in the mathematics education pipeline. This gatekeeper course, as recent studies have shown, disproportionately attracts African American (and Latino) students.

In Chapter 2, I discuss distinct phrases of research and commentaries that emerged during the past three decades and explicitly address African American students' participation and achievement in mathematics. As I argued, these publications shifted a focus on underrepresentation and underachievement to a more multifaceted emphasis on

successful practices, social contexts, out-of-school learning, and in-group achievement and resilience. These studies have also drawn on relatively new constructs that elucidate the nuances of mathematics learning; among them, identity has emerged as a central analytic tool for examining mathematics learning experiences—and particularly among African American students and in service to equity-oriented inquiry. To conclude that chapter, I presented a theoretical framework for studying the mathematics identities that students construct as narratives of their learning experiences, drawing on the existing framings in education, mathematics education, psychology, and philosophy.

The purpose of this chapter is to discuss the study's empirical elements—the particular context, participants, timeline, instruments, and protocol—used to address the three guiding research questions:

1. What mathematics identities are African American students constructing while enrolled in remedial mathematics courses?
2. What are students' academic and mathematics engagement practices look like in these courses—both in- and outside of the classroom?
3. How do students' mathematics identities relate to their engagement practices as situated in their remedial mathematics course learning experiences?

First, I describe the research context, the university at which the study takes place. The focus of this discussion, however, is on the mathematics "track"—the pipeline of single-semester mathematics courses at the study's focal institution. In the first section, I discuss the role of the mathematics placement exam in assigning students to mathematics courses upon matriculation to the university. In particular, I examine selected enrollment

data in three introductory mathematics courses disaggregated by race. I show that not only are African American students overrepresented in the lowest-level courses—particularly the remedial course—but that their enrollment trends are worsening while the trends among the whole population and among other racial groups are largely improving.

Following the institutional context of the study, I introduce the participants in the study. First, I discuss the cohort of students enrolled in the course that I studied and who consented to participate in baseline data collection. I describe the instruments used to chart their attendance, their physical arrangement and interactions in the classroom, and broad observations of classroom norms. I also briefly describe the course instructors.

Lastly, I introduce and describe the four participants who are the subjects of the case studies detailed in Chapter 4. From the cohort of 21 students, I used information collected from a research questionnaire and observation field notes to purposively select students to participate in a series of interviews about their experiences; these interviews were conducted throughout the academic year.

Study Timeline and Research Activities

The dissertation study was conducted during the 2009-2010 academic year, with the major periods of data collection occurring during the fall semester (2009). The study involves data collection from a variety of sources: (a) classroom-level, ethnographic observations; (b) student questionnaires, (c) series of semi-structured interviews with four students, (d) semi-structured interviews with the course instructor, (e) semi-structured interviews with university- and department-level administrators and past faculty, (f)

course curricular materials (and, to a lesser degree, student-generated curricular artifacts), and (g) institutional records and data on course-level enrollments.

During the fall 2009 semester, I conducted observations in a remedial mathematics course at a four-year institution that I discuss in depth later in the chapter. Along the observations, I collected data about the students through a research questionnaire. The questionnaire focused on students' mathematics course backgrounds, their attitudes about mathematics, and their experiences in transitioning to the university and the role of mathematics therein. Based on the results of questionnaires and ongoing observations of students' interactions and engagement in the mathematics course, I selected and recruited six students for a series of in-depth, semi-structured interviews about the impact of school, family, and personal forces on their mathematics participation and achievement. Four students—the subjects of each of the case studies detailed in Chapter 4—participated in interviews during the fall and spring semesters.

Research Context

Institutional Mathematics Pipeline

The present study takes place at Michigan State University (MSU), one of the largest, public, four-year, research-oriented universities in the United States. The university requires that most entrants take the Mathematics Placement Service (MPS) exam. The exam is developed, administered, and evaluated by the university's mathematics department (ibid). According to Hill (unpublished),

> MSU uses a Mathematics Placement Exam designed by the MSU Mathematics Department in an attempt to place students into mathematics courses that are at a level appropriate for them. As is typical for such tests at most large universities in the US, this test focuses mainly on algebraic

> skills. The exam is evaluated each year (and revised when appropriate) using several different standard statistical checks of the correlation between Placement Exam scores and the grades students achieve in their freshman courses. These internal Mathematics Department studies show that the Placement Exam generally directs students into courses where they can succeed (p. 4).

For the past several years, the exam has been conducted online, and students are expected to complete the computerized version before attending summer orientation sessions. Under approved circumstances, students may choose to write the exam in a proctored setting at a designated testing center.

The university mathematics curriculum is a five-tiered system of one-semester courses. Students may bypass lower tiers by gaining credit for sufficiently high scores on the SAT, ACT, and Advanced Placement (in calculus) exams. Previously earned college mathematics credits can also impact how students enter and navigate the postsecondary mathematics curriculum. Under certain circumstances, students may also bypass the MPS completely (Table 3.1).

Table 3.1. Mathematics Courses, Placement Options and Requirements at Michigan State University (adapted from Hill, unpublished).

Mathematics Course Requirement (One course at each level)	Advanced Placement Calculus Exam (>3)	Previously earned credit in College Algebra (MTH 103) or above (or equivalent statistics course)	ACT Math > 28; SAT Math > 640	Mathematics Placement Exam Scores (>)				
				19*	15	12	10	9
No mathematics course				✔				
Tier 1: Technical calculus or a higher-level course.	✔	✔	✔	✔				
Tier 2: Business/ Biological science calculus; trigonometry; mathematics for elementary education students; any statistics course; liberal arts math course					✔			
Tier 3: Pre-calculus						✔		
Tier 4: College algebra; Finite Mathematics and Algebra							✔	
Tier 5: Required to enroll in MTH 1825: Intermediate Algebra								✔

* The proctored examination is required with this score for exemption from the mathematics course requirements.

For students who score within the lowest range of scores (designated at the department level), university policy requires that they enroll in MTH 1825, a three-credit, remedial mathematics course in a remedial mathematics course (cf. ibid). Students must pass this course before they may enroll in other courses that satisfy the university's

minimum mathematics requirements. As with many remedial mathematics courses across the nation, a student's grade in MTH 1825 is included in the computation of her or his grade-point average, but the credit hours for MTH 1825 may not be applied towards graduation requirements.

Enrollment Trends in Introductory Mathematics Courses

Nearly 7,500 first-year students matriculate during each fall semester at Michigan State University (ibid); there were 7,209 first-year students in the 2009 entering class. Nearly half of these students enroll in one of three courses: Calculus, College Algebra, or Intermediate Algebra. To provide institutional context for the study, I examined enrollment totals from the fall 1999, 2004, and 2009 semesters (Table 3.2).

Table 3.2. Student Enrollment in Selected Mathematics Courses (Intermediate Algebra, College Algebra, and Calculus) at Michigan State University during the Fall Semesters 1999, 2004, 2009, with Percentage Distribution by Ethnic/Race Codes. Source: MSU Data Warehouse.

Semester	Course	Total Enrolled	(1) White (%)	(2) Black (%)	(H) Hispanic* (%)	(5) American Indian/Alaskan Native (%)	(6) Asian / Pacific Islander (%)
Fall 1999	Int. Algebra	1520	66.7	22.2	5.4	1.7	3.5
	Co. Algebra	2217	75.1	12.8	2.8	0.5	3.7
	Calculus	896	79.0	8.8	2.5	1.0	8.4
Fall 2004	Int. Algebra	1158	61.8	27.3	5.6	0.9	3.4
	Co. Algebra	2202	81.1	9.6	2.5	0.5	3.5
	Calculus	941	78.5	6.8	2.2	0.6	6.5
Fall 2009	Int. Algebra	1106	53.1	32.5	5.3	1.2	2.4
	Co. Algebra	2011	74.6	9.7	3.8	0.8	4.4
	Calculus	1011	68.7	3.2	1.6	0.5	8.1

* Due to changes in federal regulations, codes describing race and ethnicity were modified and students were re-surveyed in Fall 2009. Among the differences in reporting criteria, a new category was added for Hispanic ethnicity (H), subsuming the separate ethnic codes for Chicano (3) and Hispanic-Other students (4). For comparison purposes

only, the ethnic code categories were combined for each of these groups in previous reporting years.

Overall, enrollments in these selected mathematics courses indicate that more students are enrolling in calculus by fall 2009 than in previous fall semesters (i.e., in 2004, 1999). At the same time, course enrollments in introductory algebra courses are decreasing. This could be interpreted as a positive development for MSU; that is, that more students are entering through higher mathematics courses—with a sharp decrease (~400 students) in Intermediate Algebra enrollments when comparing fall 1999 to fall 2009.

These figures depict a less encouraging picture with regard to distribution by race—particular with regard to African American students. In each year represented in Table 3.2, African American students are overrepresented in Intermediate Algebra courses and underrepresented in calculus courses at the university (except Fall 1999, where enrollments in calculus were slightly higher). Furthermore, these figures indicate that the situation has *worsened* over time; that is, there are 5% increases in African American enrollments in Intermediate Algebra between each of the years captured in Table 3.2 (i.e., 22% in 1999, 27% in 2004, 32% in 2009). Unfortunately, the figures in calculus depict a similarly troubling picture: In Fall 1999, 8.8% of students enrolled in calculus were African American; this figure dropped to 6.8% in 2004 and 3.2% in 2009.[15]

Math Enrichment and MTH 1825

[15] In 2009, 7,199 students enrolled in courses at Michigan State University; 605 of these students were African-African students (8.4%).

The university offers introductory mathematics courses in two formats: a large lecture version with more than 200 students and a smaller, seminar-styled course option with closer to 25 students in each section. Non-tenure stream faculty members typically teach large lecture sections; each enrichment section is co-taught by two teaching assistants—one graduate student-level teaching assistant and an undergraduate teaching assistant. Enrichment courses also differ from all others with regard to class schedule. Typically, university courses meet for three hours per week (with some variations); enrichment courses meet daily and for seven hours each week, Monday through Friday.

As I discussed in the previous section, African American students are disproportionately enrolled in MTH 1825 at Michigan State University, as compared to all other racial groups. Furthermore, while overall enrollments have decreased in algebra content courses at the university, the numbers of African American students who enroll in these courses continue to increase. This multi-year snapshot also suggests a more distressing fact: fewer African American and Latino/Hispanic students, particularly, are enrolling in calculus courses during this span. While this is but a partial picture, the suggested trends are commensurate to the broader trends discussed in Chapter 1.

For the present study, I focused on students who enrolled in enrichment-style section for several reasons. First, where African American students are disproportionately enrolled in MTH 1825 overall, they are even more overrepresented in the enrichment sections (Table 3.3). Secondly, a classroom that is purposed to allow for more interactivity and classroom discourse is an ideal setting for a qualitative study of students' mathematics learning experiences.

Table 3.3. Student Enrollment in MTH 1825 Enrichment Sections (MTH 100-E) at Michigan State University during the Fall Semesters 1999, 2004, 2009, with Percentage Distribution by Ethnic/Race Codes. Source: MSU Data Warehouse.

Semester	Total Enrolled	(1) White (%)	(2) Black (%)	(H) Hispanic* (%)	(5) American Indian/Alaskan Native (%)	(6) Asian / Pacific Islander (%)
Fall 1999	115	21.7	65.2	9.6	0	3.5
Fall 2004	144	17.4	63.9	13.9	0.7	2.8
Fall 1999	137	14.6	66.4	13.9	0.7	0.7

* Due to changes in federal regulations, codes describing race and ethnicity were modified and students were re-surveyed in Fall 2009. Among the differences in reporting criteria, a new category was added for Hispanic ethnicity (H), subsuming the separate ethnic codes for Chicano (3) and Hispanic-Other students (4). For comparison purposes only, the ethnic code categories were combined for each of these groups in previous reporting years.

MTH 1825: Course and Classroom Setting

Course Setting. An enrichment-style course section of MTH 1825 was purposively selected for this study. The course instructor was contacted during the previous semester. As a prior, pilot study was conducted with this instructor in a different section in a previous semester, I updated the instructor on the purpose of the then-present study and asked for permission to introduce the study to students and recruit participants.

Classroom Setting. With few variations, the classrooms in the instruction wing of the mathematics building are unremarkably identical (the other main building wing is for faculty offices). Both rooms (MWF and TR) have an industrial-institutional feel: four eggshell-colored, cinderblock walls; beige laminate tile floors; and 37 desk-chair combinations arranged on an eight-by-five grid that fills the room. Two of the desks are fitted for left-handed writers. There were routine notices on some of the walls: a sticker to remind inhabitants to turn off the light upon exit, media support phone numbers, and a small poster advertising an hourly off-campus job opportunity.

The grid of desks faces a single table, chair, and an emerald green chalkboard that lines the front wall. A projection screen hangs, rolled, above the chalkboard. There is a second chalkboard on an adjacent wall, just next to the front door. There is another door on the same wall near the back of the classroom that is not as easily accessible. On the other wall, opposite the doors, are a line of windows and a large console for electronic media devices and computer accessories. This console is connected to the classroom's (rather shiny) digital projector that hangs securely above the center of the classroom.

Institutional Supportive Services

In Chapters 4 and 5, I refer to institutional support systems that are purposed to support students enrolled in introductory mathematics courses at the University (cf. Martin, 2000). These services are often initiated at application to the university—if not before, in some cases. Students are assigned advisers, pre-matriculation campus visits, and academic support programs before the beginning of their first semesters. For students who are first-generation college students, from low-income-earning families, or other markers of difference, supportive serves may also be offered to facilitate first-year transition to the university. One such program is the College Achievement Admissions Program (CAAP) in the Office of Supportive Services. CAAP is a "holistic retention initiative" that offers assistance to students throughout their academic careers at MSU. The program provides academic specialists to advise students and promote academic achievement. Other services are also available for students, including the Mathematics Learning Center in the Department of Mathematics.

Study Participants

Student Cohort Characteristics

The course enrollment numbers for the course shifted slightly throughout the semester. On the first day of classes 35 students were present. By the end of the first week, 31 students were officially enrolled and, after the third week, 21 students were enrolled. Of these students, 13 consented to participate in the study (Table 3.4). Observation charts were also used to chart students' attendance and interactions with peers and instructors (a sample, with names and typical seating placement, is displayed in Figure 3.5).

Table 3.4. Student Participants Cohort Characteristics from Research Questionnaire.

Student Name	Gender	Age	Yrs. of H.S. Math	Highest Math Course Taken	Race/Ethnicity
Ann	W	18	4	Geometry/Algebra 2	White/Caucasian
Cedric	M	18	3	Calculus	Black/African American
Crystal	W	18	4	Pre-Calculus	Black/African American
Deacon	M	18	4	Pre-Calculus	Black/African American
Kenyada	W	18	3	Geometry/Algebra 2	Black/African American
Latasha	W	19	4	Statistics	Black/African American
Mary	W	18	4	Functions, Trigonometry, Statistics (FST)	White/Caucasian
Michele	W	18	2	Calculus	Hispanic/Mexican American
Renetta	W	18	4	Pre-Calculus	Black/African-American
Robert	M	19	3	Geometry	Black/African-American
Ruby	W	18	4	Geometry/Algebra 2	Black/African American
Tracy	W	18	4	Trigonometry	White/Caucasian
Vanessa	W	18	4	AP Probability and Statistics	Black/African American

During the fourth week of the semester and after the consent process, I administered a research questionnaire as an inventory for gathering baseline, student-level information (Appendix B). The questionnaire included three main sections: (1) personal/demographic information, (2) mathematics course history and background, and (3) attitudes and beliefs about mathematics and assessment. The purpose of the questionnaires was multifold. While personal/demographic questions would allow me to describe the social make-up of the classroom, information gathered in the other sections would facilitate the selection of an appropriately diverse array of students as potential interview participants.

Instructors

As with most enrichment courses in the department, the course was taught by a single instructor, with support from an undergraduate teaching assistant (UTA). In this particular case, the course was instructed by an adjunct faculty member who had years of experience teaching this and other courses in the mathematics department. The instructor is responsible for all in-class curricular decisions (e.g., intended, enacted, assessed) and the UTA is responsible for grading and other record keeping (e.g., attendance). Other curricular decisions are made at the department level and applied uniformly across course sections.

Data Collection Methods

Conducting Observations

During the 15-week fall semester, I conducted more than 30 hours of classroom observations. The main purpose of the observations was to document empirical aspects of students' in-course engagement: (a) the context within which students were expected to learn, (b) students' roles in curricular enactment, and (c) students' interactions with their peers and instructors. Although I primarily used field notes to record day-to-day attendance and activities, I also developed a chart to visually represent and record in-the-moment interactions between students and instructors (Figure 3.5). Accompanying these charts, my field notes included mathematical goals, daily mathematics content, classroom participation, and other "hunches" and impromptu moments (Bogdan & Biklen, 1998).

Instructor

	A	B	C	D	E	F	G
1	Alma	Marisol	Cedric	Mary	Rudy	Vanessa	Ann
2	Dorothy	Ligia		Renetta	Tracy	Crystal	Latasha
3		Ivan		Ji	Tiffany	Michele	Ruby
4	R-Gregory (some)		Nicole	Robert	Deacon	Kenyada	Shanika
5	UTA	R-Gregory (rarely)				Aaron	
6				R-Gregory (often)	R-Gregory (majority)		

Figure 3.5. Classroom observation chart with student pseudonyms and typical seating placement.

Interview Participant Selection

Observation field notes and research questionnaire responses were used to generate a list of potential interview participants. All of the students who returned research questionnaires were also asked if they would be willing to be contacted for interviews, and ten responded. I then selected eight of the students for recruitment; the other two students were no longer attending courses and did not respond to follow-up contact. All correspondence used to recruit students was written (See Appendices A). Several students declined to participate in the interviews and, of the remaining, four consented: Vanessa, Ruby, Cedric, and Nicole.

Analysis Methods

Reviewing Course Observation Field Notes

Field notes were composed during each observed classroom session. After each course, I also briefly recorded short reflections about key informants or unexpected events. All notes were handwritten (In fact, the instructor expressly asked that I not bring a computer to the classroom). After classroom sessions, selections from notes were word processed along with the date, number of students present, any other reflections on particular students' activities during the course. In these cases, key words were also assigned to passages for later use and reference. Field notes were used informally to guide the notes prepared before and after interviews.

Analyzing Interviews

All interviews were transcribed by utterance. With the assistance of a second graduate-level transcriptionist, the digital audio recordings were converted to text, and the transcripts were tested for reliability by exchanging documents and crosschecking for errors. Codes were developed iteratively from the data but also guided by the themes in the mathematics identity-as-narrative framework. That is, the data were coded by these themes and, in instances where a theme may not have applied or a new theme seemed appropriate, a new coding theme was developed. For example, the following themes emerged from the data and were not easily categorized within the mathematics socialization framework: "mathematics as a gatekeeper (constraint)," "evaluation of the instructor/teacher," "informal academic support," "math as competitive."

Following the first phase of theme coding, the narratives were coded for narrative themes and identity themes. In this particular instance, I identified two identity narratives—as minimal instances of reifying, endorsed, and signifying narrative fragments joined by temporal conjunction. In the first narrative example, the speaker refers to herself as a "challenged mathematics student," and endorses this identity by connecting it to a lack of effort in the classroom (Table 3.6).

Table 3.6. Example of Coded Transcript Data.

Utterance Each ellipse […] denotes a 2 second pause. [00:00:00] denotes a time marker [hr:min:sec].	**Narrative Analysis (Features)**	**Identity Features**	**Mathematics Identity Themes**
[1] I would say that I'm a challenged math student. [2] Like math is one of those topics that challenges me, and do I—how can I say—[3] do I pay attention to it and try to work at it as much as I should? No. [4] And I guess that that goes back to me quote-unquote not liking it. **[5] So, now I'm trying to be that type of person where, "oh just speak it into existence" or "I love math"—**[6] that's what people tell me; [7] I guess that works. [8] But it hasn't worked for me yet. [9] But, um, what was the question again?	[1] Abstract [2] Evaluation [3] Comp. Action [4] Coda [5] Reorientation [6] Comp. Action [7] Evaluation [8] Resolution	(A) [1] Reifying [3] Endorsable [2] Significance (B) [5] Reifying [6] Endorsable [7,8] Significance	(A) Importance of math (B) Motivation to Learn Mathematics

CHAPTER FOUR

Case Study Participants: Mathematics Identities and Engagement in MTH 1825

> I continue to be struck by the small number of African Americans enrolled in higher level mathematics courses and the disproportionate number enrolled in basic level or remedial courses. Although many of these students did not experience success in junior or senior high school, I do *not* believe that ability is the primary reason for this pattern. Large numbers of these students tell me that they wished they had "focused" more on math earlier in their schooling. Many of these students remark that math was not their best subject but now realize that they have to face the challenges of mathematics learning if they want to achieve their goals (Martin, 1997, pp. 49-50, emphasis added).

> [We] understand little about the interactions among [beliefs, resources, problem solving strategies, and practices] and less about how they come to cohere—particularly how an individual's learning fits together to give the individual a sense of the mathematical enterprise….My own bias is that the key to this problem lies in the study of enculturation [and socialization]…. And if we are to understand how people develop their mathematical perspective, we must look at the issue in terms of the mathematical communities in which students live and the practices that underlie those communities (Schoenfeld, 1992, p. 363, as cited exactly in Martin, 2000, p. 18).

Chapter Overview

In this chapter, I directly address two of the three questions that guided this study: (1) what mathematics identities are students constructing and (2) how are they engaging academically and with mathematics amidst their transition to postsecondary study? Using multiple sources of data (i.e., ethnographic observations, questionnaires, semi-structured interviews), I present my analyses as four case study reports—or profiles of mathematics identity and forms of engagement among African American undergraduates enrolled in Michigan State University's lowest-level mathematics course, MTH 1825. For each question and related construct, I analyzed the data using narrative inquiry methods and qualitative coding methods associated with ethnography (Chapter 3).

In each case study report, I briefly introduce the each of the study's four student informants. Each case also includes detailed accounts of the student's school and mathematics backgrounds, her or his in- and out-course engagement, academic identities, and mathematics identities. The focus here is solely on representing the experiences of these four students in as full and systematic a way as possible, with particular attention to first two research questions posed in Chapter 1—and given the inherent complexities of the research setting. In Chapter 5, I address the third question, the relationship between identity and engagement.

About the Students, Our Interactions, and the Role of the Researcher

> They said nothing about expectations, motivation, the value their families placed on education—not even when I pointedly asked them about these things. They were proud to be students at such a strong university. Their families were proud of them. They had been successful in high school. (Steele, 2010, pp. 18-19)

In Chapter 3, I explained that four students—Ruby, Nicole, Vanessa, and Cedric—were selected to participate in a series of interviews throughout the fall and spring semesters, 2009-2010. These students were purposely selected from the study's 21-student participant pool. As I describe in each of the case study report, these four participants represent a range academic backgrounds. Overall, these students were largely successful in high school; two of the students graduated at the top of their respective high school cohorts. Each case study participant completed at least three years of high school mathematics—thereby meeting the minimal mathematics requirements for entrance to the university. Each student also earned passing grades in at least one high school-level course at or above the content level of MTH 1825.

The four case participants also represent a range of in-class engagement practices among the study cohort. I observed the students over several weeks during their enrollment in MTH 1825, and these observations also framed their selection as case participants. For instance, I quickly noticed that Cedric and Vanessa were among a small group of "front row" students—a designation that symbolized (and reified) their roles in the classroom setting. This group was consistently and almost constantly engaged in the mathematical activities and discourse of the class. This group of students also behaved in particular ways in the classroom; they raised their hands to speak, they were often the students who worked at the chalkboard when asked, and they attended class sessions more regularly. As I later learned, they were also among the more academically successful students in the course.

On the other hand, Ruby and Nicole's positions within the classroom corresponded to a very different kind of classroom engagement. While students who sat near the front of the classroom and were among the most engaged participants in mathematics lessons and other course activities, students who sat elsewhere were typically less engaged (as Figure 1, shows, this arrangement is not unusual). As I first discussed in Chapter 3, Nicole sat near the back of the MTH 1825 classroom, and as I discuss later in this chapter, her engagement in the classroom mathematics discourse was often lacking. Ruby sat in the middle section of the classroom, and while she often paid attention to the mathematics course lessons, she also disengaged periodically to either talk with other students or sometimes stare at the board.

Figure 4.1. Students positioned within a representative classroom; Artistic Credit: R. Kikuo Johnson. For interpretation of the references to color in this and all other figures, the reader is referred to the electronic version of this dissertation.

Their engagement, however, was characterized by much more than their physical position in the classroom. Cedric and Vanessa associated with a small group of students who were consistently and almost constantly engaged in the mathematical activities of the classroom.

Unlike the students that Steele described in the quotation that heads this section, these four students did open up about their expectations, their motivations in school and beyond it, and their families' perspectives on education and their related expectations. In series of interviews with each of the participants, I learned a great deal about how each student's educational trajectories had been influenced by the schools they attended, the neighborhoods in which they grew up, and the families that supported and fostered their academic achievements. Through semi-structured conversations around factors that shape the academic and mathematics learning experiences, I not only learned about the

students' pride in attended Michigan State, but also some of the challenges embedded in their social and academic transitions.

Case Participant Cedric: "It's kind of like, 'Well gee, you are really bad at math."

Case Overview and Student Background

Cedric is an African American male from a small, in-state city (<10,000 residents) located within 50 miles of Michigan State University. At the beginning of the 2009 fall semester, he was an 18-year-old, first-year undergraduate. Cedric attended the local, public school in his hometown, and he excelled academically. He finished high school ranked among the salutatorians of his graduating class, and he took advanced courses in all disciplines, including mathematics (calculus in his third year).

Cedric completed the research questionnaire administered during the fall semester, and he participated in five interviews during the fall and spring totaling more than seven hours—more than any of the other case participants. It was from the questionnaire, too, that I learned that Cedric completed calculus during his junior year. Because calculus was the most advanced mathematics course offered in his high school's curriculum, he did not take a mathematics course during his final year. Unlike the other students, he also did not take an algebra-specific course (e.g., "Algebra 1, "Pre-Algebra") during his high school years. Instead, he took a course in geometry during his first year of high school; a course in functions, trigonometry, and statistics during his second year (algebra-related, so to say); and a pre-calculus course during the first semester of his third year (and the calculus course during the second).

Overall, Cedric attended his mathematics course (MTH 1825) each day, quietly taking notes and asking questions infrequently. He sat in the middle of the classroom's front row; yet due to his quiet demeanor, would have otherwise been easy to overlook. He rarely interacted with anyone in the classroom, neither the instructor nor his student

peers. He was almost constantly writing, copying the instructor's notes on the chalkboard—and his head bobbed rhythmically as he looked from the board to his notebook. On the surface, it appeared that Cedric was academically engaged and that he regarded his mathematics learning experience with a seriousness reflected in his actions in the classroom.

In the sections that follow, I begin by discussing Cedric's family and community and, particularly, the impact of family expectations on his school achievement. I also discuss his high school background, his high school mathematics courses, and provide an overview of his experiences in math learning contexts prior to attending Michigan State. While highlighting Cedric's transition to MSU and to his mathematics courses, I then discuss the elements of Cedric's narratives that express his mathematics identity work—particularly, Cedric's view of (a) the importance of mathematics, (b) his opportunities to learn mathematics at the university, (c) constraints on his mathematics learning, (d) his strategies for learning, and (e) his motivation to learn mathematics. I also present an analysis of Cedric's narratives, in which I describe how he constructs his identities in relation to his peers, instructors, curriculum, his and others' expectations, and the broader institutional and social contexts.

To conclude, I develop direct relationships between Cedric's case and the study's main questions—about the development of mathematics identity, engagement in math learning contexts, and the relationship between identity and engagement. Cedric's case study allows us to situate these questions a particular social context, enhancing their explanatory power and relevance. For instance, what happens to the mathematics identity development of a high-achieving student who is placed in a remedial mathematics

course? How did he react academically, over time? Did the course experience have an influence on his designated identities?

Family and Community Expectations for Academic Achievement

Cedric's mother is a lifelong resident of Michigan. She was born near the town in which their family now lived; Cedric's father moved to the area from Chicago as a younger adult in search of employment opportunities. Both his parents worked in local industrial occupations, and he described his family's socioeconomic status as "working class." He described aspects of his upbringing as "average, even though we [*sic*] didn't have much money."

Following his commencement from the local high school, Cedric was the first in his immediate family to attend college and among the first generation of his extended family members to do so, as well.

> C: Um, well…I'm like a first generation student. So, my mom and my father, they never went to a four-year university, so yeah. And uhm, I don't think that my grandparents went to college either.
>
> GL: Could you talk a little bit about what that means for you? For them? What expectations there may be?
>
> C: I think that there's a little pressure, but not, like a lot. I think that more people are kinda leaning on me to do well. They want to see me do well. I've just got to keep that in mind…that people are counting on me to succeed. Like my family and friends are—mostly my family.

Throughout our conversations, Cedric explicitly connected his motivation and academic achievement to his family's expectations. While his family was "counting on"

him to succeed generally, Cedric also spoke specifically about his parents' expectations for him to attend college.

> C: Oh, I was going to college. There was no doubt about that.
>
> GL: Can you say more about that?
>
> C: Well, my dad was a big factor. He was really proud that I got into MSU. I mean, he didn't go here or anything like that, but I think that him and my mom were just really happy that I was not only going to college but going to a really good one.
>
> …
>
> C: And even family, they'll be like, 'I've got a cousin that's at MSU,' talking about me. I think that my mom and dad are just proud that they raised a son that was able to go to college. And when I tell them that I'm doing well, then that makes them feel good. And I think that that's the case for the rest of my family. Just as proud as my parents are.

Cedric was mindful of his parents' expectations for his academic achievement and the role of any course, including mathematics, in that trajectory. Cedric had not shared with them, however, what he knew about the specific role and structure of MTH 1825—not even that it was a course in which many first-year students enroll. When asked near the end of the semester, Cedric had never discussed his mathematics course with his parents.

> GL: You mentioned that you were taking this class, and you hadn't talked with your family about it.
>
> C: Mm-hm [yes].
>
> GL: Has that changed? Or has it not?
>
> C: Um, it hasn't changed. Like, they know that I'm taking a math course, but they don't know, you know, anything about the math course.

GL: Okay.

C: Yeah.

GL: Do they know that you're doing well in it?

C: Yeah.

…

GL: Have you told your family about other courses that you're taking? Is it something that you'd ordinarily do?

C: Well, yeah, I've told them. I've told them about classes that I'm taking, but they don't really know what the classes are really like about. So. And I tell them if I'm doing well or if I'm not doing well. So.

Past Academic Contexts and Identities

Cedric attended the local, public high school in his hometown and excelled throughout his four years there. He had attended schools in the city since kindergarten, and had formed strong relationships among a core group of peers. Cedric spoke highly of the academics of his school. According to statewide reports that rank schools based on standardized assessments, his high school ranked near the middle of schools across the state during his tenure there. Essentially, Cedric was a very strong student at an average public school. During our first interview, Cedric quickly identified himself as a top student and one of several salutatorians of his high school class.

C: Well, I think that there were maybe five hundred students in the whole school. I think that only one hundred or so graduated in my class. Well, I was salutatorian. But it was a lot of hard work in high school. But yeah, I was a good student.

Cedric's hometown and high school were racially mixed; the school population was predominantly African American (57%). The majority of students (61%) were eligible for free lunch. According to official records, Cedric's grade point average ranked

sixth among a graduating class of 129 students; in 2008, there were 461 students enrolled in his high school.

Cedric also credited much of his school achievement to strong connections and productive interactions with his peers, many of whom were also valedictorians and salutatorians of his high school. Surrounding himself with other high achieving students, Cedric enjoyed and helped construct an inner-school environment in which he could affirm his high-achieving academic identity (cf. Carter, 2008).

> C: I think that me and my friends kinda had like the same vision. Like we basically wanted to go somewhere. We all got into the higher classes, the honor classes. Like a lot of my friends were salutatorians along with me, so.

Having the "same vision" of academic success, Cedric and his peers sought and took honors-level courses and supported each other through their accomplishments. Although several members of his peer group matriculated to MSU, Cedric had not yet reorganized a peer network at the university. We did not pursue in the interviews whether Cedric was experiencing particular constraints on building peer relationships, but as the semester progressed he mentioned new and academically productive relationships among his peers in the course.

High School Mathematics Course Background and Identities

Cedric completed three full years of high school-level mathematics, beginning with a course in geometry in his freshman year; a course named "functions, trigonometry, and statistics" (FST) during his sophomore year; a pre-calculus course during the first semester of his junior year; and a course in differential calculus during the second

semester of the same year. On his research questionnaire, Cedric indicated that he enjoyed mathematics in high school. Near the end of the questionnaire, he scribbled:

> I did not take a math class in my senior year because calculus [was the] highest course offered, and I completed that in my junior year. Also instead of taking my time on the placement test, I rushed through it and pressed "I don't know," the majority of the time.

Cedric's opportunities to continue taking mathematics courses beyond his junior year—and beyond calculus—were constrained by his high school's course offerings. In the courses that he did complete, Cedric excelled. With the exception of pre-calculus, he earned the highest grades in his mathematics courses (he earned a 'B' in pre-calculus). He did not explore options to take courses at nearby colleges (nor did he talk about them), including the small, liberal arts college near his hometown. It is also not clear that any students within Cedric's *highest*-achieving peer group—whether interested in mathematics or not—pursued and/or received college credit for courses taken elsewhere.

Cedric consistently indicated, across a number of the questionnaire items and later in his interviews, that he considered his mathematics ability as "average." This also stands in curious contrast to other items in which he indicated that his performance in his high school mathematics courses were an accurate reflection of his ability to perform in mathematics contexts. Cedric also reported that he typically spent between two and three hours per week on his high school mathematics homework and other assignments.

Transition and the Mathematics Placement Exam

As he indicated in the excerpt above and stated clearly in his research questionnaire, Cedric believed that the MSU mathematics placement exam was an especially poor representation of his mathematical knowledge and, with better

preparation, he could have placed into a different, higher-level mathematics course. On his research questionnaire, Cedric indicated that the placement exam was "not at all" a "good indication of [his] knowledge about mathematics." During the interviews, Cedric also discussed the testing experience:

> C: Yeah…during the math placement test I just—kind of just—rushed through it. Like, I finished my—we had block classes in high school, so I finished my calculus class in my junior year. I didn't have any math in my senior year.
>
> GL: Okay.
>
> C: So [for] some of the stuff, I was just like, uhm, 'I don't know,' 'I don't know,' and I clicked off, basically through the whole math placement test. So, yeah.

This behavior on the mathematics placement exam is a practice that I call "satisficing" (Berinsky, 2004).[16] Cedric's frustration with the exam and with not feeling prepared to satisfactorily complete the task led him to a strategy of avoidance—and he disengaged. I revisit this particularly phenomenon in the other cases.

Cedric's Engagement in MTH 1825: Classroom Observations

---

[16] In studying the administration of public opinion surveys, political scientists have recognized that "it could be that the specific context of the survey interview encourages don't know responses, even among those respondents who have a sense of where they might stand on a given political controversy" (Berinski, 2004, p. 40-41). The survey, Berinski argues, can be a difficult and tedious task for the user, particular if the user feels any sense of under- or ill-preparedness to respond. Berinski continues:

> Given these demands, it might be easier for respondents to engage in satisficing behavior and move on to the next question if they have difficulty readily forming a political judgment. Thus, some respondents may offer a "don't know" response because they do not feel they have sufficiently strong views to meet the demands of the question being asked. This behavior may be exacerbated by the structure of the information conveyed from the interviewer to the respondent…Thus, the very process of asking the survey question may encourage satisficing behavior (ibid).

Perhaps in spite of his high-achieving academic identities, Cedric's course-level engagement in MTH 1825 was hardly noticeable; it was nearly as inconspicuous as he himself was in the classroom. Tall and slender, Cedric wore thinly framed glasses and sported a simple, close-cropped haircut. He also often wore a black windbreaker jacket, even as the northern weather went from September cool to a frosty, November cold. Instead of removing the jacket and turning to face the chairs and students behind him, he simply sat at his desk. Without exception, Cedric attended class for each session (i.e., daily) and sat in the middle of the classroom's front row. On one occasion, though, it seemed that Cedric would break his streak. In my field reflection notes from that day, I wrote:

> With only five minutes left of a 70-minute session, [Cedric] comes through the door in a hurry. Every eye looked up in amazement, as if to say, "Who comes to class with five minutes left?" The answer was clear: Cedric does. And without a second thought about his own tardiness, he quickly maneuvered his way into his seat. By the very next minute, his books were open and he was furiously copying the notes on the board. He didn't bother to remove his jacket. At the end of the class session, Cedric approached the instructor, apologized, and then asked if he could take a look at her notes for a few minutes.

On all other days, however, Cedric engaged silently in class—taking notes and periodically focusing on the instructor's discourse and movement as problem solutions were discussed. He rarely spoke aloud and never moved from his seat, where other students would offer answers to questions, talk with peers, pose questions, or go to the board. Cedric, interestingly, said that the girls went to the board—which, by my records, was not empirically true; other male students did demonstrate solutions at the board. As both he and course records confirmed, he completed all assignments.

Cedric's Mathematics Identities

The main focus of my interviews with Cedric was to understand how various institutional forces (e.g., curriculum, instructors, peers, school support systems) were impacting his sense of a mathematical self—i.e., his mathematics identities. I analyzed Cedric's narratives from each of our interviews with respect to the mathematics identity themes included in the framework: (a) importance of mathematics, (b) motivation to study mathematics, (c) strategies for mathematics learning, (d) constraints in mathematics learning contexts, (e) opportunities to learn mathematics, and (f) capacity to learn mathematics.

Instrumental Importance of Mathematics and Motivation

Throughout his interviews, Cedric affirmed the instrumental importance of mathematics, both generally and in his own academic background. Cedric "always did well" in mathematics, and he enjoyed his school mathematics courses—particularly in high school (as he reported on his questionnaire). Unlike some of his MTH 1825 peers, he also committed time for studying mathematics in high school; on his questionnaire, Cedric indicated that he studied more than three hours per week, on average, for his math courses.

Despite this, Cedric questioned the importance of mathematics in relation to his experience taking the university's mathematics placement exam. He delayed the exam, choosing to complete it just before the deadline—and before his summer orientation at the university.

> GL: Okay. So let's think back to this past summer/spring, before you enrolled. When did you take the placement exam?

C: I took the placement exam, I think, uhm, right before AOP, I think… Uhm, I think that there was a deadline for the math placement exam, and uhm, my AOP was during June. I can't remember when the deadline for the math placement exam was. Yeah.

GL: So, what did you think about the test? I see this smile creeping across your face.

C: Yeah…during the math placement test I just, kinda just rushed through it. Like, I finished my—we had block classes in high school, so I finished my calculus class in my junior year. I didn't have any math in my senior year. So, some of the stuff I was just like, uhm, 'I don't know,' 'I don't know,' and I clicked off, basically through the whole math placement test. So, yeah.

Cedric continued to regard mathematics with measured importance throughout his first year at the university. He questioned, for instance, the role of mathematics in his own course-taking trajectory, even though his chosen major, psychology, would require mathematics courses beyond the common undergraduate requirements. Cedric also continued to question the role of mathematics in his own developing academic trajectory at the university. Across our interviews, his discursive wrestling about mathematics evidenced changes in his own motivation to engage in mathematics learning contexts.

C: Well, I'm not going to say that I totally don't like math. But math has always been something that I kinda struggled with. I can always say, though, that I do like it when I understand it. So, um, I knew that in math I had to work just a little bit harder, so that's basically what pushed me to get good grades, to basically put in the best that I could.

For Cedric, the notion of being a mathematics student—and a certain kind, i.e., successful—necessarily included struggle and, perhaps more importantly, hard work. This *contingency* did not develop solely or particularly in relation to MTH 1825. (Besides, math was "always" a struggle and he could "always" like it when he, essentially, worked hard at it.) Cedric did work hard—very hard. In addition to attending

MTH 1825 each day, he adopted a suite of additional strategies to support his mathematics learning—all of which exemplified this particular relation (i.e., this *contingency*) between his identity and his academic engagement. As other students also attested, Cedric studied many hours during the week for MTH 1825 and considered it necessary for his success in the course.

Opportunities for and Constraints on Participation in Mathematics Learning Contexts

Cedric's high regard for the importance of mathematics was both supported by his family and portrayed in his own narratives about his mathematics experiences. Cedric's continued success in mathematics courses reinforced his sense of the subject's importance, and his interest in mathematics once led a teacher to recommend that he think seriously about a mathematics-related career.

> C: It was Mr. B, my calc teacher [in high school]. I think that he was really happy to have us all in his class. [……]
>
> GL: Who was "us"?
>
> C: Uh, Me and my friends were all in that class, and we were also the top students in the school. I think that it helped that we were all in there. I mean, it helped all of us do well to have each other. But anyway, Mr. B pulled me aside one day and told me that he thought that I was a natural at math; I was kinda shocked, because math had never really been my thing—you know? I mean, I was alright. But I had been doing well in his class the whole time, and he thought that I really had some talent for math. I liked math, but I really more interested in psychology. I didn't tell him that, though. I liked that he wanted me to know that.

Cedric also suggested that he initially struggled to "get into the flow" of his calculus course in high school, similar to his experience in MTH 1825. Cedric then discussed his teachers' expectations for students' success and mathematics, citing high

expectations as connecting to an opportunity to participate in mathematics learning contexts and to engage with mathematics in and outside of school.

> C: Well, he was very upfront; he would tell us that he's not gonna go around our questions. If we had a question, he was going to try to help and explain it in a different way, so that we would understand it. And that's one thing that, maybe, I struggle with—like earlier, with math—but he was really good. He was able to explain it to us in a way that we could understand it.

Amidst his transition to Michigan State, however, Cedric discussed the placement exam as a constraint on his full participation in mathematics learning contexts (previous section). Although the mathematics exam is the sole mechanism for sorting students into their mathematics courses at the university, Cedric also discussed the process of being placed into the enrichment section as another constraint. He also suggested that his participation in other school support programs might have influenced his placement in MTH 1825. While this is likely untrue, it does suggest that Cedric was attuned to the context around his mathematics learning and placement, and that he was actively reading the context for clues to help him understand his experience.

> C: And I'm not sure if I would've been placed in the higher math class, just because I'm a CAAP student. I think that most of us are required to take 1825, I think.

Cedric, noticing his placement as a CAAP student (and that many of the students in his course section were also in CAAP), he readily made the association. His program advisor was one of the only persons at the university with whom Cedric had previously discussed mathematics at the university. As he described it, the process entailed a one-on-one meeting with an assigned academic advisor.

> C: Well, when I was doing my schedule [the adviser] really encouraged me to do enrichment, so yeah. They were just like,

> you're going to take MTH 1825, you're gonna want to take the enrichment. I thought that it was going to be like a tutoring session or like a one-on-one thing, but yeah.

Cedric intimated several times in his interviews that he was not prepared for the transition to college and that he did not "know what he was getting himself into." This was apparent in his placement exam experience, but it was also evinced by his interactions with academic advising staff upon his matriculation to the university.

Strategies for Participating in Mathematics Contexts

Cedric attended his mathematics course regularly, with no absences during the periods observed for the study. Cedric participated quietly by taking notes and, on some occasions, raising questions in the classroom or talking with other students (but only about mathematics). As he reported about his high school mathematics experiences, Cedric regarded the university mathematics course with a particularly high regard. As I recalled from my field notes on the course's first day, Cedric rushed to his seat during the sessions final few minutes—as if it was the first few minutes. In his interviews, Cedric talked about his strategies for learning mathematics in the context of the classroom in which he was situated:

> GL: Okay. So, um, […] can you talk a little bit about the classroom environment, like how you see it? When you walk into the classroom, what feelings come to mind and how do you interact with people? How do you perceive the classroom environment?
>
> C: Um […] Well, the environment is pretty good. I guess we, um, like [Instructor] says we're a pretty talkative classroom, we can talk to each other. I hear people talking about different problems, you know. They interact with each other, they can study with each other, so. And sometimes I'll ask about different problems [00:02:00] and get their feedback on what they got for the answer and stuff like that.

GL: How would characterize those interactions? For instance, would you say that it's friendly or really down-to-business? On top of that, what effect does the environment have on your learning, in your view?

C: I think that the classroom environment does help us learn. Like for me, we can ask questions, we can ask [Instructor] before we even start about what problems we've had trouble on, and she'll answer those. We can also ask like other students, too.

Although Cedric performed well in the course—particularly after the first few weeks—getting back to mathematics was a challenge that stayed with him throughout the semester. Indeed, Cedric passed every exam, and finished the course with a 3.5 grade-point assessment (an A). But as he often pointed out, the course required a great deal of effort for him, or it seemed to do so. He sometimes remarked on the additional load of the course, comparing it to his others.

C: But I don't think that I knew that we were going to keep like moving on and have more material all the time. Well, the course moves fast, and there's a lot of material. In the beginning, I was struggling. Like with the math and with it moving so quickly. And with us having so much homework. But it's good now. Oh, I'm doing pretty well. It's at a three-point-five right now.

To support his achievement in the course, Cedric visited the mathematics-learning center. For Cedric, the center was a quiet space to work on homework where, if needed, he could pose questions to tutors who circulated among the students.

GL: And how many times, now, over the course of the semester would you say that you've been in there?

C: More than five times.

GL: Do you find it helpful?

C: Yeah.

GL: Do you work with a specific tutor? Do you sort of just ask questions of anyone who's there at the time?

C: Um, usually I'll go right after class, cus that's when I do my homework. Sometimes I'll just go in there and just do my homework—just in case I have a question, I can just raise my hand, and someone will come in and help.

GL: Alright. How much time would you say that you do study and do homework every week. So, on average, how many hours do you spend doing homework outside of class?

C: Well, math homework takes up a lot of time, so I'll spend like […] maybe like an hour and a half each day just doing like the assignments that [Instructor] gives us. And, um, usually I'll do ALEKS at night, but I haven't gotten to it this week.

Like the other case participants, Cedric struggled to finish the auxiliary assignments in the course through the individualized programmed instruction modules, ALEKS. In addition to the seven hours of structured course-time, regularly paper-and-pencil homework assignments, near-weekly quizzes and/or exams, students were also required to complete practice problems on their own through the ALEKS computerized system. The instructor would check the system periodically and obtain a report on students' participation and their scores on ALEKS items.

C: So ALEKS. [……] Usually, well, I spend like and hour per night on it.

GL: Each week?

C: Yep, each week.

GL: [……] Okay. So, let's add this all up, then. An hour and a half for homework, and about an hour—wait—so that's at least 7 hours per week. And then an hour per week for ALEKS. So we're at about 8 hours. And then it's, what, is it seven hours per week of instruction time? Something like that? About three hours on Monday, Wednesday, and Friday, and then two hours on Tuesday and again on Thursday.

C: Yeah.

GL: That's about class plus homework plus ALEKS […] roughly 15 hours each week. How do you feel about that time commitment?

C: Um, like in the beginning, I was like, 'oooh, this is a lot of work.' I was doing so much work on math that it was taking away from my work in other classes.

GL: Okay.

C: That was something that I was really struggling with.

GL: How did you negotiate that time crunch?

C: [00:08:03] Um, like I'd try—that's why I try to get like my math done first, and then I can focus on my other homework that I have.

Cedric Case Summary

Cedric was a high-achieving student from small city near the university. He graduated near the top of his class, and his closest peers were also high-achievers; several of them were also (then) first-year students at MSU. Cedric completed the placement exam during the summer before he matriculated to the university and placed into MTH 1825. On the exam, Cedric admitted that he failed to answer many of the questions, instead choosing the "I don't know" option to move beyond difficult, advanced items. He suggested that his course trajectory in high school, in which he did not take a course during his senior year—despite completing calculus during his junior year.

As a student in MTH 1825, Cedric attended each class. In the chapter, I discuss a particularly vignette in which he arrives at the classroom with only a few minutes remaining but immediately begins copying the notes (and staying behind after class to continue taking notes and asking questions). This vignette, I claimed, exemplified his engagement in the course as responsible, quietly engaged, and concerned with his

achievement. Although his background might have suggested that this course would have been easy for Cedric, it was not—at least not initially. Along with classroom activities, Cedric worked very hard on course material—often committing many hours beyond the mandated time—even at the expense of time for other courses. In the next chapter, I discuss a second part of his engagement and identity work with mathematics in this course.

Case Participant Vanessa: "Where I Thought I Needed to Be"

Case Overview and Student Background

Vanessa is an African American female student from Detroit, Michigan, a large urban center in the state's major metropolitan region. At the beginning of the fall 2009 semester, she was an 18-year-old, first-time college student. Vanessa attended public schools in the state's largest school district, and she excelled academically. She graduated from one of the largest high schools in the city and was ranked among the top 25 students in her graduating class. She completed algebra and geometry courses in high school, earning an 'A' in pre-algebra and algebra-one, and 'B' in algebra-two and geometry in each of her four respective years.

Vanessa completed four interviews during the fall semester and one follow-up interview during the spring 2010 semester. These conversations generated nearly ten hours of audio-recorded files for analysis. Vanessa was an active participant in most of the course sessions, and she missed very few of the course sessions throughout the semester. During the first five weeks, Vanessa attended all of the sessions. Her attendance waned during the final weeks of the study observations. Vanessa was, however, a particularly eager student, both in the classroom and in the interviews about her mathematics experiences. Her eagerness was evident from the very first day of her college career, and I recorded in my field note reflections from the first math course observation:

October 10, 2009

> First day of note-taking (after approval from IRB)…I asked to introduce the study today; I had already introduced myself by name on the first day of class, so [the students] may have remembered that this was coming; some students seemed to have anticipated what I may say, signaled by

> their attentiveness. [The instructor] re-introduced me; she waiting until one of the longer days, so that I could have a chance to talk about the study. With my one-pager in-hand, I talked for two minutes about the study's purpose and my plans to observe the course and schedule interviews with students. I discussed that I was open to talking with all students… After I finished, Vanessa immediately asked if she could ask a few questions. I advised her and others that I would stay after class to respond. Several students stayed. She had only one: "What do I need to do to get involved?"

Each day, Vanessa usually arrived at the classroom earlier than her peers (she also typically arrived early for her interviews, as well). Many students would enter the classroom and either quietly listen to (sometimes not-so-quiet) music on portable devices or talk with other students. Occasionally, Vanessa talked with other students—about social gossip from mutually known groups, for instance—before the instructor arrived, but more often she opened her notebook and quietly surveyed her notes. Sometimes these were notes from previous mathematics courses or a homework exercise, but Vanessa often began to work on assignments from other courses. She often greeted the first couple of students who entered through the front door (though many students entered through the back), and her seat near the middle of the front row made her a noticeable fixture in the classroom.

As in the previous case, the following sections are organized by mathematics socialization theme (Martin, 2000)—by narratives that discus family-community influences on mathematics learning, institution-level experiences, and Vanessa's self-perceptions about herself as a first-year college student and, particularly, as a mathematics student and person.

Family and Community Expectations for Academic Achievement

Despite the unparalleled social, economic, and political challenges that Detroit faces, Vanessa was both resilient and proud of her city. When I initially asked if she might instead be from a suburb of the city, she quickly corrected me:

GL: Where are you from?

V: I'm from Detroit.

GL: Okay; which part or is it the suburban area of…

V: I'm from Detroit. Oh, well, people ask me what part I'm from—but I'm from the city. I live in the city of Detroit. Like some people say they're from Detroit, and they're really from Warren or other places. I'm from Detroit.

GL: Alright, I understand. I often have [similar] conversations about where I'm from.

V: Yep. Detroit. What.

During the first two interviews, Vanessa offered only short responses about her family and home community, but during the third interview she linked her family's circumstances to her career goals. As Vanessa discussed, her mother and father developed and expressed high expectations for her schooling, particularly as they noticed her demonstrated potential:

V: Oh, my mom and my dad were really happy when I got into the honor society. I had the sash and everything, and my dad just […] it was good. […….] I'm sorry; that's […].

During the extended pause, Vanessa nearly lost her composure and began to cry. She quickly collected herself continued to talk, explaining the moment before I could ask.

V: It just kinda came all back, really quick. When I got into the honor society, my dad got sick; he had cancer. […] And it was tough for a while. I mean, really, that's when I decided that I wanted to get into nursing. [……] So, they were just really proud that I was keeping the grades up with everything going on. We're pretty tight

> knit, but we were real tight then. But my dad was really supportive—I mean, he is […] you know, about my education.

Vanessa was clearly inspired and motivated by the home experiences represented in this narrative. She also expressed, however, that she thought those expectations were only reflections of her previous achievements. Vanessa had always been a "good student," and it was a foregone conclusion for her family members that she would attend college. Vanessa was the first member of her immediate family to do so. Although she gained a great deal of general support among for her academic trajectory, she indicated that her family was largely unaware of the particular challenges that awaited her.

Past Academic Contexts and Identities

A single yet complex narrative seemed to dominate Vanessa's high school experience and her subsequent telling of it. As in many urban school districts, the downward-shifting social, economic, and political conditions of the city quickly reached school-level policies, infrastructure, and practices. These extensive shifts resulted in immediate school-level changes that significantly affected students' everyday experiences, including Vanessa's high school access to opportunities and the emergence of constraints on her academic access. As I will later argue, these school changes significantly impacted her mathematics learning experiences—and these effects continued to shape mathematics identity development well into her first year of college.

Devastated by both local financial crises and a shrinking school population, the measured and perceived quality of the city's schools has eroded considerably during the past few decades. Although it seems likely that Vanessa experienced, in the very least, subtle effects of the school system's plight throughout her K-12 experience, she spoke

explicitly about a moment that would significantly impact her high school tenure. Between her sophomore and junior years, her high school was merged with one of the less successful high schools in her city, resulting in many programmatic and environmental shifts. Vanessa talked at length about the closing and cancelling of programs through her school and the impact of those courses on school and, ultimately, on her own perspective on schooling.

V: I went to [a particular high school]. It was really good during the ninth grade. You know, you had to take a test to get in, which was really good. And then they started closing down a lot of high schools in the area, and they merged a lot of kids. That's when my school got closer to two thousand kids in the school, and they merged them all together; it became a horrible learning environment. Like, it was terrible.

GL: So, you were there before they merged the schools?

V: Yeah, I spent my whole four years there—at [that school].

GL: And at what point during your four years did the…

V: Eleventh grade.

GL: So, oh yeah, right in the middle.

V: Yeah; it was just terrible! Like I was scared to go there. It was really scary. I was mad.

GL: What were the academics like *before*?

V: It was a good school. Like, I was in this program called [STEM-specific]—that's like the best program for—do you know it?

GL: No.

V: Okay, well, [the school] is like divided into programs, and this was the [STEM-specific] program. That's what I was in. It was a college-prep program, and there was also like a commercial/media-arts program or whatever, but I was in the math one. And in the tenth grade, we had to take two math courses. It was really hard. We took Geometry and Algebra three and four. We were the only

> ones. We had to take math all four years, just my group. So, the academics were really good. But then, in eleventh grade, it just all came down. And we had to take three years of language, where other people only had to take two. So, we were like the hardest little group.

Vanessa's designated academic identity was not rerouted by the social conditions of her high school; she wanted to be successful in school, and she was. She graduated among the top fifty students in the high school and was accepted by several colleges and universities, including the University of Arizona and the Ohio State University. Vanessa had also been accepted by her leading choice, Howard University, a prestigious, private, historically black college in Washington D.C. In the interview, she talked about the possibility of these schools and how she balked at the anticipated distance from family and friends.

> V: But then I got scared to leave the state anyway. So I went to the on-site visit [to Michigan State], and I really liked it. So, I'm going to say that the change was because of my family, but then it changed because I liked it.

Vanessa's High School Mathematics Course Background and Identities.

Despite considerable changes and resulting climate shifts in her school, Vanessa excelled in all of her courses, but particularly in her mathematics courses. Ranked among the top-25 students in her high school graduating class, Vanessa completed four full years of high school mathematics and earned high (above average) grades in all of her mathematics courses.

> V: I took Algebra 1 and 2 my freshman years, and Algebra 3 and 4 and geometry in my sophomore year. Eleventh grade…what did I take? I forgot what I took in eleventh grade. And in twelfth grade, I had AP Prob and Stats. I forgot what I took during the

eleventh grade. Oh, Pre-calculus! That was it. No? I took it somewhere in there. Pre-calculus, that's it.

G: Okay. How'd you do in those courses?

V: Um, I was excellent in my algebra classes—like A's. In Geometry, I had a teacher who was terrible, and he was just like, 'Oh, is that an odd one? Just look in the back of the book.' I did not learn anything. So, when it comes to geometry, I'm just blank, because when I say that I didn't learn a single thing, I'm so serious. And then he gave me a B. He was just terrible, gave everybody a B with some A's. So, I wasn't pushed to do any work, because I knew that I'd get a B anyway. So, I didn't do any work, and I didn't learn anything. Even when I wanted to know—and I did—he would just go, 'Oh, just forget that one.' Terrible. And AP Prob and Stats. Um, I did well during the first semester, but I got a D—my first ever (!)—during the third quarter. But it wasn't on my transcript, so that was good. So then I worked my ass off—excuse me—and went from a D to a B. I mean, I really worked hard for that, do that that wouldn't be on my transcript.

Vanessa not only excelled in her courses, but she had high expectations for her teachers. As she also made clear, she did not have much regard for inflated grades. At the same time, her narrative is a reminder that poor student performance can be connected to both poor teaching and weak demand for real competence. Vanessa also reminds us, however, that the social context of her school was a distraction for many, including teachers, and attention was too often drawn away from classroom matters entirely.

V: A lot of the teachers…it was crazy. A lot of the teachers, they couldn't really teach because they had to focus on what was going on outside the building. Then they tried to bring in a lot of security.

Engagement in MTH 1825

Vanessa was a key participant in the classroom. From the first day of classes, Vanessa was the most engaged student among her peers. Like Cedric, she also sat in the front row of the classroom. She frequently answered whole-class-directed questions, and

she often (and often repeatedly, in short succession) raised her hand to answer clarifying questions—and often to the relief of peers in the rows behind her. I recorded the following passage in my field notes during an early part of the fall semester:

From October 1, 2009:

> V is very engaged today. Raising her hand a lot, asking questions—especially the ones that seem to quiet, unfortunately, the other students. They seem almost thankful when [the instructor] stops. (She's moving at a very quick pace in an effort to "catch up, because they're behind.") Catch up how? But V's making her pause, and neither person [Vanessa nor the instructor] seems to mind. She is a class catalyst.

When she was not actively participating in whole-class or one-on-one discussions about mathematics, Vanessa typically sat quietly at her desk, recording from the board or the instructor's talk. Unlike most of the students around her, Vanessa abbreviated long stretches of note taking with nearly equal stretches of time spent quietly observing the instructor. As Vanessa would carefully watch the instructor as she talked through a homework problem or other exercise, her peers would scribble furiously to transfer the mathematics from board to page. As the classroom exhaled during a lull in the day's action, Vanessa (like Cedric, a few seats away) would often continue writing.

Vanessa's Mathematics Identities

The main focus of my interviews with Vanessa was to understand how various institutional forces (e.g., curriculum, instructors, peers, school support systems) were impacting his sense of a mathematical self—i.e., his mathematics identities. I analyzed her narratives from each of our interviews with respect to the mathematics identity themes included in the framework: (a) importance of mathematics, (b) motivation to

study mathematics, (c) strategies for mathematics learning, (d) constraints in mathematics learning contexts, (e) opportunities to learn mathematics, and (f) capacity to learn mathematics.

Instrumental Importance of Mathematics and Capacity to Perform

Vanessa was engaged in a variety of formal and informal precollege activities during the summer before her first year at the university. During our interview sessions, she described her engagement in formal activities like completing the mathematics placement exam and later visiting the university for orientation activities. She also discussed the impact of certain informal precollege activities, like talking with family and community members about academics and, particularly, about mathematics in college. These narratives, corresponding to points in Vanessa's transition from high school to college, included instances in which she learned the culture and climate of college life and the university to which she had been accepted.

Vanessa took the mathematics placement test online before the beginning of the fall semester. She initially regarded the exam seriously; she had previously arranged a day, time, and place in which she would complete the required task at home. Despite her planning, Vanessa delayed the exam. In a response on her research questionnaire, she indicated that the unstructured summer contributed to her "procrastination," and she delayed the exam as much as she could. She also did nothing to explicitly prepare for the exam; although she had them, she did not review any of her mathematics assignments or notes from high school. She neither knew about nor accessed sample placement exam items. During our interviews, Vanessa discussed her experience taking the exam, the

support mechanisms available to her, how the process shaped her views on the importance of postsecondary mathematics, and her initial reaction to the placement results.

> V: Well, my [college orientation on-site visit] was, um, like June eighteenth, so I took my placement test right before that…Well, I actually didn't take it; I just pressed 'next'—like on all of them—because I knew that I wanted to be in the lowest math. I knew that I wasn't that good in math, so yeah. I just—I *tried* to do some of them, then after a while I just said 'skip this,' and I just pressed next, to the next one. I didn't want to come into college, um, like behind. Well, even though I am behind in 1825, but you know, I wanted to be where I needed to be—which is 1825.

In the preceding narrative passage, Vanessa connects her (then-held) perception of her own mathematics ability ("I wasn't that good in math") to the mathematics trajectory that she felt would best suit her ("because I knew that I wanted to be in the lowest math"). These messages are particularly strong contradictions to the perspective that she espoused about her high school mathematics experiences. Through her involvement in the special mathematics-focused program in her high school, she recognized herself and her high school peers as "math people," and that they were a tightly knit and coordinated group of students. Now as she confronted the placement exam experience, she indicated that she was no longer a math person, that mathematics was not "where she needed to be" and, by extension, not *who* she needed to be. Instead, she decided that place was a remedial mathematics course—despite her background and while acknowledging that she would potentially stunt her mathematical trajectory (i.e., "be behind").

Vanessa admitted to purposely underperforming on the placement exam, in order to place herself in the university's lowest mathematics course. Despite excelling in her

mathematics courses—and despite the strong mathematics identity that she espoused about her high school experience—she felt that mathematics in college would require a "refresher experience." Vanessa had *herself* decided that she was not ready for college-level mathematics. Given this decision, the complicating action that she undertook resolved the issue for her; she was a student in MTH 1825 because she felt it was what she needed, where she needed to be, and perhaps who she needed to be. As I probed her initial response, Vanessa discussed her expectations further:

GL: Why was 1825 where you needed to be?

V: Because it's the lowest math class here.

GL: Why not 103? Why not another?

V: Well, I probably would've taken 103 if I would've known that 1825 was going to be like this.

In the following sections, I explore Vanessa's experience in MTH 1825—her impressions of the course and, particularly, her perceptions of opportunities to learn mathematics and ability to perform in this new context. I also continue to explore the importance of mathematics for her, connecting changes in these factors to her strategies to successfully navigate her new mathematics trajectory.

Motivation and Opportunities to Learn and Capacity to Perform

Vanessa's narratives about her summer transition indicated that she had some trepidation about college mathematics. Based on these concerns, she ultimately chose to act in a way that undermined her performance on the mathematics placement exam. By her own admission, she essentially sabotaged her performance in order to purposely place

herself in the lowest mathematics course available. At other points in her interview, she also discussed these developing narratives about college-level mathematics:

> V: But no, I [haven't been talked to my advisor about my math anxieties]. Maybe in 103, I will. I'm so nervous about 103.
>
> GL: Why?
>
> V: I don't know. Like I think that it's just going to be terrible. Like, I'm really like sweating bullets about 103; you don't understand. I tried—I asked [my instructor], 'are you going to teach it [next semester]?' because I wanted her to be my teacher. I'm really nervous…because I'm already—I already know the stuff in 1825…Well, yeah, because like in 103 I'm not going to know. It's going to be all new to me. And I'm just worried.

Vanessa's concerns about the difficult of college-level mathematics courses were now threatening her motivation to pursue mathematics at the college level; the concerns weren't limited to her capacity to performance on the placement exam. Before she completed MTH 1825, Vanessa was already concerned with the difficulty that she might face in MTH 103, and that fear was driving her motivation to pursue mathematics at the college-level, despite her proven capabilities. Vanessa was one of the top-performing students in her section of MTH 1825, and she routinely finished her exams with noticeably less effort than her peers:

> GL: Okay. So, how'd you do on the test?
>
> V: It scares me that I finished before everybody. Like, it does.
>
> GL: Do you often finish before everybody?
>
> V: Yeah.
>
> GL: You always finish first?
>
> V: Yeah.^ [……] And that worries me because […] like on our quiz, [the instructor] said, um, that it was going to take the whole hour. I took it, and I was done in like fifteen minutes. So after fifteen

minutes, I'm thinking, I must've done something so wrong. And I got a nineteen out of twenty! I'm like […] I was like so shocked! I-could-not-believe-it!^^[……] And I was done in like fifteen minutes, and she was so serious; this was going to take a whole hour. Take your time; all that.

GL: Oh, and this was the quiz from last week that […] people didn't do well on.

Vanessa's concerns about the difficulty of college mathematics—despite her success on all of the exams in MTH 1825—caused her a great deal of distress throughout the semester. These concerns reached their peak by mid-semester. After the mid-term exams, the instructor met with each student individually, asking students to step outside of the classroom for a brief discussion about the progress in the course. When recounting this episode, Vanessa made a startling announcement:

V: No. But yeah, I went up to her; she was asking everybody to come outside and talk about their grades.^ Cus I didn't even want to—I was thinking about dropping the class.

GL: You were thinking about dropping the class? When?

V: So, I could just take later—I mean, a lot of people have started dropping classes.

GL: Right?

V: So, maybe you should, too?

GL: But why would you drop if, if you're doing so well?

V: Mm; I don't know.

GL: So, we gotta talk about this, because you said something like this the last time. You said then that you were afraid of 103. Does that have anything to do with this?

V: I am! I am afraid. Yesterday, I was in WRA, and these girls were talking about it; like, oh, it's so hard! I think that they have an exam today, too. They were saying how the first chapter was really

easy and then it gets really hard after that. And this girl is [...] smart. Well, in writing; I don't know how she is in math.

…

GL: Well, do you know anybody else personally that dropped?

V: Well, I just meant all of those kids that have—none personally. My good friend Ruby, she tried to drop it. But um, she's on scholarship, so she couldn't. I ran into her today. So, yeah.

Vanessa's admission was shocking.

Case Summary

Vanessa was a high-achieving high school student from Detroit, Michigan. During the summer before her first year at Michigan State, she took the mathematics placement exam in its online format at her home. As she later reported, Vanessa deliberately indicated that she did not know answers to questions when she was, in actuality, engaging in an act of "satisficing" on the exam (Berinsky, 2004). As a result, she was placed in MTH 1825, the remedial mathematics course at the university. Despite her high achievement in college and her background courses in algebra (and courses beyond algebra), she claimed that MTH 1825 was not only the appropriate placement for her, but that MTH 103 would be a great challenge even after completing MTH 1825. Vanessa excelled in MTH 1825, completing assignments quickly and consistently completing quizzes and major exams nearly 20 minutes before the next student—and as consistently, she scored near the top of the class on each exam.

Along with her high performance in the course, Vanessa was very engaged in the classroom. She was the focal point of student activity near the classroom's front row; she raised her hand often, she talked with other students about mathematics, and she often

went to the chalkboard to demonstrate solutions to problems. Other students respected her as a peer, and often consulted with her when questions would arise. Yet and despite all of this, Vanessa lacked confidence in her mathematics abilities, and she credited that condition to the institutional setting—claiming consistently that it was because she was "in college" that mathematics was now a difficult subject for her. In the next chapter, I discuss a second part of her engagement and identifying in her mathematics course at the university and the roles of other forces on her mathematics identity work: sociohistorical narratives and their transmission through the university culture.

Case Participant Ruby: "Ready to Get It Over With"

Case Overview and Student Background

Ruby is an African American female student from St. Louis, Missouri—a major metropolitan area in the Midwest. At the beginning of the study and the fall 2009 semester, Ruby was an eighteen-year-old, first-year student enrolled in her first courses at the university, including MTH 1825. She was also the only out-of-state student to participate in the study's interviews.

Ruby's out-of-state status did not factor explicitly into our interviews—and I did not intend this—but it did play an unexpectedly critical role in my interactions, as the researcher, with Ruby. As I learned from the first few minutes of our first interview, she and I were from the same metro area, and that fact facilitated our discussions about her past and present experiences. I was able to draw on first-hand and detailed knowledge about the communities in which Ruby had lived, I had some knowledge of the schools that she had attended, and I could offer stories of my own as she shared hers—with common referents. As a result, Ruby seemed pleased to talk with someone with whom she could relate, away from home. She also was willing to discuss her engagement in her current course, and how that experience was shaping her mathematics identities.

Overall, Ruby attended her mathematics course regularly during the semester, but as I recorded during the classroom observations, she missed 16 of 39 sessions observed for the study (mostly near the end of the semester). She sat in the second row of the classroom and seemed to almost hide behind the students in the front row. She was physically shorter than the students in front of her (Vanessa and Cedric among them), and

she sat low in her seat. Ruby would occasionally look up and around to see the board more clearly as she continued her almost constant note taking. She was a very quiet student; during the semester, she never asked questions in-class and instead choosing to ask questions of her peers, Vanessa among them. When asked, she preferred that students did not talk in class, a preference that she attributed to peer interactions typical of her high school classes.

During a series of three interviews, Ruby talked at length about the importance of her family to her educational academic trajectory. Particularly, she discussed her mother's impact as an alumna of the university and as, along with her grandmother, a fierce academic supporter. In one narrative, Ruby discussed the strategies that her mother employed to support her education before college, sacrificing at great lengths to move her daughter from the city's public schools to private middle and high schools.

Ruby also discussed her academic engagement with the school environments, her teachers, and her peers. As she recounted, her engagement seemed unchanged between high school and college. Specifically, she continued to express—both about high school and university contexts—a low regard for mathematics (confirmed repeatedly in her interviews and on her research questionnaire). She described herself overall as an "average" student in high school, where mathematics was "just another class."

Ruby's narratives about her transition to MSU were similar to Cedric and Vanessa's accounts. Particularly, she completed the exam during the summer months and without any preparation. Not knowing what to expect, she approached the mathematics placement exam with no particular agenda. She was surprised by what she saw on the exam, and was distracted by items that included mathematics material that she did not

recognize. As she talked about completing the "exam," she could approximate the exam difficulty for her with a one-word, disbelief-laden expression: "wow."

Not surprised and seemingly unfazed by her mathematics placement, Ruby struggled in MTH 1825. She talked at length about her frustrations with the course material, institutional support systems, and peer interactions in the classroom. Ruby also expressed frustration while attempting to solve problems and recall strategies that had been discussed in the course. She approached mathematics learning as a process of transferring memorized knowledge from the classroom to the course homework and tests. Early in the semester, her strategies worked for her; she would work to acquire as much of the introductory math content as she could in her notes, She struggled when the content moved beyond simplifying linear equations to simplifying rational polynomial expressions with several variables and exponents. Ruby also struggled with the language of algebra, written and spoken.

Before the end of the fall semester, Ruby indicated that she would not pass MTH 1825. She also began to miss class sessions regularly; she explained that she intended to focus on her other coursework. She had not completely given up, however, on MTH 1825. She studied independently and with a tutor, attending some classes to learn more about content that she did not understand on her own. This change in strategy was emblematic of her regard for academic work, but she did not express motivation to study mathematics, particularly.

In the sections that follow, I discuss Ruby's family and community—particularly, the impact of family expectations on her school achievements and her perspectives on both schooling and mathematics as a discipline. I also discuss her school background, her

high school mathematics courses, and her interpretations of experiences in those academic settings. I highlight Ruby's transition to MSU and to MTH 1825, and I then discuss the elements of her narratives that express her mathematics identities work—i.e., her (a) views on the instrumental importance of mathematics, (b) her opportunities to learn mathematics and in mathematics settings at the university, (c) constraints on her mathematics learning, (d) her strategies for learning, and (e) her motivation to learn mathematics. I also present an analysis of her narratives in which I describe how she constructs her identities in relation to her peers, instructors, curriculum, her and others' expectations, and the broader institution.

Family ad Community Expectations for Academic Achievement

Ruby and her mother lived in various sections of St. Louis throughout her childhood and adolescent years. Ruby described her upbringing as working class, and she described many of the neighborhood within the metropolitan areas where she had once lived as "rough" places. As she explained, her family relocated for the economic opportunities that were available, but she also suggested that schooling opportunities were also a critical factor in family choices to move.

Ruby's narratives indicate how family/community forces shaped by her mothers' "educational strategies, plans, and actions" adopted to enrich her academic progression and enable her achievement. After describing her transition from public schools to a private high school in the city, Ruby suggested that her mother made her expectations very clear for Ruby's academic achievement.

> R: Well, my mom, she was pretty much disappointed with me throughout my whole high school career. For the simple fact that she knew that I could do better.

This sentiment also extended to expectations for Ruby to attend college. As she suggests, her college matriculation was more obligatory than optional, and her mother played a central role in her matriculation, particularly at MSU.

> R: Well, basically, it's because of my mom. She's an alumni. And I always tell people that, uhm, I've been brainwashed since birth pretty much. Because seriously, though, every year for Halloween, until I got a mind of my own, I was a Spartan cheerleader. And I had the baby bottles, the bibs, the pacifiers, anything that, pretty much, Michigan State manufactured; I had it. So, yeah; I was kinda brainwashed, and she was pretty much a main influence. And MSU also gave me the most money, too. So, it was the most affordable. Yeah; it was either between here or Arizona State University. So, uh.
>
> GL: Can you talk a little bit about your mom's connection to MSU?
>
> R: [1] Well […] She bleeds Spartan green. [2] She's highly active with the St. Louis Alumni chapter, [3] and she's also becoming more active in the MSUBA. [4] So, I'm not quite sure that she has any connections on campus now, [5] but it's just the simple fact that she's—she just came here for Homecoming, actually. [6] She participated in the Homecoming activities, through MSUBA [7] and she throws watch parties and stuff back at home, when Spartan athletics are happening.

These expectations also extended to Ruby's opportunities within the academic curriculum. By the time of her matriculation at MSU, Ruby had already sought to avoid mathematics engagement, as I explore in later sections. Her mother, however, emphasized the importance of a career that was financially viable, but also reinforced her support for Ruby's choices.

> GL: So, would it be safe to say that she's a strong supporter of your college education, and all of that?
>
> R: Yeah^. She pretty much was [supportive] as far as my major goes. [2] I'm majoring in journalism. [3] So, she's kinda iffy about that just for the simple fact that the whole media outlet is kinda crumbling under the whims of the economics and society, so it's

just ‘Whyyyy’ [or a similar sound^^]. [4] So she’s just like “how are you going to support yourself? [5] I’ll be with you 100%, but still, you just have to have a plan B.” [6] So, she’s really supportive with anything that I do. So, yeah.

GL: [……] Any other community or family expectations to attend college, or to attend MSU, in particular?

R: Uhm, not necessarily MSU. [2] Because seeing that I am from Missouri, a lot of people tend to gravitate towards Missouri colleges, so of course Mizzou would be a big one. [3] Then you have SLU^. [4] But people—especially within my community—kinda wanted me to stay […] kinda close to home. [5] Just for the simple fact—especially my grandma—she worries sick about me^^.

GL: Of course.

R: Yeah. There aren’t—there’s not really a demand for me to be here, but it’s the fact that I’m getting my college education—which is *huge*^^^ back home. So. […]

As a second-generation MSU student, Ruby drew support from her mother’s experience-based guidance concerning her academic trajectory. Particularly, her mother’s perspectives on university mathematics were important for Ruby as she negotiated institutional choices and engaged in her first-year courses. When Ruby was placed in MTH 1825, she sought advice from multiple sources; unlike the other case participants, however, she also sought and prioritized her mother’s advice:

R: My mom was saying that I should drop it, knowing my math history or whatever. And of course, I went to my advisor, who knows nothing about me, (laughs) [……] but really, these last few weeks in this math class, when I do go, it’s just like I do have to know my limits and know what I’m capable of.

Ruby associated her mother’s academic support with a broader relationship to her mother’s high expectations for her education, and she prioritized her mother’s advice accordingly. In this instance, her mother advised her to consider dropping MTH 1825,

particular as she expressed difficulty in the course. But in this short narrative, Ruby also expressed that her mothers' advice was connected to knowledge about Ruby's capacity to learn mathematics—and that her assigned university-assigned advisor was somehow fundamentally disconnected from her trajectory. She continued to indicate her mother's influence on her academic course taking is related to common experience.

> R: Like really the only person that I do talk to about my academics is really my mom. But like I said earlier, like that I should've dropped the course and, when I said I wasn't going to, that I should I be expecting a one-point-five. And I'm like, 'what?↑' And look where I am now. I'm a one-point-five. […] In lots of ways, she knows me better than I know myself; it's that type of relationship. And then there are people at church who want to be resources. They're like, 'you'll do fine. Just stick it out. Math isn't that hard.' And they don't know me like that. […] But my mom, she was never that good at math, either. So, she understands. Because she took, uh, an equivalent course to MTH 1825 when she was here. And she failed it. I couldn't believe it, as hard as she gets on me. But like, she failed, and she understands what I'm going through. So, I just choose to talk to her about it. And she was the one who said, 'when you get back, just be prepared to hit the community college or [the other local university], for when I come back next semester or next year.

Ruby's experience in mathematics during her first-year at MSU was shaped, in part, by her mother's experiences in the same course, MTH 1825. As Ruby discussed her mothers' experiences with mathematics, she explicitly likened her own emergent self-conceptions to those narratives. Ruby's mother struggled with mathematics—in the same course and at the same university—and the associated set of experiences moderated her expectations for Ruby's achievement strategies. Before Ruby even began the course, it was clear to her that MTH 1825 was a problematic course, she had first-hand knowledge of failure, and she had an exit strategy—in case it was needed.

Past Academic Contexts, Course Background, and Academic Identities

Ruby's family relocated within the St. Louis area several times—and at least part of the reasoning was that Ruby could attend better schools than the options of her neighborhood. When Ruby began middle school, her mother pulled her from the public school system completely, and she attended private schools through her high school career. She attended a particularly prestigious middle school in the area and a parochial high school that was known for academic excellence. Despite the esteem of these school contexts, Ruby did not develop a greater sense of motivation to participate in mathematics contexts.

> R: Math was just another class. It wasn't heavily concentrated upon. I mean we had—I guess I can give him his props. Mr. B, he was a good teacher, smart, and he's been there ever since St. Lucy's opened.[17] I think. So, the math program was pretty much him. So, the math program wasn't really looked at because of it's curriculum; it was looked at because of Mr. B. Freshman year, we had pre-algebra and algebra lab—where we did like the basic stuff. And then sophomore year we had geometry. And then junior year [00:10:00] […] what did we do junior year? Oh, I think junior year we had algebra two. We had algebra two. And then senior year we were offered college algebra, which I took. And AP Calculus. Well, college-credit calculus, because we didn't have any AP courses at St Lucy's. So, it was pretty much just like another class. It wasn't city-renowned for math.

Ruby struggled in her mathematics courses throughout high school. She took algebra and geometry courses throughout her four years, and her struggles in high school mathematics only confirmed longstanding negative experiences with mathematics.

> R: [1] Um, as far as pre-algebra went, that was pretty much freshman year, [2] so I clowned a little bit. [3] But I pulled off a two-point-something. [4] I know that it wasn't anything like bad or anything. [4b] But that's how that went freshman year. [5] I've never had a

[17] St. Lucy's is a pseudonym—as most of the proper nouns in this document are.

> strong math history, like at all. [6] But um, sophomore year, when I did geometry, [7] which I failed at, I got—[8] I was lucky to pass with a D, [9] because all of it just went over my head. [10] Like I couldn't grasp the concept at all. [11] There were certain things that I could get, but after a while, [12] after learning so many things, I mean— [13] I just lose what I knew. [14] And then Algebra 2; [15] we definitely clowned that year, too, [16] but I pulled off a C in that class—[17] just for the simple fact that I did most of my homework, quizzes and tests, and [18] I tried to buckle-down and—[19] I really could've gotten a four-point out of that class, but. [……] [20] But College Algebra was when I really surprised myself, [21] because I pulled off a B average, during both semesters. [22] So, I never really thought that I'd be able to pull that off. [23] I think that it was also because during quizzes and tests we were allowed to use our notes and stuff like that. [24] And homework-wise, it was never really graded heavily at all. [25] If we did the homework, we'd get full credit for it. [26] All we had to do was to just turn in our homework assignments, and [27] we could automatically get a C in the class. [28] So, there was no reason for anybody to have below a C in the class. [29] And as far as quizzes go, [30] I averaged a C with the occasional B and A—very rare A. [31] But then, um, as far as exams went, during the first semester, [32] I believe that I got a C. [33] In the second one that I took, I got a D. [34] I was supposed to be exempt, but they didn't exempt me. [35] So, I was like screw it. [36] I was graduating, [37] so I was like forget it. [38] That's pretty much how my years went there, as far as math goes.

While Ruby struggled in her mathematics courses—at least, with the mathematics content—she still earned grades that allowed her to progress through the high school curriculum. In the context of discussing the differences between her high school mathematics experiences and her transition to undergraduate-level mathematics, Ruby also discussed the role of courses and teachers.

> R: [00:07:30] One big difference is that we got to use books, notes, and whatever we wanted to use on exams and quizzes. In college, of course, we don't have any of that. The biggest transition that I had was from having a crutch in high school to not having anything at all. Um […] the teaching style is pretty much the same—except for my high school professor, he taught a whole bunch of shortcuts, and that tended to confuse everything. But [this instructor] she usually does everything

straightforward. Those are pretty much the biggest differences between high school and college math courses that I've had.

Transition and the Mathematics Placement Exam

Like both Cedric and Vanessa, Ruby completed the mathematics placement exam during the summer months, at home, and without any purposeful preparation. On her research questionnaire, Ruby indicated that she did not regard the exam seriously when she took it. She recognized its significance, however, and knew that the results would govern her placement in mathematics courses at the university. Despite this, regarded the exam as something "to get…out of the way."

GL: So, why don't we go back to the spring and summer before you enrolled. When did you take the placement test?

R: I actually took it one day when I was bored at home. [……] I was just like, hey, I have to get this out of the way. So, I just sat down in front of the computer, grabbed my calculator, and got to work…1] From what I remember, [2] it was like 30 questions, or something like that. [3] And it took me like [……] [4] Well, I didn't know most of the stuff on there. [5] It's like, I can learn the material. [6] That's no problem. [7] I can't retain it. [8] So, everything that I've learned over the past four years in high school is just gone out of the window, pretty much. [9] So with the test, I finished it to the best of my ability, [10] but there was other stuff that I'd never seen in my life. [11] It was just like, "wow."

From this narrative, I recognized that Ruby's experience with the placement exam seems very different than both Cedric and Vanessa's experiences. Ruby indicated that she did not *recognize* some content on the exam. In this way, the exam was indeed identifying the areas of mathematics in which she may not have been prepared.

Ruby's Engagement in MTH 1825: Classroom Observations

Ruby did not speak often in the classroom. She arrived early to most sessions, walked directly to her usual seat, listened to her portable music player before the start of the class, and took notes during class. Vanessa was typically seated when Ruby arrived, and the two students would often greet each other. Occasionally, they would also talk about some of the social happenings on campus. As other students came in, however, Ruby would fall silent and while the others began conversations and continued them across the classroom.

For most of the semester, Ruby's quiet engagement became the basis of her overall strategy for learning math in the course. She did not interact with peers during the class sessions. She was teacher-centered, even when others would pose questions to other peers or share answers and problem-solving strategies. If Ruby had a question, she would quietly raise her hand and wait for the instructor to come over while others worked.

Often, students would disengage during the longer Tuesday and Thursday sections and begin to talk socially, sometimes to the point of disrupting the class. During one period, I noted Ruby's clearly articulated agitation with her peers:

From Thursday, October 15, 2009

> Ruby was more quiet than usual today. Not talking to anyone, even before class. Deacon and Robert were in rare form today, they were bored with the worksheet session and started to talk loudly. [The instructor] had already asked them to keep it down once. Ruby turned around in her seat and let our a deep, frustrated sigh. It caught a lot of folks' attention. Deacon recognized it, and he respected it. They were back on task moments later.

Academic and Mathematics Identities

I was surprised to learn that, although Ruby was one of several very quiet students in the classroom (Cedric being another), she was not a quiet personality. In our interviews, she was vibrant and talkative (as the length of some of her narratives affirm), and our sessions often extended far beyond the designated hour (although I learned to become more diligent about the clock, in an effort to protect their time as consenting participants to the research protocol). Ruby's disposition in the classroom, she remarked, was even a change from who she was and how she engaged in high school:

> R: I was one of the outspoken students who would pretty much speak their mind about any- and everything. [6a] I'd be respectful, of course, [6b] but I would still want to get my voice heard. [7] […] Uhm, St. Lucy's kinda played toward those who making those three-point-fives and up, [8] and they wanted to cater towards that and had certain programs toward that. [9] Of course, because they are achievers, and they do deserve it. […] [10] But, they kinda […] publicize them more than the average student. [11] And I thought that that was kinda wrong, because they were putting on a façade to make the school look like it's perfect when it's really not. [12a] I just feel as though institutions should be as honest as possible about their student population, [12b] and they weren't.

Ruby indicated that, in high school, "average students" were not the points of focus for teachers and administrative staff—and that she often felt ignored. At the high school, however, this did not deter her from being outspoken, from voicing concerns, and from seeking the help that she needed. But Ruby also discussed how being an "average student" also allowed her to sometimes recede from view and "slack off":

> R: ^I was an average student while I was there. […] Uhm; I did my work—depending on what class it was. I'm just going to be honest. I did my work depending on what class it was. If there was test coming up that I felt that I wasn't prepared for, I'd study for it. I graduated with a two-point-eight GPA. So, I really felt as though going to St. Lucy's I could've been a four-pointer, but you know, I slacked off because it just wasn't challenging enough.

Importance of Mathematics, Strategies, and Capacity to Perform

Although Ruby felt that her school was not challenging enough generally, she did find a challenge in mathematics. While she recognized the general importance of mathematics, she also openly admitted that the subject was of very little *instrumental* importance to her and for her projected career.

> R: Ruby doesn't do math or [1b] Ruby is not a math person (laughs) [00:05:00] [2] Like really, it's just—I don't know. [3] It's just […] it's just something that I can't really fully enjoy or even get to a point that I can conquer it, [4] because it's just—there's something about it. [5] I mean, I don't like to have a defeatist attitude about it, [6] but I like to be realistic with myself. [7] I'm not going to put myself on a pedestal or anything and say, 'hey, I'm great at everything,' [8] but I know that I'm not. [9] And math is just one of my downfalls. So, yeah. [10] Me and math—it's just […] math is here in the States, and I'm somewhere in Bangladesh or somewhere. (laughs) [11] We're definitely at two different ends of the spectrum. [12] For sure.

Despite "being not a math person," Ruby did not associate this with her general academic identity. She drew clear separation between being a mathematics student and being a student generally. This identity move was useful for Ruby, because it allowed her to continue to pursue excellence in other areas while not carrying concern for her mathematics identity. Any anxiety that she did express about mathematics was about being rid of it. Instead of opportunities to participate in mathematics contexts, she explicitly sought opportunities outside of mathematics.

> R: [1] As a student, I'd say that I'm pretty open-minded. [2] I'm very focused—very determined. [3] As far as a math student, [3b] I'm honestly just ready to get it over with. [4] Because seeing as I'm a journalism major, [5] I just have to take 110. [6] And then I'm finished—like forever. [7] It's just something that I'm really happy about. [8] So, I'm more anxious with math—[9] to just get it over with and out of the way so that I won't have that stress level. [10]

> And so I can have an opportunity to concentrate on that will apply to my major.

The sentiment that mathematics was something to get out of the way—was a central theme for Ruby. In high school, mathematics was never the focus, and it continued to play a minimal role in her expectation-setting for school and her career planning. But overall, this academic identity was congruent with her mathematics identity vis-à-vis the instrumental importance of mathematics:

> R: [1] I really don't know. […] [2] Like, I guess that I've never been the type of person that […] [3] if it doesn't really apply to my life or [4] if I can't do anything with it [5] then what's the point of remembering it? [6] Like I try to go into the math classes with an open mind in general, you know. [7] I know that it's for a grade, [8] it effects my GPA, [9] which can ultimately effect what type of job that I can get coming out of college. [10] I try to keep that in mind, [11] and I, you know, try to apply those methods to real life. [12] Like, oh, I can go to the store and buy some peaches. […] I don't know, *x* will be the number of peaches that I buy. [13] I don't know. [14] Like, I try to actually make it fun for myself, [15] but it's just something that doesn't click.
>
> GL: Have there been instances in which it did click? If so, what was that like? Who was involved? Was there a particular teacher, for instance, that helped
>
> R: There's never really been a time where a teacher would try to apply real life to math. [2] Well, Julie's done that. [3] Like she's done that before, [4] and it makes it a little bit easier. […] [5] But I wouldn't necessarily call it fun. [6] It just kinda clicks a little bit more, [7] but naturally I just sort of forget it after a while. […]
>
> …
>
> R: [17] That's pretty much my outlook on math. [18] You have all these problems, all of these objectives, and so many ways that people—[19] like my high school math teacher, whatever—would be like "well there's a shortcut for this or that—blah, blah, blah, blah, blah—[20] he never really taught us the real way to do things. [21a] And I come here, [21b] and it's just like I have to relearn this whole thing. [22] It's backtracking. [23] I'm backtracking. [24] So, that's pretty much how that whole thing goes. [25] It just doesn't—not with math.

Capacity to Perform in Mathematics

Ruby's mathematics identities were not particularly strong. Her "outlook" was not positive; she shunned mathematics, wondered about its general importance, and denied its potential role in her personal pursuits. In MTH 1825, Ruby struggled with the mathematics content. While she quietly engaged in the course—taking notes and asking questions, primarily—her progress in the course did not reflect her engagement. Her identities, as I have argued, continued to reflect and relate to her low grades.

> R: [1] Well, from what I've seen I have a two-point. [2] And I've talked with [the instructor] about that, [3] and [the instructor has] relayed the fact that I really should be going for a three-point, [4] just for the simple fact that when I do take the final exam, [5] it could drastically drop my GPA in the class. [6] So, I should be able to have that cushion, pretty much. [7] Um, […] as far as tests and quizzes go, I'm not doing so well. [8] Again, just for the simple fact that I really can't retain the information, [9] and I find myself in the middle of class—[10] like when people are having problems themselves, [11] and they start asking questions, [12] then start trying to figure stuff out aloud— [13] it just confuses me, to like a maximum level where I can't even function myself. [14] And I'm like, 'whoa; shut up, just stop.' [15] So, I can try to be able to figure it out myself. [16] So, like, as far as that goes, success in the class—I feel like I'm not doing as well as I possibly could be.

Ruby readily related her struggles to mathematics at the university to her experiences in past mathematics contexts. She pointed to opportunities in mathematics contexts and how, through various circumstances, she had not fulfilled them (or herself therein). She argued that, despite the resources that she has had, she had not been able to access mathematics.

> R: [1] Like, I've given myself so many chances in the past, [2] and I've disappointed myself, [3] and I'm tired of going through that

> disappointment with math. [4] It's just that I've done the work before, [5] I've done the tutors, [6] I've done the extra resources, [7] and it still didn't work, [8] so I already know what to expect. […] [9] And I understand that, you know, try, try again, and that whole motto-thing, [10] but it just doesn't work with math, honestly! [11] So, now I'm just not going to stress myself out over something that I know what the general outcome will end up being.

In the course our interviews, Ruby also discussed what fueled her capacity to perform—even at a limited level—in MTH 1825. She indicated that her peers were often a distraction in the classroom, and that she instead preferred to direct her questions to the instructor. She also talked about the mathematics curriculum and how she thought about the process of doing mathematics.

> R: Like honestly, whenever I'm learning about those linear equations and stuff with lines—[2b] that's when it's clicked. [3] Because there aren't lots of ways to do that. [4] I mean, you've got slope, point-slope, slope-intercept, [5] but that makes sense. [6] Those are actual formulas instead of suggested steps that you have to do. [7] There's a rhythm to it. [8] You have to take this number, [9] you have to plug it into this variable, [10] do some things, and [11] get your answer. [12] Like that's logical. [13] So, whenever I'm in the class [14] and we're doing stuff with lines or something with, um, the quadratic formula. [15] Whenever I can plug into a formula, [16] I'm good. [17] I'm at my most confident point.

Ruby, whether in the classroom of on her own, sought to memorize—to acquire mathematical concepts and skills, retain them, and disgorge those facts on assessments. This was reflected in her participation in the classroom (e.g., seeking the instructor and not participation with peers), and it was also present in her narratives about mathematics participation outside of the classroom.

> R: [00:24:00] Like, we had a review session. Actually I've studied for the quiz all week. I went to my friend; she's a math tutor. And like she pretty much tutored me all week. Even last night, there was a group of us from class […] we got together and reviewed.

While Ruby reached out to others in this instance, she also talked about why these efforts did not translate into success for her in the mathematics classroom.

> R: [1] It was about five or six of us. […] [2] Yeah, so it was about six of us that got together. [3] And we looked at everything that was supposed to be on the quiz. [4] And I was doing fine, [5] but we had a little review session […] an out-loud, in-class review session before the quiz [6] and I went in there thinking that I would just get the quiz [7a] and then […] here it goes […] [7b] people just started asking questions and stuff like that, [8] and it's confusing me. [9] I'm losing all of the information that I had from last night. [10] And it just crashes. [11] Like, I just get the test in front of me [12] and [……] I just knew last night that I was doing well, [13] it was right in front of me, [14] and I knew exactly what to do, [15] but I just couldn't pull it out. […] [16] Like, the sum of cubes and the difference of squares and the difference of cubes—[17] I knew all that stuff, [18] just for the simple fact that there were different methods to do things, [19] and I was losing my method which worked and came out with the right answer. [20] And I just lost everything. […] [21] I couldn't function, [22] and the problem was just dead to me. [23] So, that's pretty much what happens with every test and quiz. [24] Like, I've used my resources, [25] but I've yet to actually go to the Math Learning Center. [26] But I use my resources as far as getting study groups together and getting a tutor, doing ALEKS or whatever. [27] You know, making sure that I'm getting the concept or whatever. [28] People just started talking, [29] and I just lose everything. [30] **It has been like that.** [31] Just stop talking. [32] I just lose everything. [33] **It's been like that for forever.** [34] So, yeah.

Case Study Conclusion

Ruby described herself as an "average" student, and she never identified herself as a high-achieving student—at any level of her school career. Ruby was from St. Louis, Missouri, and had attended very strong academic institutions in the area. Her family members were staunch supporters of her education, and her mother made several sacrificial efforts to move her family to areas of the city that offered better opportunities for Ruby. She attended private middle and high schools, and unlike the other students in

the study, she was not a first-generation student. In fact, Ruby was a second-generation MSU student; her mother had also attended MSU and was a driving force in her choice to attend the institution.

Ruby completed algebra and geometry courses in high school and earned marginal grades. When she took the mathematics placement exam for the university, she was startled by the advanced mathematics content to which she had no previous exposure. Placed in MTH 1825, she knew that she only needed to pass the course in order to move to the next; she had no aspirations of high achievement.

Case Participant Nicole: "Now I'm paying the price for it"

> So, I feel like it goes both ways, and I feel that that's what a lot of people need to realize…It's not just the students. It's not just the professors. It's a two-way street, a relationship. So, it goes both ways. It takes two…to do this. So, I feel like a lot of people just need to wake up and see that it's not just one person, but that it goes both ways.
>
> - Nicole

Case Overview and Student Background

Nicole is an African American female student who, at the time of the study, was beginning her first semester of university-level coursework. At the beginning of the fall 2009 semester, she was an 18-year-old student who matriculated from a suburban city in the state's largest metropolitan region. Nicole attended a local inter-suburban high school near her hometown (i.e., serving multiple communities) and excelled overall. She also noted the school's racial diversity, support systems, and strong academic resources. She graduated from high school with a 3.8 (of 4.0) grade point average—and in the top quartile of her graduating class. For Nicole, attending college—and particularly MSU, a family alma mater—was the next step in a trajectory marked by academic achievement.

Like the other case study participants, Nicole completed the research questionnaire and consented to participate in a series of interviews spanning the fall and spring semesters. On her questionnaire, Nicole indicated that she had completed four years of high school mathematics courses, including two full years of algebra courses ("pre-algebra," "algebra one," and "algebra two"). She did not, however, complete any "advanced" mathematics courses, even though they were offered in her school (e.g., calculus, Advanced Placement courses). She also reported mostly negative attitudes towards mathematics, both on her questionnaire and throughout her interview. Despite

her overall academic achievement, her opportunities to engage in mathematics learning contexts were limited—and possibly due to her own academic strategies.

Although Nicole maintained a relatively high grade point average throughout high school, she avoided difficult math courses in high school and enrolled based on perceived ease of "getting the grade." She avowed a preference her humanities courses, and she reported studying for mathematics less than one hour per week during her high school years. She also openly reported copying math assignments and not taking her math courses seriously. While she broadly recognized the importance of school and achieved academic success in other disciplines, she was satisfied with average (2.0-3.0) grades in each of her high school mathematics courses.

After matriculating at MSU, Nicole continued to disengage in mathematics. Like the other case participants, she hurriedly completed the placement exam before the required date and did not prepare in any way. With her resulting placement in MTH 1825, she initially saw the course as an opportunity to ease into the postsecondary transition. During the first four weeks of the semester, Nicole actively engaged in class sessions, routinely asking questions or offering solutions. Our first interview occurred during the sixth week of class, just as her attendance and classroom participation began to wane. She also began to show other, more explicit signs of academic disengagement. She routinely slept during class sessions. She bantered and joked more frequently with her peers in the back of the classroom—often drawing the attention of the instructor and other students.

Family and Community Expectations for Academic Achievement

Nicole was from a small city in southeast Michigan, near Detroit. As she described it, her hometown shared many sociohistorical and then-contemporary similarities to the larger metropolitan center. She also suggested, however, that her community was more racially diverse than, perhaps, a similar subsection of the inner city.

> N: I'm from Inkster, Michigan, a small city in Michigan, of course. Similar to Detroit, some would say…I went to a really diverse high school, so coming to Michigan State isn't like new to me. I've seen people from all shades and colors. Uhm…My neighborhood was really small, everybody knew everybody on a first name basis. It wasn't big. Some would call it "hood," I guess—urban, mostly African American. Like I said, really similar to Detroit, but on a smaller scale.

Nicole also spoke about the closely-knit relations among her family members. Upon the initial news of her acceptance to Michigan State, she spoke about her family's joyous reactions. Nicole had broad academic support among her family members for both her general education and her matriculation to MSU—particularly among those who had also attended the university.

> N: My whole father's side went to Michigan State University. They are all alumni of Michigan State University—besides my father.
>
> GL: Oh, so your father wasn't, but everyone on his side of the family was. Okay.
>
> N: Mm-hm. So his brothers and sisters attended Michigan State, and their kids attended Michigan State. I'm the last grandchild on my dad's side left to attend Michigan State. I mean, there's one below me, but he's got some years to go. Was that encouragement to come here? Yes, very much so. It's not like a hard-core tradition, but it was like "Ah, girl, you got into State, go 'head!" [Nicole *laughs* for three seconds] So, it was like support 100%—most definitely…Yes, family has attended here. They are alumni here. Um, would I say that I was gung-ho about coming to Michigan State? No.

Despite the familial legacy and broad academic support, Nicole was not immediately excited (i.e., "gung-ho") about attending Michigan State. Although she did not fully elaborate this evaluation, she did provide some clues as to what factors mediated her lack of intrinsic interest. One of these factors was the potential separation from high school peers. Nicole regarded the community members (from her hometown and neighborhood) with whom she had attended schools throughout her life as *family*.

> N: I felt like the people that I went to school with were like family. Like I said, the neighborhood that I grew up in, those were the same people that I went to school with. All the way from second grade…all the way to twelfth grade. So, like I said, I saw these people from when we were—didn't know nothing in life until we thought we knew everything. So, it's like we all grew up together. That was my family, you now what I saying? That's who I rock with. Those were the people that I affiliated myself with. They know me. They know the type of person that I am, and vice versa…It was just like that was my nest of people…That's what I mean by family.

For Nicole and her neighborhood peers, attending a "good" school took them beyond their community's borders, and she regarded these relationship as particularly significant. As such, her transition to MSU involved a critical decision that placed her peers on one side and her self-interests and the interests of her MSU-alumni family members on the other.

> N: And that's where we could go back to my family from high school; a lot of them went to Oakland University, closer to where we stay. And you can have cars on campus there—no issue—so that's where I wanted to go. So, but I knew that, at the end of the day, Michigan State was a better place for me. I knew that getting a degree from here would be better than getting a degree from Oakland University. Let's be real here: things are based on names. So, "oh, you got a degree from Michigan State" versus "you got a degree from Oakland University" –major difference. Michigan State holds a lot of weight. So, that's why I chose to come here. And I knew that, at the end, it was real for me. It was better.

As she cited throughout her interview, however, Nicole's family espoused support for her academic choice-making, particularly on whether to attend Oakland University or MSU.

> GL: Do you feel like your family would've supported you had you gone to Oakland?
>
> N: Mm-hm; I feel like my family would've supported any decision that I would've made.
>
> GL: Oh, okay; good, okay.
>
> N: I don't have one of those types of families that like "No, you better go." If I'm going to fall, I'm going to bump my own head and learn how to get back up by myself.

Overall, Nicole indicated that her family and community were supportive of her academic trajectory. As a "latest generation" college student (as opposed to first generation), she had the support of extended family members who praised her decision to attend their alma mater. While many of her high school peers did not come to MSU, some did, and she also briefly discussed the importance of their social support. She did not take classes with her peers during her first year; given the nature of the large university, they were spread across the campus. During our relatively brief interaction, Nicole did not discuss her parents' expectations with much detail; and despite being asked to, she did not explicitly discuss any expectations for her mathematics learning and achievement. Instead, she mentioned her parents' expectations incidentally, mapping them to her own identities:

> N: My parents always preached the grades, you know? And I was all about my grades. *I was always a good student.* That was definitely important for me.

Nicole's Past Academic Contexts and Identities

Nicole attended a large, public high school that attracted students from several neighboring suburban areas, including Nicole's home community. She attended the school throughout her high school years. During her interviews, she described the academic environment and her general student experiences.

> N: It was a really diverse high school. It went through 12th grade, all four years. Really good teachers, staff. Would I say that it has prepared me for Michigan State as some others? No… Was it easy? Yes. My cumulative was a three-eight all throughout high school. So, that speaks for itself. But coming here is a wake-up call to me. So, that's that.

Nicole did not articulate why, despite having "really good teachers" and staff, she evaluated her high school preparation as insufficient for a successful college transition. This might suggest that her high cumulative grade point average (3.8 of 4.0) was an insufficient indicator of her academic ability—i.e., speaking "for itself." On her questionnaire, Nicole did indicate, specifically, that her GPA was a poor reflection of her ability to perform in math learning contexts.

> N: As a high school student, I would describe myself as great. I wasn't one of those people who cried when I got a B, but I knew that I was capable of getting an A in any class that I got. So, I always pushed myself. I was always the person who wanted good grades, you know? I always felt like grades were important, no matter what type of person you are. So, that was always what I was brought up on, so that's what I always followed.

As this narrative example shows, Nicole's first-person academic identities were positively oriented. She regarded herself as a "great" student and correlated her school engagement accordingly (i.e., "always pushed myself"). On the other hand, Nicole's

sense of academic obligation centered on her grades; that is, she regarded these measurable outcomes (and not, say, learning) to be the primary objective of her academic engagement—"no matter what type of person" she may have otherwise been. As a good (or especially "great") student, Nicole aligned her expectations for schooling with what she got out of it. Despite being a great student, Nicole felt that this academic identity was untenable.

> N: I feel like when I attend school, I don't want to be just a number or, um, just another student or statistic or whatever. So, I feel like, um, I like to know my teachers, and for the teachers to know me. I like to know them, not on a personal level, but just inside the classroom, you know, so that we can relate to something that would make me more interested in the subject—and more interested in me as a student. So that our relationship can be more than just, "Oh Nicole, did you do your homework last night?" I feel that that's important.

Nicole continued to discuss her high school learning experiences, illuminating why, despite being a great student, she seemed to initially prevaricate.

> G: Okay. What was school like, day-to-day, for you then? Was there some struggle or challenge? How would describe it?
>
> N: Easy…You really didn't have to… As with everyone, high school is totally different than college, granted. But, it was challenging for some, but the curriculum that was given to me was…it wasn't really hard. No, it was more like you just came to class, you participated, you show effort in your work, you got the grade. More so than now in college, if you didn't know that stuff you could just kinda slide by in high school. You can't do that now. So that's what I mean when I say easy. But that's my take; somebody else would probably think different, you know?

Like Ruby, Nicole indicated that her perceptions about curricular expectations mediated her academic engagement in high school. Nicole downgraded her own self-assessment because of her low regard for those curricular expectations. Despite being a

great student, Nicole did not see full engagement as a requirement for academic achievement. Instead, she could "kinda slide," by attending classes but exerting—or only *displaying*—full effort (instead of fully engaging).

High School Mathematics Course Background and Identities

Attending the same high school for four years, Nicole completed three full years of mathematics courses.[18] Within those three years, she took a three-course algebra sequence (pre-algebra, algebra one, algebra two), a geometry course, and a statistics course. Her grades in those courses were at or above average; she earned B's in geometry and statistics courses and C's in her algebra courses. According to Nicole, she avoided a fourth year of mathematics in order to avoid calculus courses, which she feared would jeopardize her grade-point average.

> N: Freshman year, I had math—okay—high school consists of four years. I had math from freshman year through junior year. You know, after your freshman year and, I believe, your sophomore year, classes are really up to you…Um, I know that I stopped before I got to precalc…So, that would've been the next class that I had to take, and I didn't take it…So, I didn't take that, because I just didn't want that to mess up my GPA. So, I chose not to take it, but I took three years of math in high school.

Perhaps surprisingly, this endorsable narrative about mathematics course-taking did correspond to Nicole's broader academic identity. Although she elected to limit her mathematics trajectory, she did so to preserve her academic identity as a "great student" or, as she attested, someone who earned good grades. But why did she choose to limit her

[18] Nicole was among the last cohort of Michigan high school students to take only three years of high school mathematics, by law.

mathematics course-taking? And why, for Nicole, was relatively poorer performance in mathematics not a threat to her academic identity?

> N: What I enjoyed about high school was, subject-wise, I'd have to say, mm, history …I liked the history. I've never been a fan of math, for the record…I liked, um, you know, literature, English; things of that nature. But never math.

Like Ruby, Nicole did not identify as a mathematics student or, as she put it, "a fan[-atic] of math." While she satisfactorily completed her high school math courses, she did not choose to take courses that advanced beyond the minimum requirement. Preferring humanities courses (e.g., history, "literature, English; [and] things of that nature"), she shied away from mathematics and did not regard it with the same importance as her other courses. As a strategy to succeed in the math pipeline, Nicole identified courses and teachers that she and her peers regarded as easier than others.

> N: Um, my teachers were real laid-back. I would have the teachers that some would call the 'easy-four-point', some here at Michigan State. So, it wasn't like, 'dang, man, I'm stressing out over this math class.' It was like, 'Girl, let me see your homework' and then I'd…So, the quizzes were, 'Girl, pass me them answers.' Let's be real here; that's how it went.

As she extended this narrative, she described a strategy that would foreshadow her disengagement in MTH 1825.

> N: They weren't tough to me; I got it. Could I have applied myself more? Yes. I stopped right before I knew that it'd get tough.

Engagement in MTH 1825: Classroom Observations

Despite her difficulties with the course content, Nicole was frequently an active classroom participant—often raising her hand to ask questions or going to the board to demonstrate problem solutions. On the other hand, she was one of several students who

could often be seen sleeping during a particularly length lecture or an early Monday morning session. Seated near the very back of the classroom, Nicole was also active in the classroom's social sphere, often exchanging banter and chat instead of devoting attention to the classroom mathematical discourse.

Across the 39 observed sessions during the fall semester, Nicole was seen sleeping in 10 sessions. It was often difficult to spot or confirm her sleeping; as many students do, Nicole assumed a familiar pose as she disengaged. With her left elbow on her desk, she would prop the dome of her head on her left hand; her pencil would sit upright in her other hand as if she was still writing. She often held this pose for as many as 20 minutes, and in most instances, with an blank notebook page beneath her—just before another student (Robert, usually) would wake her.

Nicole's Mathematics Identities

Nicole's engagement in the classroom decreased throughout the semester, and it also extended to her participation in the study. After our first interview, it was increasingly difficult to reach out to Nicole and to schedule subsequent interviews. She began to miss class more frequently and after the second interview, I lost contact with her. During the two interviews in which she did participate, the focus was to understand how the various sociohistorical, community, and institutional forces were impacting her mathematics identities.

Importance of Mathematics, Motivation to Participate, and Capacity to Perform

Like the other students, Nicole completed the mathematics placement exam during the summer before her first semester at the university. During the interviews, she described the transition from high school to MSU. Similar to other cases, Nicole's narratives alluded to her sense of the instrumental importance of mathematics—both in her past academic experiences and in her then-current transition to the university.

GL: Uhm. Let's see. Let's go to the transition from high school to MSU. So, talk a little bit about your experience taking the placement test. When did you take it? Uh, what did you think about it?

N: (laughs: 2 seconds) [1] So, let me tell you. [2] I took the placement test—[3] and if the placement test was due on the ninth, I took it on the eighth.

GL: Okay.

N: Um. [1a] Did I take the placement test seriously? [1b] No. [2a] My whole thing about coming to Michigan State; [2b] I knew that I was not strong in math. […] [3a] Honestly, I went—the mindset that I had when I took the placement test was—[3b] I wanted to get a low score on it, [4] so that I could start with the basic math here. [5] So, then, I could build my foundation up here at Michigan State. [6] So, if I got Math 1825, [7] then 103 would build off of that, and so on and so forth. [8] So, that's kinda what I wanted to do. [9] I wanted to start off, you know, as low as possible and work my way up. [10] [00:20:00] No matter how long it took, [11] I know that I would've been straight as a student when it came to math at Michigan State. [12] Um; I don't even remember what score I got on the placement exam. [13] I know it was low, because I'm (laughs) in Math 1825. [14a] Did I take it seriously? [14b] Like I said, no. [15] But that's just really the mindset that I went into when I took it.

…

GL: So you said, you know, as long as it takes. What did you mean by that?

N: [1] Oh, well, as long as it takes for me to get the required math courses that I need here. [2] If it takes me all of four years—if it takes me that extra year, then that's I have to do. [3] To me—at the

> end of the day—I just want to get my degree from Michigan State. [4] Um; what comes along with that, I know that it's not going to be easy. [5] College is nothing like high school. [6] This is a whole new life for everyone, so. [7] That's what I've prepared myself for. [8] So that was the mindset that I took to it; whatever it takes, I know, that's what I gotta do.

Nicole's experience with the placement exam shares elements from each of the other case participants' narratives. First, she delayed the placement exam despite recognizing its influence on her academic trajectory at the university. Like Vanessa, she used the placement exam as a way to control her curricular requirements. By not taking the test seriously, as she puts it, Nicole wanted also to "reset" her mathematics identities by essentially starting over with mathematics at the university level. As she discussed early in the first interview session, negative beliefs about her capacity to perform in mathematics contexts had been a consistent part of her identities:

> N: I never liked math […] [2] honestly, because I've never been taught the basics of math. [3] I've been taught, yeah, your addition, subtraction, but like I said, […] you showed up, you participated, you got the grade. […] [4] You had to show work—yes, of course—[4b] but it wasn't like as strenuous as it is now. […] [5] So, I would say like I don't like math because of my teachers from the past. [6] Not like, uh well, I don't like the math as far as they can teach, [7] but I feel like they could've pushed the issue a little bit more. [8] [00:08:00] Not give me the grade—that's easy. [9a] Because if I get an A, [9b] then that's the end of the story. [10] What else or more is there for me to do in this course—I have an A, and I know that that's what I'm getting so, I've got that four-point. [11] What's next, you know? …[1] So, that's kinda like what I don't like about math.

Along with the declaration that she "never" liked math, Nicole also qualified that message by indicating that low expectations were also involved with her disengagement

with mathematics. She also indicated that this had occurred consistently throughout her academic career.

> N: I feel like I got lost a long time ago, [3a] so now with the stuff that I'm learning, [3b] it's like the professor or the teacher is speaking a whole other language to me. [4] So, that's why I don't take—or like math as much as some other people would. [1] I don't, because honestly, to me, [2] I'm not even going to hold you up. [3] The things that I learned in math today […] [4] I feel like if I'm not about to be an engineer—[5] I'm not going to work for NASA—[6] what am I learning this stuff for? [7] I'm not even going to hold anyone up. [8] I don't see where I'm going to use that in my field.
>
> GL: What's your field?
>
> N: As of right now, my major is, uh, human resource management.
>
> GL: [00:16:00] Alright; I understand. [……] So, you said a bit about this, but I'm going to ask the question again. How would you describe yourself as a math student? […] And what experiences in high school would support that description?
>
> N: Me as a math student. Wow. Is there a word that can describe that? Hm; let's think here. Um. […] I want to say that I'm horrible, as being a math student…1] I would say that I'm a challenged math student. [2] Like math is one of those topics that challenges me, and do I—how can I say—[3] do I pay attention to it and try to work at it as much as I should? No. [4] And I guess that that goes back to me quote-unquote not liking it. [5] So, now I'm trying to be that type of person where, "oh just speak it into existence" or "I love math"—[6] that's what people tell me; [7] I guess that works. [8] But it hasn't worked for me yet. [9] But, um, what was the question again?

Constraints on Mathematics Learning and Capacity to Perform

Nicole's experiences with school and with mathematics pointed to several constraints. As she mentioned, low expectations were elemental causes of her underperformance, particular in school settings. She did, however, accept ultimately responsibility for her own achievement and her own expectation-setting.

N: [10] So, that's how high school was for me when it came to math. [11a] So, I guess that I cheated myself, [11b] and I felt like the teachers cheated me, too. [12] So, now I'm paying the price for it.

Nicole also indicated that the MTH 1825 course structure was also a constraint on her motivation to participate in mathematics.

N: [1] Oh, um. Honestly I don't know; I don't know. [2] I dread coming to this class every day.

GL: Could you say a little bit more about that?

N: [3] I have MTH 1825, Monday through Friday, at 10:20 AM through 11:10 on Mondays, Wednesdays, and Fridays, [4] and on Tuesdays and Thursdays, I have it at 10:20 to 12:10, [5] plus tutoring from 1230-1:50. [6] And I still don't get it. [7] So, that's where it goes back to: [8] I feel like you have to know the basics to learn what we're learning now. [9] And like, my professor in class, she goes: "Well, this is a review." [10] Well, this isn't a review to me. [11] So, like I said, that where it goes back to square-one with me going to school and my high schools, or whatever. [12] This isn't review to me, like it would be for some. [13] I spoke to my professor about this. [14] So, it's kinda like, um, I don't know. [15a] Like when I wake up, [15b] and I have to come to this class; [15c] honestly, I dread it. [16] It's because I don't understand, [17] so it's like I'm in this class, [18] and this teacher is speaking this whole other language to me. [19] Do I want to pass the class? Yes, of course. [20] Do I go to tutoring? [21a] Do I try to pay attention in class? [21b] Most definitely. [22] But, links just don't link together, [23] so it's kinda just like I'm fighting this fight that I'm not going to win. [24] So, it's kinda just like, ugh. Seriously. [25] But, you gotta keep pushing.

…

G: [00:21:15] [*8 second pause*] So far, how are doing in the class?

N: [1] I'm failing Math 1825.

GL: […..] Okay. […] What percentage would you give yourself?

N: [2] I have a zero point. [3] That's another reason why I chose to do this interview. [4] Um; due to the fact that everybody that comes to Michigan State, [5] I've heard the subjects that they struggle with most are math and writing. […] [6] I feel like either you've got one

> or you've got the other. [7] I haven't met many people who do strong in both, [8] and I know my weakness is math whereas with writing I'm really strong.
>
> GL: Okay
>
> N: So; […] yes, I'm not afraid to admit that, yes, I'm failing Math 1825. It's not like an, "Oh my god"—It is what it is. I know that I need to pass it. Is it a high possibility that I won't and I have to take it again, here at Michigan State? Yes. Cus it's late in the game.

Along with her admission that she was failing the course, Nicole supports her own low performance and achievement with rhetorical stock plot; she claims that of "everyone that comes to Michigan State" math was one of two subjects that were commonly difficult for students. She used this narrative to shield her own underachievement, and she understood that she would necessarily repeat the course. Nicole discussed her status in the course with her parents, her instructor, and her advisors—and received various kinds of feedback.

> N: Whereas when I spoke with my professor, she told me to drop the course. So, at that time, that's another reason why I'm kinda like—I'm in this teeter-totter—because I really don't know which way to go, because it was like one person was telling me one thing and another person was telling me another. My professor is telling me based on experience. She's telling me that she's seen people fail MTH 1825 four times in a row, because they refused to go and take a lower math course. Whereas my advisor is telling me keep the math course, because if you drop it, […] if you drop it, um, you're not going to have math. You're not going to me studying math for two months. So, it was kinda like da-da-duh-di-di-di-da^, and then you know, at the end of the day, it's really my decision—what me and my family decide to do. So, I spoke with my parents, and they wanted me to, you know, go ahead and keep the course, um. I told them that, like, it was a high possibility that I'n going to fail it and I'll have to take it over. Um, and they were fine with that. You know, that's the type of relationship that we have, open with one another. And that's what I told them. Yes, the zero point is going to most definitely hurt my GPA, but I know that I'll be

> much better prepared for it the next time around. Would I like two-point it and still move on? [00:24:00] *Of course!*^^ But, I mean, reality is reality. So, that's what I'm dealing with, as of now.

Case Conclusion

Nicole was a high-achieving high school student in the suburban areas of the state's largest metropolitan area. Despite her positive academic identities, she struggled with mathematics, had a very negative views about the subject, and she admitted that her high school grades in mathematics courses may not have reflected what she actually knew about the mathematics in those courses. She completed three years of mathematics, with algebra-two being the highest course completed. Like Ruby, she was not only a latest-generation college student, but she was also had family members who attended MSU and influenced her decision to attend. Her family members and peers also shared their stories about the institutional culture, and she knew, for instance, that low-level mathematics courses came with a particular reputation.

Nicole attended MTH 1825 regularly during the first weeks of the semester, but even then, her engagement was very limited. She often slept in class and she interacted with her peers on a social basis more often than she did about mathematics. Her mathematics identities reflected very negative views about mathematics and a number of constraints on her participation. She was not motivated to study, to participate in class, or to even talk with the instructor (she viewed the instructor as someone who did not have her interests in mind). Nicole, however, did not struggle; she simply opted to not participate.

CHAPTER FIVE

Relating Mathematics Identities and Engagement in MTH 1825: Two Cases Revisited

> Decades after colleges and universities across the country began actively recruiting minority students, many campuses are more diverse than ever. But that does not mean that students connect across racial and ethnic lines….The whole discussion used to be about numbers….Now it is about what kind of educational environment is in place (*The New York Times*, as cited in Purdie-Vaughns et al., 2008, p. 615).

> The problem is that the pressure…changes what you are about in a situation. It gives you an additional task. In addition to learning new skills, knowledge, and ways of thinking in a schooling situation…you are trying to slay a ghost in the room…You are multitasking, and because the stakes are high—survival and success versus failure in an area that is important to you—this multitasking is stressful and distracting…it can cause highly inefficient strategies and rigidities…And when you realize that this stressful experience is probably a chronic feature of the setting for you, it can be difficult for you to stay in the setting, to sustain your motivation to succeed there. Disproving…is a Sisyphean task; something that you have to do over and over again as long as you are in the domain where [the pressure] applies (Steele 2010, pp. 110-111).

> To counter these norms, students must be encouraged and helped to develop strong personal identities and the kind of individual agency that are able to withstand these pressures (Martin, 2000, p. 110).

In Chapter 4, I explained how four students—Cedric, Vanessa, Ruby, and Nicole—negotiated the transition to university-level mathematics at MSU while enrolled in a remedial mathematics course, MTH 1825. Using multi-case study as a format and research strategy, I reported findings that addressed two of the study's three research questions. Because mathematics learning experiences are complex and deeply influenced by numerous math socialization forces, I limited the scope of those questions by focusing on two constructs: engagement practices in math learning contexts and, as a more central focus, the construction of mathematics identities.

The purpose of this chapter is to address the study's third research question, which hypothesizes a link between the primary, concept-driven questions. In Figure 1, I represent this supposed relationship diagrammatically.

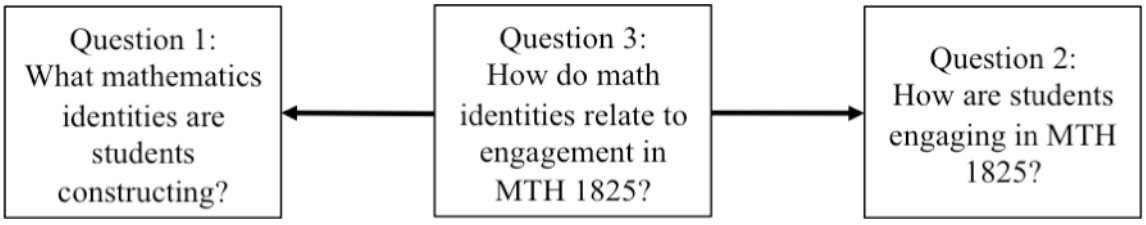

Figure 5.1. Research Questions Revisited

What, exactly, is this "mysterious link" between an individual's mathematics identities, on one hand, and her engagement in mathematics learning contexts on the other (Steele, 2010, p. 16; cf. Martin, 2007b)? In the study, I addressed this question by continually reexamining the various data for consistency of themes across the cases (during the data collection periods, through the end of the formal data analyses, and throughout the writing of the dissertation report). In the following sections, I discuss how the case study data support an emergent response to this third question. Particularly, I revisit Cedric and Vanessa's cases. As I noted in the previous chapter, while both these two students easily passed the mathematics course (although Cedric did struggle during the first few weeks), there was evidence in both cases that their mathematics identities were shifting in critical ways.

In the next chapter, I discuss the theoretical contribution of the third research question, offering a reprise of the theory discussed in Chapter 2. I argue that the students in this study each negotiated *identity contingencies* that mediated the relationship between who they were as certain kinds of mathematical persons (i.e., their mathematics

identities), and what they did in situations that involved mathematics learning and teaching (their engagement practices). For Cedric and Vanessa, negotiating this additional identity work challenged various components of their mathematics identities—their motivation, their strategies, and perhaps most strikingly, their perspectives on the instrumental importance of mathematics in their lives—and, ultimately, the range of opportunities to pursue courses and careers involving mathematics.

Similarly, both students identified two sites of mathematics identity work in their narratives—between what it meant to be a mathematics student and African American on one hand, and what it meant to be African American in this particular context of learning mathematics on the other (c.f. Martin, 2007b). Drawing on his own self-initiated observations of the institutional environment, Cedric identifies a master narrative about the former—an assumed understanding of what it meant to be an African American mathematics student in MTH 1825 at Michigan State. Vanessa, on the other hand, identifies this master narrative through her interactions with peer groups—interactions that were organized by school support programs (and by identity). For each of these students, the task of dissecting and negotiating these broader narratives (cf. Stinson, 2008) became additional work—on top of the added hours of classroom enrichment and, particularly for Cedric, the hours of study time dedicated to mathematics outside of the classroom.

This additional identity work pushed Cedric and Vanessa to also negotiate what it meant to be African American in this mathematics learning setting and the institutional setting, as well. For Vanessa, this contingency challenged her to question, "where I needed to be" [*sic*] and, as a result, *who* she needed to be as a mathematics learner.

Cedric, noticing where he was in relation to who he was, was also challenged to make critical decisions about who he would need to be as a mathematics learner to not only succeed in this course, but to continue with mathematics courses at the university.

Noticing and Wondering: Cedric Locates Identity Messages in the Institutional Setting

> Black students, Treisman found, offered a contrast to both [White and Asian students'] styles. They were intensely independent, downright private about their work. After class, they returned to their rooms, closed the door and pushed through long hours of study—more hours than either whites or Asians. Many of them were the first of their family to attend college; they carried their family's hopes. With no one to talk to, the only way to tell whether they understood the concept of a problem was to check their answer in the back of the book. They spent considerable time doing this, which made them focus less on calculus concepts and more on rechecking their arithmetic against answers in the book. This tactic *weakened* their grasp of the concepts…This was a frustrating experience, which made them wonder whether they belonged there (Steele, 2010, p. 101).

In Chapter 4, I introduced Cedric, a former high-school salutatorian who placed into MTH 1825 before his first year at Michigan State University. As a first-generation college student, Cedric often associated his engagement in school and mathematics with his family's high and supportive expectations for his academic achievement. His parents and other family members were exceedingly proud of his academic accomplishments, especially his matriculation to a major university near their hometown.

In the math classroom, Cedric was exceedingly quiet. Although he attended every class session, he rarely asked questions and almost never talked to the other students. He took copious notes, however, often transcribing the instructor's step-by-step strategies for simplifying expressions or solving equations and inequalities. While his peers would often compare notes and homework answers as they worked during class (or simply copy

them), Cedric would only refer to his text, verifying his answers to odd-numbered problems using the key in the back of the book. (As it was, the instructor made it a point to assign these problems, indeed hoping that students would use the answer key as a resource—as Cedric did.)

As I explain in Chapter 4, Cedric struggled in the beginning of the course. This was jarring for him, and he was embarrassed. While he told his parents about his achievements in his other courses (and identified those courses for them), he had not told them about his mathematics course. As it was for me to initially reconcile, it was difficult for Cedric to understand how a student who not only ranked among the top five in his high school graduating class but also easily succeeded in calculus during his third of four years, could have any difficulties in a high-school-level algebra course. Although he admitted that he likely struggled because of the time away from studying math, he also suggested that the course content and expectations were motivationally underwhelming, given his background and ability. Effectively, he was struggling to reconcile his existing narratives of achievement and success in mathematics with his current context and associated engagement.

During our first interview, Cedric began to openly question why he had been placed in MTH 1825, despite openly recognizing his placement test experience as being the deciding factor:

> C: Uhm, I think that, uhm, maybe if I had like a math class in my senior year that I probably could've done a little bit better. I probably would've remembered some of the stuff. And I'm not sure if I would've been placed in the higher math class, just because I'm a CAAP student. I think that most of us are required to take 1825, I think.
>
> GL: Oh. Well, let's talk about CAAP a little bit.

C: Uhm […] Well CAAP, I know that the way I was enrolled in MSU was through CAAP. Basically for, I guess, low-income students […] it's a whole bunch of like different range of students who accepted into CAAP.

As I explained in preceding chapters, the College Achievement Admission Program (CAAP) is a school support program that provides general academic advising and tutoring for students whose "economic, cultural, or educational backgrounds or environments" may warrant "special supportive services in order to realize their academic potential."[19] Throughout the semester, Cedric made use of and showed appreciation for the resources offered by the program, but he began to wonder if his involvement in that program had some impact on his placement in the course. What was it about the CAAP program that would stand out as significant for Cedric—so much so that it might have something to do with his placement in MTH 1825?

Later during that interview session, Cedric discussed the process of selecting his courses, his course section, and whether he selected the enrichment option.

GL: Did you have a choice in whether or not you took enrichment, versus the large lecture version of the class?

C: Uhm […] Well, when I was doing my schedule [my academic advisors] really encouraged me to do enrichment, so yeah.

GL: Okay; so how did that conversation happen?

C: Uhm, [……] they were just like, 'you're going to take 1825; you're gonna want to take the enrichment." I *thought*^^ that it was going like to be a tutoring session or like a one-on-one thing, but yeah. […] But I don't think that I knew that we were going to keep like moving on and have more material all the time.

[19] Retrieved from http://admissions.msu.edu/admission/freshmen_requirements.asp on September 22, 2010.

According to Cedric, his placement in MTH 1825 signaled to his advisors that he should take the small enrichment sections instead of the larger lecture hall-style version. It seems likely that his placement in MTH 1825 was an indication to others that he was not a good mathematics student. As Cedric notes above, however, the arrangement was not clear to him, particularly the part about the section's quicker pace and the extra assignments. Cedric was beginning to openly wonder about his circumstances.

As Cedric continued to question his placement in MTH 1825, he also began to do his own detection work. As he discussed during our second interview session, he often took stock of others' engagement in the classroom. While he took his notes and attended to the lecture, he wanted to know what others were doing, trying to understand who they were as mathematics students. As he made comparisons to himself and his own practices, he was particularly attuned to the practices of his African American peers:

> C: [00:20:30] Like, um, it brings to mind like—I guess, like—I kinda question what's their work ethic like. Are they just going to give up on the class? Or are they going to try to do their best? Try, even though it may be a struggle now, just to try to and get through it. And like, um, I don't know; it's just—I see a lot of African American students that have dropped the class or just aren't there anymore, and like I'll see them come in and sometimes they'll just leave and […] I don't know, it's just kinda […] *It kinda opened my eyes up to like where I am.* Like for this class, I want to do well. So, I'm going to come everyday, I'm going to, um, take notes, do whatever I can just to get a good grade, and to get out of it whatever I can.[20]

Cedric's assessment of the course environment was accurate, according to my own observations. There were mostly African American students enrolled in the course section, and many of them were dropping the course (or changing sections or no longer

[20] Emphasis added.

attending). For Cedric, however, this was not acceptable; to him, they were giving up—not getting through it and not trying.

This was a pivotal moment for Cedric's mathematics identity development in this context. At once, he saw himself as different in one way while similar in other ways; to paraphrase his words, his eyes were opened to who he was as a mathematics learner in relation to the others. Cedric endorsed this mathematics identity by correlating it to certain actions: he would attend everyday (which he did—perfectly); he was going to take notes (which he did—profusely); and he would, by any necessary means, earn a good grade, which he did—eventually. This identity was significant for Cedric, because it affirmed his high-achieving academic identity. Nevertheless, affirmation was costly for him, because it required juxtaposing personal success against the lagging achievement of many of his classmates.

Cedric's identity work continued to involve comparisons to his African American peers, particularly since this was the only one of his classes in which there were so many. Our second interview ended earlier than others, so I yielded the extra time to give Cedric an opportunity to ask questions and shift the direction of our conversation. This was significant, because his choice of topic was unanticipated but especially enlightening.

GL: Okay. […] Um, […….] [00:28:00] Any questions that you have for me about the class, or anything like that?

C: Um, [……] I want to know, like, what do you think about like, um, the African Americans in the class? And like the large number of African Americans in the class?

GL: Okay. Well, let me just ask a quick question before I answer. But I will; I'll definitely answer your question. But, you noticed. And first, what do you think about that?

C: It just; okay, when [the instructor] explained that this was—[the instructor] basically said that this was a remedial course. [The instructor] was like, um, this is the lowest course that you will take at MSU. [The instructor] said that it doesn't get any easier than this. And then I kinda looked around, you know, and I see that most of—even when I go to the Math Learning Center—I see that most of the students there in 1825 are African American. [00:29:01] And […] it just kinda […] I don't know, I would just like to see more African Americans in like the higher level math class than just like 1825 or like the low math class. […] Like, I don't know […] And then when I see myself in the like 1825 class, I just […] it just like […] pushes me more […] to just like, you know, get into the upper level classes. [……] yeah.

Indeed, Cedric had sought opportunities to verify what he thought was a consistent (and consistently reified) message within the institutional environment: That African American students were overrepresented in the lowest mathematics courses at MSU. He looked in a number of places, becoming what Claude Steele (2010), a social psychologist, calls a "contingency detective" (p. 141). In other words, he began to notice how the institutional setting "was organized by identity," a narrative that he endorsed and found significant (ibid):

C: I mean I see it. I walk these halls everyday. I see who's in these classes. I'll see calculus on the board, and no black students in the seats. Sometimes one or two… Okay. I just feel like […] it […] I don't know, it kinda hurts me to see so many black people, like me, in the classroom. I just feel like we're [……] I feel like we could do better. [……] Like, if we're going to come to MSU, then um, and just be put in the 1825 class, and then to see people, like um, just drop out of it; that just, kinda like, hurts me, because it, kinda like, says to me, 'okay, African American students can't succeed in this class, you know.' And it's remedial, the lowest class, so […] So, it's kinda […] I don't know.

G: Could you talk a little bit about what you think that term [remedial] means? Do you think that it applies to the course that you just took?

C: The word means like simple or, like, dumb. Well, I don't want to say 'dumb,' but…(whispers: And how it applies to the course that I

just took?) I think that most of the material was simple. But…and I feel like…Okay. Like when people ask you, like, what course are you in, 1825, it's kind of like, "well, gee, you're really bad at math." So, yeah.

G: Have you had that conversation with anybody? Has that come up?

C: Not really. I mean, not me personally. But you know, I've heard about people that have had that experience.

G: If it had happened to you, how would you have responded? Let's say that you didn't know me. I was introduced to you by somebody else, and we had that conversation. 'Oh, 1825; I know a little bit about that course. Oh yeah, you must not, um, you must struggle with math a little bit.' If I said that, what would you say to me?

C: I really wouldn't know what to say. Because I know that the fact that I'm in 1825 doesn't determine that I'm dumb at math or anything like that. I think that I'd probably just let that slide. In the inside, I know that I'm going to pass this course; I'm going to go on to 103 and I'm going to do well in that course, too. So, yeah.

Cedric recognized what I call a *threatening master narrative* depicting African American experience in mathematics at MSU (v. Martin, 2007b; cf. Nelson, 2001; Purdie-Vaughns et al., 2008; Steele, 2010).[21] But he wasn't just constructing it from thin air; Cedric had accumulated enough contextual cues from the institutional environment to give rise to this narrative. For him, the air was thick with threat. According to Steele (2010), for the contingency detective, "cues implicating one's marginality" are major; "the number one such cue is the number of other people in a setting with the same identity—the 'critical mass cue'" (p. 140).

[21] I define this term and situate it theoretically in Chapter 6.

What did it all mean? How did this threatening master narrative affect Cedric? In other words, how did this contingency on his identity mediate the relationship between who he was and how he engaged in his mathematics course?

> GL: So, what does that say to you? I mean, I see that you recognize that, but does it have any bearing on how you experience this class? Does it affect how you go about doing what you have to do?
>
> C: It actually does. It pushes me. It pushes me to do better in the classroom. I'm already here, but I want to do better; get a good grade in the class. I want to prove that, you know, there are African American students that will get a good grade in this class. That we'll succeed in this class. […] It pushes me more than it pushes back.

As major as the contingency was (i.e., the critical mass cue), Cedric's response was absolutely crucial and decisive. He countered the narrative. Despite the threat to his identities, Cedric maintained his motivation, his strategies, and his sense of the importance of the mathematics course experience. Even more, he positioned his extant identities (i.e., as reflected in the is-statement, "I'm already here") as a contrapuntal force against the master narrative—he sought to disprove it with his own, singular case of academic success. This *counternarrative* diverted the threat; he was able to subdue its potential damage (its "push") by reasserting his own mathematics identity.

Hearing and Doubting: Vanessa's Identity Messages within the Institutional Context

> Yet, considerably less is known about people's appraisal of what a given setting might be like further upstream, before they experience the setting directly. If aspects of a setting convey devaluation of one's group identity, a person may choose not to enter the setting or may leave before ever reaching the performance stage…a deeper understanding of which cues lead people to appraise settings as likely to be threatening or safe is

> desirable. Illuminating this process may establish how people come to sense a "threat in the air" in settings… (Purdie-Vaughns et al., 2008, p. 616).
>
> The culprit, in their case, is not their quantitative skills but, more likely, the prospect of living a significant portion of their lives in a domain where they may forever have to prove themselves—and with the chronic stress that goes with that (Steele, 2010, pp. 111-112).

The second case study presented in Chapter 4 centered on Vanessa—a first-year student from Detroit, Michigan—and her mathematics learning experiences while enrolled in MTH 1825. Vanessa was the first in her immediate family to attend college, and she, too, discussed her family's pride in her academic accomplishments and her undergraduate pursuits. Despite turbulent high school experiences, Vanessa graduated near the top of an extraordinarily large class (her school had merged with another in the city's shrinking district). She was accepted to a number of nationally recognizable four-year institutions, with scholarships; she chose Michigan State because of its proximity to her hometown.

Like Cedric, Vanessa excelled in high school and in high school mathematics. She took math courses during each of her four years, and during her sophomore year, she was admitted to a mathematics- and technology-focused program of study at her high school. After her sophomore year, the city and state's economic conditions necessitated a shifting of school personnel and students, and her school merged with another district high school. With existing resources overburdened, many of her school's pre-existing academic programs were jeopardized or cancelled, including the National Honor Society chapter in which she had been inducted.

As a new undergraduate, Vanessa was enthusiastic about the change of institutional context. Her outlook on mathematics, however, was already beginning to

change. Her worries about the transition to college were amplified in her talk about mathematics; her worry grew throughout her first semester.

In the mathematics classroom, Vanessa was a veritable star student. She missed relatively few days of class, and she was the most active classroom participant. She complimented her note-taking by frequently posing questions to both the instructor and the whole class; she helped other students with assignments; and she was the top grade-earner in the course section. During the hour-long exams, Vanessa would finish within the first twenty minutes and usually returned the top score in her section. While her grades in the course were excellent, she admitted to rarely studying outside of the classroom.

Like Cedric, Vanessa struggled with tensions between identities—her former, high-achieving mathematics identities versus her then-newly emergent, college-level mathematics identities. Furthermore, this new identity work for Vanessa was also initiated by her experience with the mathematics placement exam, and she discussed this experience during our first interview:

> V: Well, I actually didn't take it, I just pressed next—like on all of them—because I knew that I wanted to be in the lowest math. I knew that I wasn't that good in math, so yeah. […] I just—I *tried*^ to do some of them, then after a while I just said 'skip this,' and I just pressed next, to the next one. I didn't want to come into college, um, [00:16:00] like behind. Well, even though I am behind in 1825, but you know, I wanted to be where I needed to be—which is 1825.
>
> GL: Why was 1825 where you needed to be?
>
> V: Because it's the lowest math class here.

Vanessa, like Cedric, subverted the mathematics placement exam, and this move yielded a similar result: Vanessa undermined her own forward movement through the mathematics pipeline. Why? Vanessa claimed that by "skipping this," she could place herself where she believed she needed to be. She had decided, before taking a single course in college, that she was already behind. And for Vanessa, being behind required and supported her action.

Why did Vanessa see MTH 1825 as some place that she "needed to be," where her mathematics identities belonged? In other words, why was she complicit in keeping herself behind? As I learned throughout the semester, this act of academic sabotage was not isolated to the placement test. During our second interview, Vanessa began with a status report about her progress in the course:

V: I didn't finish ALEKS for the first time.

GL: What's that?

V: I didn't finish ALEKS for the first time.

GL: Oh.

V: (laughs)

GL: Did [the instructor] mention anything about it?

V: No. But that's the only time, and I've pretty much turned in everything else. I mean, I know that some of the other kids don't turn stuff in, but not me. That's not me. I turn my stuff in.

GL: When you say, that's not me, what do you mean?

V: Oh, like that's not how I get down. I'm about business when I come to class, so I make sure that I have my stuff in. I don't mess around with homework; I never have. So, when I get to class, I just make sure that I get my homework to [UTA].

GL: So, they don't seem to be too worried about you?

V: No. But yeah, I went up to her; she was asking everybody to come outside and talk about their grades.^ Cus I didn't even want to—I was thinking about dropping the class.

GL: You were thinking about dropping the class? When?^

V: [00:05:00] So, I could just take later—I mean, a lot of people have started dropping classes.

GL: Right?

V: So, maybe I should, too?

GL: But why would you drop if, if you're doing so well?

V: Mm; I don't know.

As the midterm exams approached, Vanessa was actively questioning her mathematics identities—in particular, her motivation to pursue mathematics learning. Despite this, she continued to do well in the course. As I later learned, however, Vanessa's high grades in the course were not clear reflections of her ability to perform; this was evidenced in part by the ease with which she completed her exams. Vanessa also talked about her ability to perform with respect to her identities:

GL: Would you classify yourself as an over-achiever?

V: No. No! I am not! Like I told you, I do the bare minimum. I am not an over-achiever.

GL: So, what more could you do? If you do the bare minimum now, what more could you do?

V: I could actually study. I didn't study last night. I can study. I can do more problems from the homework. Like, I don't know I didn't study last night! Like I looked at the book; I opened the book. I closed it. I don't know.

While Vanessa was adamant that she was not an overachiever, she also began to say more and more that she was not a "strong" student, and as a result, that she belonged in MTH 1825. Her mathematics identities were beginning to shift toward underachievement. In a move that borders participative inquiry (cf. Stinson, 2008), I probed this area, albeit indirectly, by asking Vanessa directly to evaluate this narrative. She claimed that "I am not an overachiever," and she endorsed that identity fragment by correlating to specific actions (e.g., not studying; not doing more problems; simply looking at her book). It was not clear, however, what the significance of this narrative was for her.

GL: Okay. So you don't study, but you do well on everything. Do you think that you belong in this class?

V: Yeah! I placed in this class.

GL: But do you think that you could've placed into 103?

V: No.

GL: Why not?

V: Well, I don't know. Because I did take the test over the summer. I didn't remember anything; I just kept clicking next, next. Maybe if I had studied, Maybe if I'd come in with the right frame of mind—instead of "I need to be in the lowest class." Maybe I should've; I don't know.

GL: But you're okay where you are?

V: Yep…Do you think that I should be in 103?

GL: I don't know *for sure*. That's my honest answer. But I look at your quizzes, I look at our conversations, I even look at these problems that we've just work on, how you talk about what you do, you seem confident when you're doing it. You're doing so well in this course. I do think that you'd do very well in MTH 103.

> V: I don't know. I talk to my friend, who's at Bowling Green, and she's like, "yeah, you should be doing well, like it's a low math," so it's like why wouldn't I be doing well? Because it's high-school math, and we're in college. She's like, "you better get an A out of there! Duh!" But she's at Bowling Green with like three freshmen in her math class, so…

This underachievement identity continued to develop throughout the semester, and with no regard to her high achievement, it was clearly connected to Vanessa's engagement in MTH 1825. Vanessa identified the problem as being outside of "the right frame of mind," but what was encouraging her to maintain this mindset? As Cedric did, Vanessa discussed the emergence of a master narrative—a threat in the contextual air.

Vanessa and the MTH 1825 Masternarrative

> If doing well in mathematics is given a negative connotation among students, then the factors contributing to students' mathematics success and failure are not confined to teacher attitude, biased curriculum, and student background but are also affected by attitudinal and behavioral norms that exist among students themselves (Martin, 2000, p. 110)

During our third interview, I asked Vanessa to talk about some of the institution-level factors that impacted her mathematics socialization at the university. While we discussed the influence of the instructor, the curricular expectations of the course, and Vanessa's negotiation of the classroom environment, one of the more powerful forces was the student culture and the role of her peers. Vanessa mentioned, as I have shown in this chapter, the influence of peer's perceptions of the course (e.g., her friend from home and student at Bowling Green State University), but she also talked about organized peer groups and their influence on her mathematics socialization.

Like Cedric, Vanessa participated in programs hosted through the Office of Supportive Services. A CAAP student, Vanessa talked highly about the programs and how they provided a motivational support system. One of the activities hosted there included evening sessions in which students talked about their experiences at the university, sharing strategies, dissecting constraints, and reinforcing the importance of college, particularly for non-dominant groups who have been systematically marginalized in American institutions (e.g., African Americans). In this way, these sessions worked as an identity-affirming counterspace (Carter, 2008). During our interview, she described one of the sessions and an activity that had really imparted a certain kind of impression on her:

> V: …It's this little skit. They have this group called "Eighteen-twenty-five"
>
> GL: I don't know anything about any of this. Please continue.
>
> V: Yeah, It's like, it's mainly for—I'm not going to—like mostly black kids. It's every Tuesday, right down the hall…you should go; it's really enlightening. Um, well, [the program] is really about this group of kids that are going through certain stereotypes or whatever that kids go through, and they just make—I don't know—1825 just has this reputation—yeah!
>
> GL: And what does that reputation mean?
>
> V: I mean, we know that the skit is going to be funny, first off. We know that the kids are going to struggle through something. Like in every little skit, they have something to overcome. Like, it's just ironic that they named it eighteen-twenty-five.
>
> GL: Yeah, that's interesting. Any other characteristics of…
>
> V: Yeah, there's always something about the skit that…there'll be some kid who's lazy, doesn't come to class, or something like that, and then there's somebody who comes and enlightens him. Point of the matter is that it's always something going on with the person

in the skit. And it's about freshmen. Like their all quote-unquote freshmen. But they're upperclassmen playing freshmen.

GL: That's really interesting. How does that make you feel?

V: Being that they're all black, it's kinda like most black kids are in 1825. That's kinda what it seems like to me. Which is kinda true, in a way.

Through this academic identity-affirming program intended to support students as they transition to college, Vanessa was also negotiating a very different message about the achievement of African American learners in mathematics at the university. Inadvertently, the program was communicating negative identity messages about MTH 1825. The skit group, itself, bore the colloquial name of the course, and as Vanessa indicated, at least some of the skits pointed to assumed understandings about how MTH 1825 courses are organized—and how African Americans should respond in turn. Students depicted here were not engaged academically, were not motivated to learn mathematics, and did not employ appropriate strategies for learning mathematics. The student culture promoted here did not support the development of productive mathematics identities.

With some probing, Vanessa continued to discuss the substance of this narrative. She also discussed the impact of this shared narrative on how she view herself, he background, and her trajectory.

GL: So, in these skits, they play up the idea that there are a lot of black kids in these courses? And if so, how does that make you feel?

V: Yeah. And I feel like it's DPS.

GL: What?

V: I feel like it's DPS. I feel like we have this inadequate schooling, and that we are behind. I really do. Just like the standards of our school is way lower than in other places.

GL: Say more about that.

V: Like, when I told you about my environment in high school—fights, paper ball throwing and fights, not caring about the teacher—we didn't have someone who made us do anything or like the work wasn't challenging, so of course, when we get to college we're going to have to be in the lower math classes, because we haven't had any type of hard curriculum that's going to prepare us. That's how I feel. So…there are some schools, though, [and these particular schools] that are good and hard and strict are supposed to be, but the majority—that's only two schools out of how many in Detroit?

Vanessa placed into MTH 1825 not because of her ability to perform (because she refused to), but because she downgraded her ability to perform. The group narratives presented in the school support program inadvertently supported this notion.[22] This supportive setting confirmed a situational cue for Vanessa (Purdie-Vaughns et al., 2009)—similar to Cedric's detective work. Unlike Cedric, who immediate produced a counter story, Vanessa did not counter the master narrative about African American students in MTH 1825. Instead, she strengthened the narrative, by connecting it her own (e.g., "It's like DPS").

Chapter Discussion

[22] To be fair, Vanessa did not talk about the context of these stories and whether they were countered in the peer support group—by either students or the paraprofessional facilitator. As part of my work with these types of courses, I have observed sessions like the one that she described, and while these narratives are "in the air," they are often countered as a central point of activity for the group. To be sure, these groups are not designed to support these negative master narratives, but it is also clear that for Vanessa, these messages were salient.

In this chapter, I re-presented two cases of successful students in this mathematics learning context, a university-level remedial mathematics course. The purpose of the chapter was to address the study's third research question: How does mathematics identity work (question one) relate to context-based engagement practices (question two)? To address this meta-question, I drew on a comparative reading of the data and the structural analyses presented in Chapter 4. From this grounded theory analysis, I argue that certain *situational cues* tied to *threatening master narratives* mediate the relationship between the students' mathematics identities and the ways in which they engaged in MTH 1825 (Martin, 2007b; Purdie-Vaughns et al., 2008). In the next chapter, I discuss the theoretical implications of master narratives as a particular kind of identity contingency (Steele, 2010).

For Cedric and Vanessa, these identity contingencies mediated the relationship between identities and engagement in particular ways. Cedric constructed a master narrative of African American underachievement in mathematics based on institutional cues about African American *overrepresentation* in the institution's lowest-level mathematics course. Vanessa constructed a version of the same master narrative based, at least in part, on her interactions with and messages circulating among peers in school-based support programs.

This master narrative evoked different reactions from Cedric and Vanessa. Where the master narrative dictated underperformance, lack of effort and agency, and ultimately underachievement, Cedric responded by correlating the narrative to a different set of actions—i.e., *reconfiguring* the narrative (Nelson, 2001; Stinson, 2008). He over-performed in the course (i.e., tried "twice as hard") and he did "whatever" was required

to pass that course and disprove the "statistic." Effectively, I argue, Cedric was able to construct a counter story as an act of identity resistance in his narratives and therefore, his engagement with mathematics in and outside of the classroom.

Vanessa struggled with the emergence of her master narrative. Unlike Cedric, Vanessa knew students from her home city and school who were also in MTH 1825; through her peer networks, she had repeated exposure to narratives from and about African American students in mathematics learning contexts at MSU. In the classroom, she was socially engaged with many of the students (although she didn't socialize during official class activities). Despite easily earning the highest grade in her course section, she did not reconfigure the would-be conventional narrative. Instead, she attempted to substantiate the master narrative, suggesting that underperformance was linked to students' backgrounds, including her own. For her, MTH 1825 seemed to be a place in which she "needed to be."

In the Chapter 6, I present a theoretical discussion of mathematics identities-as-narrative and the existence of contingencies, threat, reconfiguration, damage, and repair. With the empirical results as grounding support, I argue that identity contingencies mediate the relationship between students' identities and their academic engagement practices. This mediator, however, is critically important, because it represents a range of situational cues for the student—from opportunities to debilitating vulnerabilities. I suppose that master narratives also span this range, from affirmative master narrations about the experiences of certain kinds of students in mathematics learning settings to threatening master narratives in those settings. These threatening master narratives, I argue, may lead to various outcomes—as the data in my study support. Students may be

threatening to reconfigure their own identities in relation to a threatening master narrative, and their identities may be "damaged" of at least "infiltrated" in the process (Nelson, 2001). I also argue that, in cases of damage, identities may be repaired through the construction of counternarratives.

CHAPTER SIX

Study Discussion: On Mathematics Identity Contingencies, Threat, and Counternarratives

> Once labels are applied to people, ideas about people who fit the label come to have social and psychological effects. In particular, these ideas shape the ways people conceive of themselves and their projects (Appiah, 2005, p. 66).

> Identities mark certain people as candidates for certain treatments, and within abusive group relations these treatments are *seldom* benign. The connection between identity and agency poses a serious problem when the members of a particular social group are compelled by the forces circulating in an abusive power system to bear the morally degrading identities required by that system. These mandatory identities set up expectations about how group members are to behave, what they can know, to whom they are answerable, and what others may demand of them. (Nelson, 2001, pp. xi-xii, emphasis).

> [Some] surrender their identity; melt into a structure that delivers the strong persona they lack. Most others, however, grow beyond it. But there are some who collapse, silently, anonymously, with no voice to express or acknowledge it. They are invisible. (Morrison, 1993, pp. ix-x).

> Identity threat, the subset of identity contingencies that actually threaten a person in some way—is a primary way by which an identity takes hold of us, in the sense of shaping how we function and even in telling us that we have a particular identity…Identity threat, diffuse and Delphic as it may be, is nonetheless powerful enough to single out an identity and make it the center of a person's functioning, powerful enough to make it more important, for the duration of the threat at least, than *any* of the person's other identities (Steele, 2010, pp. 71-72, emphasis added).

In Chapter 5, I presented a reexamination of case study data in order to empirically address a third research question: How did students' mathematics identities relate to their engagement practices in the mathematics learning setting? Using a grounded theory approach, I advanced an emergent argument about the students' mathematics learning experiences in this institutional setting. The students, I claimed, were recognizing and negotiating *identity contingencies* in the environment. These identity contingencies were mediating the relationship between identities that students

were constructing about themselves, the ways in which they were engaging in mathematics learning settings, and, ultimately, the role of mathematics in their academic trajectories.

In this chapter, I unpack the idea of identity contingency (and the study's third question) and present a theoretical version of the argument presented in Chapter 5 (Figure 2). The purpose, then, is to discuss how the cases presented in Chapters 4 and 5 may signal and connect to a broader theoretical phenomenon. Accordingly, the discussion in this chapter connects to, reprises, and expands the theories on identity that I discussed in Chapter 2. Here, I focus on the following questions: If identity contingencies do mediate the relationship between identity (who one is) and engagement (what she does—as a mathematics learner), what kind of thing are they? Why do they matter, and what is at stake?

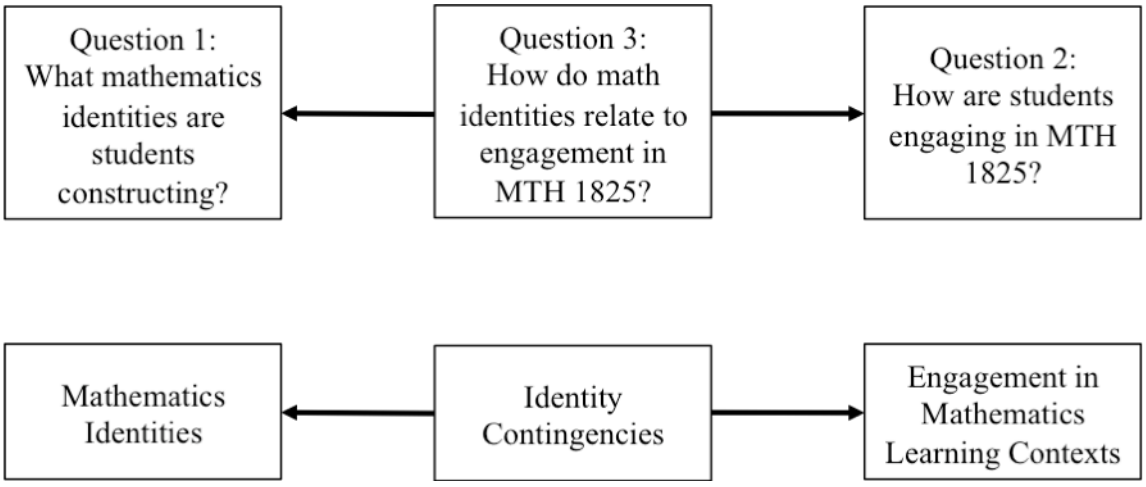

Figure 6.1. Identity Contingencies as Mediators between Mathematics Identifying and Engagement in Mathematics Learning Contexts

The first task for this chapter is to define identity contingencies. Along with offering a standalone definition, I accomplish this by arguing that they are isomorphic[23] to *masternarratives* (Martin, 2007; Nelson, 2001; cf. Purdie-Vaughns et al., 2008; cf. Steele, 2010). As others have shown, masternarratives can affirm or threaten our identities (or they may, in effect, be benign), depending on the situation and the resulting cues (Nelson, 2001; Steele, 2010). I explain the concept of masternarratives and their potential forms of impact in the following sections.

In the previous chapter, I presented narratives from one of the principal study participants, Cedric, in which he explicitly constructed and negotiated a masternarrative about African American achievement and participation in mathematics. He constructed this narrative, as I showed, with the help of situational cues that he gleaned from the institutional environment (cf. Steele, 2010). The masternarrative that he constructed was mirrored in the literature on African American students' participation and achievement in mathematics, as I discussed in Chapter 2. As I concluded in that chapter, this particular masternarrative was an identity threat for Cedric, challenging the narrative development

[23] By "isomorphic," I mean to express the similitude in form between masternarratives and identity contingencies—i.e., that they share certain structural properties. As I explain in this chapter, identity contingencies and masternarratives each represent continua that map vulnerability (in the case of contingencies) and threat (in the case of masternarratives) on one end and opportunity and affirmation on the other, respectively. In this way, these two constructs have the "same essential structure" and may be claimed to be "identical up to an isomorphism" (Weisstein, 2011). The principal factor of difference, then, is the divergent pair of traditions in which they are conceived. Masternarratives necessarily belong to a discursive, constructivist way of knowing where stereotypes are a hallmark of a belief-driven, psychological way of knowing. The isomorphism bridges these ways of knowing, mapping (bijectively) one construct to the other.

of certain parts of his mathematics identities—specifically, his motivation, strategies, and capacity to perform in the course.

As the analyses of these students' narrative indicate, threatening masternarratives, I argue, can lead to a crisis in which our identities may sustain *damage*. As evidenced in the empirical study, identity damage is presented in at least two ways: as *infiltration* and as *deprivation of opportunity* (Nelson, 2001). Fortunately, identity threat is not deterministic, and identity damage is not a necessary end stage. I conclude the chapter by describing a process through which agency plays a central role, and by which damage may be averted and even reversed—or repaired.

What are Identity Contingencies?

The term, identity contingency, refers to "the range of vulnerabilities and opportunities a person expects to face based on the settings' response to one or more of the person's social identities" (Purdie-Vaughns et al., 2008, p. 616; Steele, 2010). In other words, identity contingencies are the possible judgments that we face in particular social situations. As this would suggest, they are "situational predicaments" of everyday life (Steele, 2010, p. 59), and they represent opportunities available to us in a specific context, our vulnerabilities therein, or the rather benign effects that are simply endemic to being in that environment. It is these predicaments, I argue, that mediate the relationship between who we are and how we enact our "projects" (Appiah, 2005, p. 66). In Figure 2, I represent this relation diagrammatically.

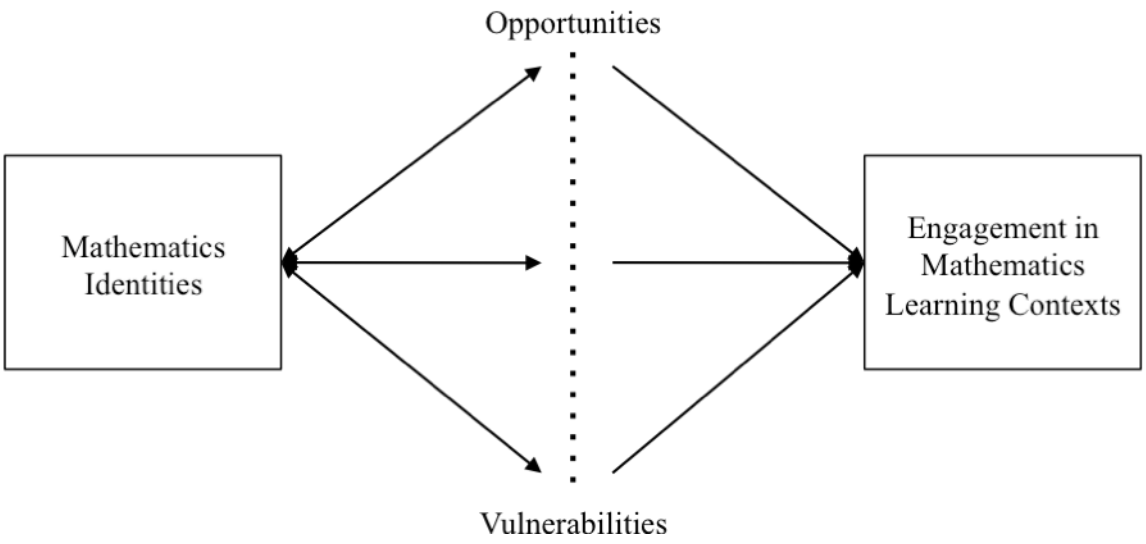

Figure 6.2. Opportunities and Vulnerabilities as Identity Contingencies

As they represent opportunities in a given context, for instance, we might think of identity contingencies as affirming our identities—or providing access to spaces in which our identities might connect to productive engagement and, likewise, to productive identifying (cf. Carter, 2005; 2008; Stinson, 2008; also cf. NRC, 2001). In the worst cases, identity contingencies represent the scenarios in which our identities are most vulnerable to threat (Steele, 2010). Threatening identity contingencies, then, "have the greatest power. Being *threatened* because we have a given characteristic is what makes us most aware of being a particular *kind* of person" (ibid, p. 73, original emphasis; cf. Appiah, 2005, p. 66; cf. Gee, 2001; cf. Nelson, 2001, pp. xi-xii; Sfard & Prusak, 2005). As I presented in Chapter 5, situational cues may convey threatening identity contingencies—just as they did for Cedric and for Vanessa.

What is the Problem? Threatening Identity Contingencies, Masternarratives, or Stereotypes

> Whereas so far we have been speaking of an identity as narrative primarily in virtue of its form—I make sense of myself or others by arranging what I care about into a story—identity is also narrative in virtue of the *already existing stories* and fragments of stories with which we identify ourselves and another (Nelson, 2001, p. 82, emphasis added).

> People from other groups in other situations might face very different stereotypes—about lacking math ability…for example—but their predicaments would be the same. When they were in situations where those stereotypes could apply to them, they understood that one false move could cause them to be reduced to that stereotype, to be seen and treated in terms of it. That's stereotype threat, a contingency of their identity in these situations (Steele, 2010, pp. 6-7).

As I discuss in Chapter 5, during his semester in a remedial mathematics course, Cedric became a "contingency detective" (ibid). He easily noticed (and noted) that most of the students in his MTH 1825 course were African Americans. He talked with his peers and heard similar stories about other low-level mathematics courses at the institution. Each day, as he walked the halls of the building in which the mathematics courses were held, he conducted the same simple investigation, attempting to confirm or disconfirm an emerging trend: As he passed a room with mathematics on the board, he would take note of the content. Then, he would scan the students in the classroom. He talked about situations in which he saw algebra on the board that matched the content in his course. In those cases, he remarked that there were likely more African American and Latino students in the seats than when, say, calculus was on the board. (Although he emphasized that there were often African American and Latino students in the room—but never more than a few).

When I asked Cedric about this result and what it meant for him—i.e., its significance—he reported that it "hurt." From my analysis of his narratives, I suggested that it threatened his high achieving identities, his mathematics identities that signaled

high motivation and the instrumental importance of mathematics. The idea that he and his African American peers were overrepresented in low-level mathematics courses—yet underrepresented among the broader student body—was a contingency that Cedric gleaned from the social context. It threatened him, because he felt as if this situation *said something* about African American students and mathematics: that they—and he, possibly—could not succeed.

This threatening identity contingency was a narrative in form. Of course, the particular narrative of this case was not unique; in fact, it emerged in each of the cases that I studied. As I discussed in Chapter 2, the general form of this narrative has a long history in mathematics education. It is a stereotype, or in narrative terms, a masternarrative about the experiences of African American students and mathematics (Martin, 2007). As this study documents, students are neither shielded from nor oblivious to this masternarrative.

Masternarratives and stereotypes are particular kinds of identity contingencies and enable a variety of effects in mathematics learning contexts. On one end, they may affirm students' identities—encouraging us to seek out opportunities and enabling our capacity to learn. On the other, masternarratives may threaten our identities; they allow our vulnerabilities to control how we navigate social processes –particularly when those vulnerabilities are systemically or systematically imposed through dominant discourses (Nelson, 2001; cf. Hammack, 2008; Stanley, 2007). As Nelson also suggests (personal communication, EMAIL DATE), masternarratives are also simply a matter of life—we "can't live without 'em"; as such, they may have little discernable influence, dependant upon how the narrative is negotiated.

As identity contingencies, masternarratives can also affirm our identities, thereby mapping to opportunities. But they may also threaten us, as Cedric was threatened, and expose our vulnerabilities in a setting (See Figure 6.3). In this way, masternarratives are isomorphic to identity contingencies. Masternarratives also function as stereotypes do. When positive, they can strengthen our self-conceptions. Like negative stereotypes, however, threatening masternarratives can undermine not only our identities, but also our performance in a setting (Purdie-Vaughns et al., 2008; Steele, 2010; Steele & Aronson, 1995; Steele et al., 2002).

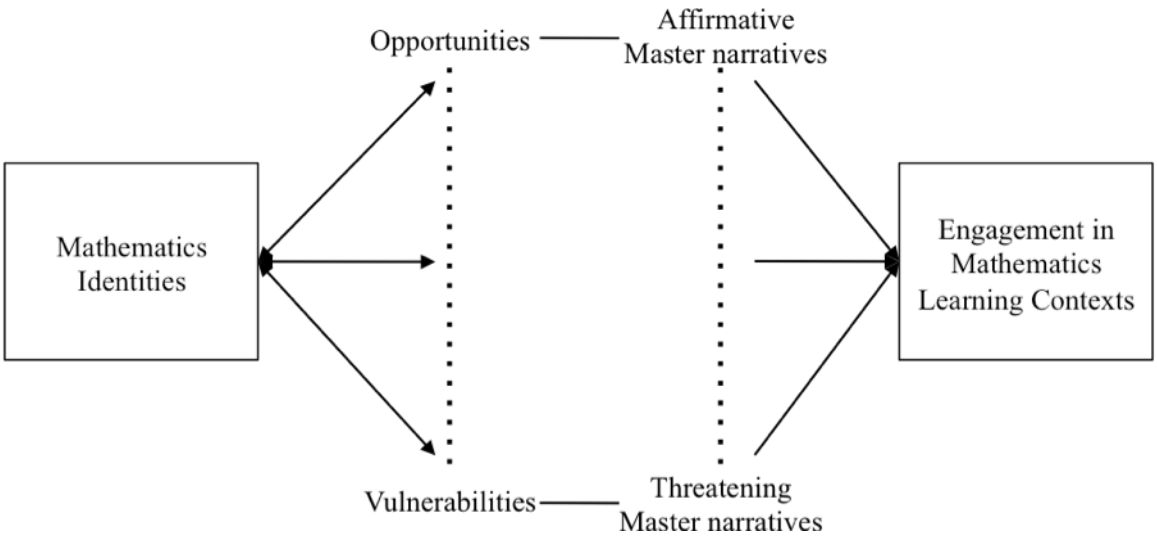

Figure 6.3. Masternarratives as Identity Contingencies

What is the Danger? Identity Threat and the Possibility of Identity Damage

> The concept of a master narrative is consistent with notions of a "dominant discourse" that social theorists have long argued is confronted by individuals as they make meaning of their cultural surrounds….The experience of identity threat, or of existential insecurity in matters of identity, most certainly influences the process of social regeneration (Hammack, 2008, p. 224).

In Chapter 5, I also discuss Vanessa's negotiation with the masternarrative of African American performance in mathematics contexts, particularly at MSU (the version that she constructs). Unlike Cedric, Vanessa did not choose to become a contingency detective; the contingency found her. In her school support program, student mentors "passed down" the masternarrative through organized skits about their experiences in the institutional setting. The skit group, in fact, was named after the mathematics course in which Vanessa was enrolled, signaling the deep influence that the course had within the student culture.

For Vanessa, this masternarrative was especially threatening, as she relied on her connection to peers for support. Many of these students were from Vanessa's home city—even from the high school that she attended. It is unfortunate that formal peer groups played a role in substantiating this narrative. For Vanessa, this masternarrative invaded her personal narratives, posing a very specific kind of challenge to her mathematics identities—particularly her sense of the importance of mathematics, her motivation to pursue mathematics courses and even a career that involved mathematics,.

As mechanisms of identity threat, masternarratives can invade our thinking about our selves, and offer to substitute fragments of an individual's identities with taken-as-shared replacements. This result, I now argue, is a form of *identity damage* (cf. Nelson, 2001). In particular, I call it identity infiltration, when the significant and endorsable fragments of one's mathematics identities, in this case, are replaced by masternarrative parts.

The other form of mathematics identity threat, deprivation of opportunity, evolves from students' self sense-making with respect to the masternarrative. In particular, it

involves a three-way relationship between an individual's mathematics identities, the masternarrative threat, and any of the individual's related *designated* identities (Sfard & Prusak, 2005). For Vanessa, for instance, the masternarrative of African American underperformance in mathematics not only threatened to infiltrate how she thought about her self as a certain kind of mathematical person, but it threatened to shake her designated identity as a prospective nursing student. Vanessa knew that more mathematics courses would be required for her major requirements, but her experience in MTH 1825 was unnerving for her, and she doubted her capacity to perform in mathematics contexts at the university beyond MTH 1825. For a moment, as I discussed in Chapter 4, Vanessa doubted the fulfillment of her longstanding and deeply seated designated identity based on the challenges that she perceived in mathematics courses ahead.

Where is the Hope? Identity Repair and the Necessity of Counternarratives

> Perspectives that run opposite or counter to the presumed order and control are *counter narratives*. These narratives, which do not agree with and are critical of the master narrative, often arise out of individual or group experiences that do not fit the master narratives. Counter narratives act to deconstruct the master narratives, and they offer alternatives to the dominant discourse in educational research (Stanley, 2007, p. 14).

> In any case, a story needn't uproot the entire master narrative to be a good counterstory. If it manages to dilute the moral poison of the narrative and so free the group members' moral agency, then despite any constraints under which it operates, the story is good enough…By pulling apart the master narratives that construct a damaged identity and replacing them with a more credible, less morally degrading narrative, counterstories serve as *practical* tools for reidentifying persons. They serve to repair the damaged identity (Nelson, 2001, p. 186).

Fortunately, there is nothing deterministic about mathematics identity threat. While the threat may be vicious and even invade one's own narratives, it does not control the individual's ability to resist and enact her agency. In Cedric's case, the threat posed

by the narrative of African American overrepresentation in low-level mathematics courses was weak, and it neither infiltrated his narratives nor deprived him of any opportunities to develop mathematics identities beyond MTH 1825. In fact, Cedric countered the threat, almost instantly, in his narratives about himself as a mathematics student:

> C: It actually does. It pushes me. It pushes me to do better in the classroom. I'm already here, but I want to do better; get a good grade in the class. I want to prove that, you know, there are African American students that will get a good grade in this class. That we'll succeed in this class. […] It pushes me more than it pushes back.

For Cedric, the masternarrative of underperformance and failure pushed him to achieve more and to resist its lure. Cedric's counternarrative was especially robust and left no space for the threat to infiltrate his narratives. He deflected it but converted its power for his own use.

Counternarratives are constructed under circumstance where the stock plot, or masternarrative, does not fit nicely with the individual's experiences. These narratives of resistance perform just as Cedric's did, and deconstruct the unfamiliar parts of the masternarrative and explore their validity (as Cedric did with his contingency detective work). Counternarratives can also act as ways to repair an infiltrated identity—even a temporarily affected one—by offering an alternative that is based in the individual's experiences. As with Vanessa who struggled against the masternarratives in her own experiences, her capacity to look back over her mathematics experiences and reconstruct herself as a strong student and a "good math student" helped her to also deflect the narrative of underperformance and group underachievement.

CHAPTER SEVEN

Conclusions, Affordances and Limitations, and Implications for Future Research

> Broad-brush attempts to deal with underachievement in mathematics often aggravate the very problems they are trying to solve. Raising standards for graduation often widens the gap between those who know mathematics and those who do not, since increased standards are rarely accompanied by program changes to provide appropriate courses for students who are not motivated to study mathematics (National Research Council, 1989, p. 13).

> Perhaps most troubling with respect to mathematics education research is the paucity of first-hand data collected from African American learners themselves. Very little is known about how African American learners make sense of their mathematical experiences and outcomes (Martin, 2009b, p. 22).

> Now that we know the barriers can we begin to address them? Can we take the existing educational system that…reinforces the status quo and change it to one that offers real opportunity? The answers lie within us, in our willingness to speak truth to power, to accept nothing less than *real* opportunities for all children, and to take on the responsibilities to be true to our democratic ideals. No matter where students begin, we must not let their aspirations die in the shallow end of the pool (Malcom, 2008, p. vii).

Overview of the Dissertation Study, Purpose, and Goals

The primary goal of this dissertation was to shed light on a complex and persistent phenomenon in the mathematics education pipeline: disproportionately high student enrollment rates in remedial mathematics courses—particularly among entering, African American college students. As data have indicated throughout the past few decades, African Americans and other students of color have been disproportionately "gate-kept" upon matriculation to four-year universities and relegated to courses that flank the shallowest end of the postsecondary mathematics curriculum. In Chapter 1, I discussed both the character and politics of remediation as an issue of *equitable curricular access*

for African American students—and as a thriving, inequity-reinforcing, yet equity-oriented phenomenon in the mathematics pipeline.

As I inferred in Chapter 2, this phenomenon intersects a predominating narrative in mathematics education literature that over-amplifies academic underachievement and disengagement among African American students. This deficit-laden *masternarrative* allows and encourages some to narrowly perceive this scenario as one that reflects, writ large, African American students' inferior capacities to learn mathematics and to succeed in the university system (as typically contrasted with peers of white and Asian parentage). Versions of this narrative have pervaded all areas of the mathematics education enterprise, including policy, research, institutions and classrooms, and—as the present study shows—students' own narratives about their experiences.

The purpose of this inquiry was to counter—and contribute to deposing, ultimately—this otherwise conventional narrative and probe to the level of individual, personal-level mathematics learning *experience*. The ultimate goal is to inform those who have a stake in schools and higher education institutions and encourage the equitable redistribution of attention and extant resources toward addressing this nationwide phenomenon. This study, then, focused on the distinctive experiences of African American learners in order to highlight their particular responses to this phenomenon, the conditions by which they succeeded and persisted or languished and faltered, and the factors involved therein. Toward these ends, a variety of data collection methods were used in this study: survey responses, semi-structured interviews, and classroom observations. To interpret the data, I compiled several existing frameworks based on two

central constructs: mathematics identity (-as-narrative) and mathematics engagement (-as-socialization).

Framing the Study: Mathematics Identity-as-Narrative, Socialization, and Remediation

> The theory begins with an assumption: that to sustain school success one must be identified with school achievement in the sense of its being a part of one's self-definition, a personal identity to which one is evaluatively accountable. This accountability—that good self-feelings depend in some part on good achievement—translates into sustained achievement motivation. For such an identification to form, this reasoning continues, one must perceive good prospects in the domain, that is, that one has the interests, skills, resources, and opportunities to prosper there, as well as that one belongs there, in the sense of accepted and valued in the domain. If this relationship to schooling does not form or gets broken, achievement may suffer (Steele, 1997, p. 613).

In Chapters 2 and 3, I introduced and operationalized the study's primary theoretical framework and constructs. As a way to re-represent a sociocultural view of mathematics learning experience, I relied on several theories in the mathematics education and education research literatures: mathematics identity, mathematics and student socialization, identity as a "narrative-minded" construct, and race-critical perspectives (e.g., Critical Race Theory). By merging these theories, the resulting framework parses students' narratives in ways that fully and simultaneously acknowledge the specific disciplinary context of mathematics as well as the social role of difference in African American students' learning experiences in a predominantly white university setting.

The primary theoretical claim is that identities constitute a special class of narratives, but more specifically, that identities *are* narratives. As personal identities, these narratives represent the socially circumscribed, self-defining performances of a

certain kind of person. When those narratives are (interpretable as) fundamentally about mathematics learning and evince certain themes or factors about mathematics activity or communities of practice, those narratives were regarded as mathematics identities. The themes or factors, then, represented various aspects about the teller's socialization process.

What do these theories have to do with the phenomenon being studied? In other words and with regard the primary goal of the study, do mathematics identity and socialization shed a particularly useful light on mathematics remediation? I claim that they do. Mathematics identities provide the individual-level lenses needed to personalize and contextualize the experience of being and learning in a remedial mathematics course. By exposing the factors that work to structure the nature of success and failure in these settings—along with complicating conventional perspectives that place mathematics skills or abilities at center—I hope this study highlights the personal and structural components of mathematics learning experiences for African American learners.

The Student Cases and Remedial Mathematics Education: Key Lessons from the Study

The study's primary findings are centered on the academic transitions of four, principal "case" participants. Vanessa, Cedric, Nicole, and Ruby are African American students who, before matriculating to a major, predominantly white university, were in the vanguard (in terms of achievement) of their respective high school graduating classes. Despite their respective histories of academic achievement, the students were enrolled in a remedial mathematics course during their first year at the university.

During a five-month period, I observed their course classroom, noting norms, regularly activities, and patterns of interaction among the students and instructors. To supplement the ethnographic research, I conducted a series of semi-structured interviews with each case study participant to explore their mathematics histories and then-contemporary experiences in formal and less-than-formal mathematics learning settings, and to allow students—in their own voices—to discuss the factors that influenced their mathematics education and learning trajectories.

A key finding from the study of these four students' backgrounds and experiences debunks the seemingly commonplace, anecdotal assumption that students who place in remedial mathematics courses are not motivated to learn mathematics or do not value the discipline. As newcomers to an institution that they respected (and in some cases, the institution was a multi-generational family alma mater), each student in the study was highly motivated to do well.

Vanessa and Cedric (whose narratives inform the analyses presented in Chapters 4 and 5), in particular, had both strong high school backgrounds in mathematics and deep-seated intentions to pursue careers that required considerable mathematics knowledge. Cedric aspired to become a science teacher or school counselor, had completed a course in differential calculus during his junior (third) year in high school. Vanessa, who was considering a career in medicine, completed four years of high-school mathematics, including three courses that focused on algebra content.

Although these two students were ostensibly learning in their university mathematics course, participating at high levels, and—in Vanessa's case—completing the course exams and other materials with very little actual effort, their mathematics

identities changed over the course of several months. Cedric began to openly question his capacity to learn mathematics at the undergraduate level, especially as he struggled with spending extraordinarily many hours to complete lists of repetitive exercises and complementary online modules. His focus and motivation waned. As the semester progressed, he considered changing his major concentration to one that did not require as many mathematics courses to complete. Cedric became more secretive with others about his academic trajectory; for instance, he kept his parents informed about all of his other courses, but he refused to tell them about his mathematics course—and that it was remedial.

Vanessa also began to doubt her intended trajectory, and she wondered whether a career in medicine was still attainable. Despite the ease with which she completed assignments and exams, Vanessa wrestled with the status of those achievements in relation to her peers in other courses. Over time, she began to disengage with her peers in the classroom, and in the interviews, derided their apathy, mistakes, and misconceptions.

Neither Cedric nor Vanessa indicated that the curricular content was new or unknown, and they each expressed frustration with their placement after the first few weeks of instruction. When asked about the mathematics placement exam and their experience with it, they reported strangely similar accounts and goals. In both cases, the students wanted to find a relatively "safe" place to land in the postsecondary mathematics curriculum, and attempted to subvert the exam by using the "I don't know" option during the computer-administered session. In Chapters 5 and 6, I discuss this particular finding in more detail and I draw hypothetical comparisons to similar phenomena in the literature on public opinion reporting. I inferred that the students were "satisficing"—satisfying the

requirements of the institution but sacrificing an opportunity to engage in effortful mathematical reasoning. This behavior was reinforced, too, by the lack of front-end advising and information about the nature of the course in which they were each placed.

From the study of these cases, I concluded that students' experiences in remedial mathematics courses involved much more than the attainment, maintenance, or development of mathematics skills, concepts, or procedures. Students' identities as mathematics students (or users, doers, and otherwise mathematical kinds of persons) were being actively challenged by the environment around them, and this phenomenon played out in different ways for each case participant. There was, however, a surprisingly common attribute in both their experiences—and one that seemed to mediate the relationship between who the student were as mathematical persons and how they were choosing to engage with mathematics and in the course classroom.

An Unexpected Factor: Masternarrative (Stereotype) Threat, Counternarratives, Mathematics Learning, and Implications for Future Research

> Every individual is a unique combination of countless social identities (e.g., gender, race, religion, nationality, career, etc.), and a social identity that is critical to an individual's functioning in one context can become meaningless in the next context…The social identity that is most salient to an individual's functioning in a given situation is often determined by society's attitudes toward certain identities in that setting…Many academic environments allege a race-based inability; thus, racial identity can be critical to an individual's functioning within academia—what Steele (1997) referred to as a "threat in the air" (Davies, Spencer, & Steele, 2005, p. 278).

In Chapter 4, I presented the analyzed findings of the four case participants' narratives in order to examine their mathematics identities—the discipline-specific, structurally identifiable narratives that articulate the students' senses of importance,

motivation, strategy, opportunity, constraint, and capacity vis-à-vis mathematics learning. The purpose, too, was to implicate the roles of various factors on the students' mathematics socializations as they transitioned to the (high-status) postsecondary mathematics curriculum of a major, research-intensive university.

Through a close examination of the students' narratives and respective patterns of activity in their course classroom, I discussed students' interactions with their peers, their instructors, the enacted mathematics curriculum, as well as with other, unconventional influences—with family or home community members, extracurricular support systems, and other members of the institutional community. From the many hours of interview data, I began to evince and advance a central finding: The conventional perspectives are extremely limited explanations, particularly with regard to who the students in remedial mathematics courses are (or tend to be), what supports they have, or how they choose to support their own achievement.

Although the primary subject of these conversations with the students was mathematics and the nature of their mathematics experiences, the students often discussed the intersecting nature of their various other identities (e.g., as sons or daughters, as first-generation students, as members of working-class families or communities) with their mathematics-specific identities. Most prominently, students openly discussed the racialized nature of their mathematics learning experiences—that is, what it meant to be African American in this particular mathematics-learning context. Unsurprisingly, it was clear that race was operating in very different ways in each of the students' narratives. It was surprising, however, that the students reported various sources

of these racialized mathematics identities, and the sources or contexts of the narratives had as much impact as their content.

In Chapter 5, I cite specific, extended examples from Cedric and Vanessa's narratives. I first discussed a scenario in which Cedric canvassed the campus building in which the mathematics courses were held, looking in each classroom for African American students. Through that act, I argued, he was actively searching to endorse a narrative that was emerging as a threat to his own (high-achieving) identity. This emergent narrative was not a personal one—i.e., it was not about *him*, per se—but it was a social narrative about African American students like him, students who had been placed in a remedial mathematics courses. Similarly, I also discussed a scenario in which Vanessa discusses her interactions with an institutionally supported peer group. In this setting, as Vanessa recounts, narratives about African American students in mathematics courses at the institution were rife, and she began to question the legitimacy of her own identities in contrast to those offered by her peers. In both cases, as I discussed in an analytically focused Chapter 6, the students were negotiating the threats posed by *masternarratives* about African American students in mathematics settings, a phenomenon that I compared to the oft-cited theory on stereotype threat.

Stereotype threat, a social-psychological phenomenon originally studied by Claude Steele and his colleagues (e.g., Steele 1997, 1999, 2010; with Aronson et al., 1999), was originally posed as a potential explanation for situations in which short- and long-term intellectual underperformance could be related to stereotypes. According to the theory, threats posed by a negative stereotype about an individual's group membership(s) can undermine his or her performance in a setting where the stereotype may apply. Steele

and his colleagues (and many others since) have focused on the extent to which this occurs in mathematics-specific situations, particularly in the context of mathematics assessment. Moreover,

> Steele and Aronson (1995) found, for example, that African–American college students were dramatically affected by stereotype threat conditions; they performed significantly worse than whites on a standardized test when the test was presented as a diagnosis of their intellectual abilities, but about as well as whites when the same test was presented as a nonevaluative [*sic*] problem solving task. When the test was framed as diagnostic, Steele and Aronson hypothesized, the possibility of confirming the well-known stereotype of African–American intellectual inferiority became salient, and thus disruptive. A number of studies have found that women, too, perform less well when the societal stereotype that they face—low math ability—is made relevant by experimental instructions (Aronson et al., 1999, p. 30).

While stereotype threat has been shown to apply in short-range diagnostic situations (albeit with potentially longer-term impact), does it apply to extended situations in which negative stereotypes may be consistently evoked from the same or various sources, like whole courses or other sites within university settings? That is, if a stereotype about group ability applies in a testing situation, could it also apply in a course setting—particularly when that course was implicitly or explicitly framed as a diagnostic situation of one's capacity to perform or succeed at a university? How does that process happen? What does stereotype threat look like over an extended period of time?

As the analyses of scenarios in Chapter 5 bear out, the present study engaged this set of questions directly (albeit unexpectedly). From the study of students' identity development and engagement in the context of a remedial mathematics course, I hypothesized that the relationship between identity and engagement was mediated by narratives about typical behaviors, attitudes, and other ways of being or doing based on group membership. These narratives were certainly stereotypical; instead of talk about

being a "certain kind of person" (identity), these narratives were specifying what it meant to be a *typical* kind of person—in this case, a typical kind of African American mathematics student at this particular university. But stereotypes, I observed (as others have), were "standard predicaments" of being in a setting (Steele, 2010), and they worked to structure individual-level experiences in ways that are often benign, sometimes affirming, and as we know well, sometimes threatening.

Fortunately, the study's story does not end with the prominence of racialized masternarratives in remedial mathematics course settings. Although students were facing threats to their identities as a consequence of masternarratives, these contingencies (as I refer to them in Chapter 6) were not deterministic mediators. In the face of identity threats, I observed that students also had opportunities to enact their agency in the form of counternarratives. Those counternarratives were, in Cedric's case, not only tied to the struggle for mathematics literacy for himself, but they also bore overtones of sociohistorical narratives regarding liberation for African American people (i.e., "we can succeed in mathematics" and "there are African American students who will do well"). As I observed from Vanessa's case, however, these counternarratives must be nurtured if they are to succeed in overthrowing the deeply rooted masternarratives or they may have little effect in safeguarding positively oriented identities. At times, she seemed to doubt her own demonstrated mathematics identity (as high-achieved) in the context of social activities where failure in her course was enacted and perhaps accepted by the African American students around her. Such instances transformed an intended identity-affirming counter-space into a threatening one and compromised her capacity to counter the masternarratives therein (cf. Carter, 2007).

Beyond Underperformance and Successful Practices, Toward Balance: Implications for Research on the Mathematics Educations of African American Students

> Our worst side has been so shamelessly emphasized that we are denying we have or ever had a worst side (Du Bois, 1926, p. 296).
>
> This conversation [about the achievement gap] will almost surely reinforce the national ideology of Black intellectual inferiority. And, as such, the conversation is likely to be the location of yet another narrative that further undermines how African-American students are seen by others and *by themselves*. (Perry, 2003, p. 8, as cited in Martin, 2009, p. 13; emphasis added).
>
> If we are serious about addressing equity in mathematics education, we must develop a more balanced approach for the future. A focus on advancement and the context of learning can serve as a humanizing tool in mathematics education research (Gutiérrez, 2008, p. 362).

Throughout the past several decades, there have been discernable themes—and shifts in themes—among research and commentary publications that center on African American participation in mathematics education. In Chapter 2, I charted the emergence of these themes and shifts during the 1970s and -80s, a period that followed the national "watershed decade" of the 1960s and, before that, the primary *Brown v. Board of Education of Topeka* school desegregation decisions (1954 and 1955; Allen, 1992, p. 26). In the wake of that preceding period, there was a central, recurrent theme—especially in the late-1970s and 1980s—that amplified underperformance, relatively low rates of participation, and comparatively low achievement among African American students (esp. in contrast to their white peers). In curious coincidence, this theme emerged as the measured gap between White and Black students actually narrowed, albeit temporarily (Lubienski, 2002; Tate, 1997).

During the period between 1990 and 2010—concurrent with successive social, sociocultural, and sociopolitical turns in mathematics education research—there has been a considerable shift in focus toward the nature of success among and successful pedagogical practices with African American students in mathematics. This change also concurs with events in the broader education research literature—developments like the emergence and growth of critical race theory in education and/or seemingly progressive, general attitudes toward equity, diversity, and inclusion. As a result of these convergences, researchers began to position their work among successful or high-achieving African Americans as a seemingly concerted counternarrative to a well-established and deficit-ridden perspective.

By no means, however, has this success-oriented shift put an end to deficit-oriented rhetoric. Particularly at the national level and in accordance with federal education policy (e.g., the Elementary and Secondary Education Act [No Child Left Behind]), research and commentary continues to frame assumedly objective measures of mathematics achievement as "factual and indisputable" evidence of African American students' inferiority. Even when not explicitly framed in this way, the pervasiveness of the contemporarily common "achievement-gap lens" perpetuates this myth (Gutiérrez, 2008, p. 359).

But should we trade the intergroup achievement-gap lens (or just abandon it) for one that looks exclusiveness at the nature of success among African American students, as a growing cohort of contemporary researchers seem to have done (cf. Martin, 2009c)? What, exactly, should the study of African American students in mathematics education be the study of (ibid)? Although the success-oriented counternarrative has an important

and instrumental purpose, a myopic focus on success is also problematic. Through the work of this dissertation, I contend that we should focus on the spectral nature of intragroup achievement in various types of learning scenarios, in order to better understand the broad nature of mathematics learning experience and, moreover, of *being* for African American students and other students of color. Pursuing that goal will mean engaging successful and confident students with positively oriented mathematics identities *as well as* less successful, less confident, perhaps intimidated students in the kind of close-up, intensive qualitative analyses in mathematics courses like the one that I investigated.

Affordances and Limitations of the Dissertation Study

As with any research study, there are both affordances and limitations associated with each choice made during the planning and execution of research procedures. Many of these choices, however, were not anticipated at the proposal stage, yet the results of those choices had considerable influence on the study. For a qualitative research project, in particular, these choices interact explicitly with the researcher's background, biases, assumptions, and attitudes toward the study and the participants. In this section, I detail major affordances and limitations of the dissertation.

Affordances. Among the discernable affordances, the primary one is not associated with a choice but a given, so to speak. I am African American, and the extent to which that feature shaped this project and my interactions with the participants was neither incidental nor accidental. At every stage, this commonness with the target participant group facilitated the recruitment phase, and undoubtedly catalyzed the

interview processes. Race was not the only discernable identity marker that was relevant to my interactions with study participants. The fact that I was also from a Midwestern city, had educational experiences similar to many of the participants, and had similar classed experiences also stimulated the interactions.

A second, deeply related affordance was arguably based on choice. As an African American researcher with deep commitments to the education (and mathematics education, in particular) of African American students, to public education, and to equitable access to educational opportunity and the social capitol and mobility that it enables, my ideological grounding is especially salient. Those commitments are deeply implicated vis-à-vis the structure and rationale of the dissertation study, but also implicated in my stance toward participants and their narratives. In particular, my observance and use of race-critical theoretic perspectives has also provided a distinctive lens (e.g., Ladson-Billings & Tate, 1995; Mills, 1999; Solórzano & Villalpando, 1998).

Limitations. As a qualitative study, one central limitation is the extent to which the findings can be generalized to the broader population from which the sample of participants was originally drawn. This was neither an explicit nor implicit goal of the study. Instead, I claim that this study generalizes to literature and theory—that the findings presented in this dissertation are corroborated by the work upon which it is fundamentally based. To that extent, and as I have presented in this chapter, the findings, conclusions, and implications of this study are generalizable to the extent that they are connected to research on the mathematics education of African American students, equitable access to mathematics, and masternarrative/stereotype threat in mathematics education. Furthermore, the relative size of the sample to the population further limits

any broad notions of generalizability, but the depth of the analyses do support general statements that are backed by established theories and theoretical framings.

There were other specific choices that were made that translate to limitations on the broader study. The study is limited in the variety of academic and mathematics learning experiences included. All of the participating students were high-achieving high school students, and by their own accounts, were otherwise successful first-year undergraduates. Similarly, these students were selected within a particular course section, and the choice of section could have served to limit the kinds of statements and data from students. I selected an enrichment-style course to study and not a lecture-based course. This choice was made in an effort to support the classroom observations, but it also limits the extent to which the findings may be considered for students who were did not experience this kind of course section.

Concluding Remarks

This dissertation relies fundamentally on a simple premise—and one that undergirds my philosophy as a mathematics education scholar and teacher: Every person, without exception, deserves access to great stories. We know that uncountably many social forces conspire against equitable access to comparably privileged life stories. Fortunately, investigating life stories is far beyond the scope and possible reach of this dissertation. Here, I take a much narrower lens by focusing on the narratives of mathematics learning experience, among certain types of persons and in certain kinds of settings. Given my own interests and positioning as an African American mathematics

education researcher, this study focuses on African American students and their educational experiences in remedial mathematics courses at a four-year university.

If my simple premise applies to mathematics education, specifically, I would claim that every person deserves access to great mathematics identities. We certainly know that there are severe, predictable, and chronic gaps in the opportunities to craft those identities, particularly across differences in race, gender, and socioeconomic positioning. Those gaps say nothing about what we can do as individuals, but they bellow about our capacity as a society to distribute excellence equitably. But in the same way that masternarratives recede in the face of suitably robust counternarratives, there is hope that we can produce the change that we need and seek—for all students.

APPENDICES

APPENDIX A

RESEARCH STUDY CONSENT FORM

Research Study Consent Form | Student Participant

A study of mathematics identity among students enrolled in a university remedial mathematics course

Researchers

Gregory Larnell
Doctoral Candidate
Division of Science and Mathematics Education

A-721 Wells Hall, Michigan State University
517-432-3635, larnellg@msu.edu

John (Jack) P. Smith, III
Associate Professor
Educational Psychology and Educational Technology Program
509C Erickson Hall, Michigan State University
517-353-6397, jsmith@msu.edu

Purpose

This form represents a request for your participation in a research study on remedial mathematics courses (MTH 1825 at Michigan State University). The goal of this study is to gain more understanding of students' experiences in developmental mathematics courses and to develop theories about how students experience mathematics in these courses. The study has been designed and is being conducted by a doctoral student in the Division of Science and Mathematics Education (College of Education and the College of Natural Science) to fulfill the partial requirements of a doctoral program.

Your Participation and Rights to Say "No" or Withdraw

As part of this project, you are being asked to participate in several ways. **You may refuse to answer particular questions. You may terminate your involvement in any part of this study at any time.** In other words, **you have the right to say no.**

Overview of the Study's Structure

First, the researcher will conduct focused observations of the course classroom, taking notes as he observes. You are not asked to do anything extraordinary while the researcher observes. In the course of those observations, the researcher will distribute a questionnaire that you will be asked to complete and return to the researcher. The purpose of the questionnaire is to learn help the researcher learn more about your personal and mathematics background as well as your attitudes towards mathematics. Following the questionnaire, 4-8 students will be asked to be interviewed by the researcher. The time and commitment will vary; interviews will be arranged with the researcher.

Please sign your initials if you consent to the following:

_____ I may terminate my participation in this study at any time.

_____ I give my consent to be interviewed if asked. Each interview (maximum of four) will not exceed 60 minutes. For the interviews, I also consent to be audio-recorded for research purposes only. The interview will include topics related to personal experiences in schools, mathematics education background, and mathematical tasks (i.e., doing math problems related to the course content).

Any information gathered from these interviews and used in this research will be reported under a false name (confidentiality). **You may choose not to answer specific questions or to stop participating at any time.**

_____ I agree to complete a questionnaire related to this project. None of my responses to this questionnaire will be shared with anyone associated with this course in ways that identify me. Any information gathered from my questionnaire will be reported under a false name.

_____ I give my consent for Gregory to collect copies of my homework, quizzes, or tests (or other class materials) for the study if I am asked. Complete copies of these materials will not be shared with anyone. I give Gregory permission to use portions of my work in his research, understanding that my real name will not be associated with those materials.

Potential Benefits to You

If you do choose to participate, this is an opportunity for you to reflect on your own mathematical experiences and other math-related experiences as a MTH 1825 student. Research shows that discussing academic experiences can be empowering, and our hope is that this will be an empowering experience. Over the course of the interviews, students who particulate will also be asked to talk about and do mathematics with the researcher. The mathematics will be closely related to the course material, and extra attention to the content of these interviews will reinforce what students are learning in the classroom. More broadly, this study may contribute to the understanding of student experience in these courses.

Potential Risks to You

Just as discussing academic experiences can be empowering, discussing negative experiences in mathematics can also be a potential stressor. As part of the purpose of this study, however, we are supportive of students' struggles and hope to help whenever possible. Otherwise, there are no foreseeable risks associated with participation in this study.

Privacy and Confidentiality

Any materials we collect, any interview recordings, and any personal information will be kept confidential to the maximum extent allowable by law. Data will be stored in the researcher's university office; electronic information will be password-protected and physical data (e.g., notes on paper, written materials) will be locked in a file cabinet to which only the researchers have access. Your real name will not be associated with any personal information; instead, false names will be used. The results of this study will be published and/or presented at professional meetings, but the identities of all research participants will remain anonymous.

Costs and Compensation

There is **no** financial cost to participate in this study. Similarly, you will **not** receive money or any other, formal compensation (e.g., extra credit) for participating in this study.

Contact Information for Questions and Concerns

If you have any questions about this study, such as scientific issues, your role, or to report an injury, please contact the investigators, Gregory Larnell, A-721 Wells Hall, MSU; larnellg@msu.edu; 517-432-3635 or 517-488-9957 or Dr. Jack Smith, at 517-353-6397; jsmith@msu.edu.

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, MSU, East Lansing, MI 48824.

Documentation of Informed Consent

Your signature below means that you voluntarily agree to participate in this research study. You will be given a copy of this form to keep.

_____

Student's Name (Printed)

_____

_____

Student's Signature Date

APPENDIX B

RESEARCH QUESTIONNAIRE

Research Questionnaire

This questionnaire is associated with a research study on MTH 1825-Enrichment. The goal of this study is to gain more understanding of the experiences that students have in these courses. The study has been designed and is being directed by a doctoral student in the Division of Science and Mathematics Education (College of Education and the College of Natural Science) to fulfill the partial requirements of a doctoral program course.

Your participation in this project is welcomed, but *you are not required to participate*. Also, this questionnaire is not connected to your grade or coursework in this or any courses that you are taking or may take in the future. Your responses to these items will not be shared with your instructor. By completing the survey and returning it to the administrator(s), you are volunteering your responses. There is no monetary compensation associated with this questionnaire.

Contact: Gregory V. Larnell (larnellg@msu.edu), Division of Mathematics and Science Education, Michigan State University

---

This questionnaire will be used to help us better understand the experiences of students in MTH1825-Enrichment based on your high school backgrounds and your general dispositions towards mathematics. Thank you for your willing participation. Please enter your name below. After Gregory has collected all of the questionnaires, the names will be changed to pseudonyms and your responses will no longer be associated with your true names. **You may refuse to answer any particular questions.**

NAME:

_____

E-MAIL ADDRESS or PHONE:

_____

(Please indicate the easiest way to contact you; if by phone, please indicate best times)

Thank you again!

Research Questionnaire

This questionnaire is associated with a research study on developmental mathematics courses. The goal of this study is to gain more understanding of the experiences of students taking developmental mathematics courses. The study has been designed and is being directed by a doctoral student in the Division of Science and Mathematics Education (College of Education and the College of Natural Science) to fulfill the partial requirements of a doctoral program course. The administration of this questionnaire has been approved by the Department of Mathematics. **Your participation in this project is welcomed, but *you are not required to participate*. Also, this questionnaire is not connected to your grade or coursework in this or any courses that you are taking or may take in the future. Your responses to these items will not be shared with your instructor. You may also refuse to answer any particular questions. By completing the survey and returning it to the administrator(s), you are volunteering your responses. There is neither charge nor monetary compensation associated with this questionnaire.**

Contact: Gregory V. Larnell (larnellg@msu.edu), Division of Mathematics and Science Education, Michigan State University

Please respond to the following questions.

Section 1. Personal Information and Background

1. **What is your name?** _____

2. **What is your sex?** (check all that apply) Male _____ Female_____ Other (please specify) _____

3. **With which racial/ethnic group do you identify?** (check all that apply)

_____ American Indian, Native American, or Alaska Native; please specify further if you can _____

_____ Asian or Asian-American; Please specify further if you can: _____

_____ Black (not of Hispanic origin) or African-American; Please specify further if you can: _____

_____ Hispanic, Latino, or Latino-American: Please specify further, if you can _____

_____ White (not of Hispanic origin) or Caucasian; please specify further if you can: _____

_____ Other/None of the above. Please indicate any groups with which you identify.

_____
_____

4. **Are you 18 years of age or older?** Yes _____ No _____

5. **What is your current university classification?** (Please circle your response)

   Freshman Sophomore Junior Senior (+)

6. **Were you admitted to the university under the College Achievement Admissions Program (CAAP) or any other student service programs at MSU?**

   Yes, CAAP _____ No _____ Unsure_____ Other(s): _____

7. **When did you graduate from high school?** (month/year) _____/_____

8. **When did you first enroll as an MSU student?** (month/year) _____/_____

Section 2: High School Coursework preparation

9. **How would you best describe your view of mathematics in high school**?
   I liked math. _____ Indifferent (It was ok; no big deal) _____ I disliked math: _____
   I did not have an opinion about math _____

10. **In what year(s) did you take mathematics in high school?** (Check <u>all</u> that apply.)
    Freshman_____ Sophomore_____ Junior_____ Senior_____ Additional Year(s)_____

11. **What mathematics classes did you take in high school?** (Please check all that apply and indicate the grade you earned. If a course that you took in high school is not listed here, please check the course that is closest to that course)

	Which year did you take this course? (Fresh/Soph/Jun/Sen)				**Was this course offered at your school?**			**What grade did you earn?**	
	F	So	J	Se	Yes	No	Don't Know	Grade	Don't Know
Pre-Algebra									
Algebra 1									
Algebra 2									
Geometry									
Trigonometry									
Pre-Calculus									
Functions, Trigonometry, and Statistics (FST)									
Calculus									
Statistics									
Business Math									
Technical Math									
AP Calculus									
AP Statistics									
Integrated Algebra/Geometry (IAG)									
An Integrated Math Sequence									

Section 3: Attitudes (and habits) toward mathematics

Please circle your response on a scale from 1-5 (1 is least and 5 is greatest):

	Least		**Average**		**Greatest**
12. **How would you describe your math ability?** (1=not capable; 5=very capable; 3=average)	1	2	3	4	5
13. **Do your grades accurately reflect**	1	2	3	4	5

your math abililty? (1=absolutely not; 5=definitely yes; 3=maybe/possibly)

14. **How much will mathematics play a role in your chosen field of study?** (1=none; 5=a lot/a great deal; 3=some)	1	2	3	4	5
15. **How much do you think mathematics will play a role in your everyday life?** (1=none; 5=a lot/a great deal; 3=some)	1	2	3	4	5
16. **Please rate your initial interest in the MTH 1825 course.** (1=I was never interested; 5=I was very interested)	1	2	3	4	5
17. **Please rate your interest in the topics of this course, MTH 1825.** (1=not interesting; 5=very interesting)	1	2	3	4	5

18. **Have you taken the SAT or ACT tests? If so, what were your scores in mathematics (If you can recall them)?**
SAT-Math_____ ACT-Math_____

19. **Do you think that your scores on such a test would accurately reflect your ability in mathematics?** Yes_____ No_____

On average,

20. **How many hours did you spend per week studying mathematics in high school?** (circle your response)	Never	0-1	2-3	4-5	More than 5 hours
21. **How often did you participate in class?** (circle your response)	Never	Once per week	Twice per week	3-4 times per week	Everyday

22. **Did you plan to use the Mathematics Help Room as a resource this semester?**
Yes_____ No_____

23. **Did you complete the MSU Mathematics Department Placement Exam?**
Yes_____ No_____
If yes, how did you take the exam?
On-campus with proctor_____ Online_____ Unsure_____

	Least		Average		Greatest
24. **How influential did you feel the placement exam was to your placement in the course?** (1=not influential; 5=very influential; 3=no effect)	1	2	3	4	5
25. **Do your feel the placement exam was a good indication of your knowledge about mathematics?** (1=not at all; 5=very much so; 3=maybe/possibly)	1	2	3	4	5
26. **Do you feel with better preparation your score would have improved?** (1=not at all; 5=very much so; 3=maybe)	1	2	3	4	5

27. **Is this your first time taking this course?** Yes_____ No_____
    a. If not, how many times have you taken this course previously?_____
    b. For each previous attempt, please indicate whether you dropped the course or earned a 1.0 or 0.0 in the course.
        1st attempt- drop_____ 0.0_____ 1.0_____
        2nd attempt- drop_____ 0.0_____ 1.0_____
        3rd attempt- drop_____ 0.0_____ 1.0_____

28. **What do you believe the outcome for this semester in Math 1825 will be?** (Please circle approximate grade)

    0.0 1.0 2.0 3.0 4.0

29. **What mathematics course do you plan to take next?**
    _____ Will not take any courses in math
    _____ Plan to take Math 103
    _____ Plan to take Math 1825 again
    _____ Plan to take a different math course than the ones listed here
    _____ Waiting to see what the outcome of Math 1825 is this semester (I don't know)

30. **If you are not planning to take a math class, what is the reason?**
    _____ Could not fit into your schedule
    _____ Taking a semester off from mathematics

_____ Not offering the course I want
_____ Could not get the professor I wanted
_____ No additional mathematics needed for my degree
_____ Unsure what mathematics to take next
_____ Other Please describe_____

31. **What best describes the reason for your placement in Math 1825?**

_____ I had previous exposure to the topics in this course, but needed a refresher experience before proceeding to college-level mathematics courses.

_____ I had no previous exposure to the topics in this course and this experience was to develop the skills to enter college-level mathematics courses.

_____ Neither of the above, please indicate the reason

_____
_____

_____
_____

32. **Is there anything else that you'd like to say that we didn't ask? We'd like to know!**

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE!!!!!

APPENDIX C

CASE PARTICIPANT INTERVIEW PROTOCOL SCRIPT AND QUESTION POOL

Overview of Each Interview:

Case Interview 1

- School background
- High School Math Background
- Transition from high school to MSU
- Transition to mathematics at MSU
- Overview of experience so far in MSU MATH
    - WHIM (What's happening in math class?)

Case Interview 2

- WHIM (with course-level content)
- School-Level Factors
    - Institutional Resources
        - CAAP/CAMP/OSS/UGS
        - Math Learning Center
    - Personal Resources at school-level
        - Studying and Time-on-task
    - Other resources:
        - Other Students?
        - Extracurricular Activities?
- Course-level Factors
    - General classroom engagement
    - Interaction with instructor
    - Interaction with other students
    - ALEKS

Case Interview 3

- WHIM (with tasks)
- Expectations of course outcome
- Academic Trajectory
- School-level factors (check-in)
- Course-level factors (check-in)

Case Interview 4

- WHIM (with tasks)
- Course Grades, Outcome Perception
- Self-assessment (Course)
- Self-assessment (Classrooom)
- Assess School-level Factors
- Assess Classroom-level Factors
- Assess All-Student Participation

Introduction

GL: Thanks for being here and for agreeing to participate in this series of interviews.

[IF NEEDED: My name is Greg, and I'm a Ph.D. student in the math education program. These interviews are a part of my dissertation study.]

So, let me say a few things about why we're here.

As a math education researcher, I'm interested in how students experience entry-level math courses as they transition from high school to college. I'm interested in the role that math places in your transition. So over these interviews we'll be talking about a number of related topics—talking about your past school math experiences, your school experiences more generally, how you think about math and about yourself as a math student, and how you're experiencing math in your current math course.

We'll also talk about the actual math in the course and do some math problems from time to time—mostly things that you've seen in the class and the course materials. The point of that is to just get a sense of how and what you're learning mathematically. Although our whole focus won't be on doing math, this could be seen as a chance for you to talk about and *through* any difficulties you're having or questions that you may have about the mathematical content.

[**Q:** Any questions about the study, the interviews, and your role?]

Case Participant Interview 1: (60 minutes; appr. 12 minutes for each section)

I. WARM-UP/ICE-BREAKER/ABOUT YOU

A. TELL THEM A LITTLE BIT ABOUT **ME**.
   i. 6th Year Doc Student, Math Educ;
   ii. Originally from East St. Louis, IL, a small city with social and historical similarities with Detroit, MI and other post-industrial era cities.
   iii. College outside Chicago, studied math.
   iv. Interested in improving the math experiences of African American and Latino/a students; interested in the transition from high school to college-level mathematics

B. TELL ME A LITTLE BIT ABOUT **YOU**.
   i. Tell me a little bit about WHY YOU CHOSE TO ATTEND MSU.
      1. COMMUNITY/FAMILY EXPECTATIONS to attend college? To attend MSU?

   ii. WHERE ARE YOU FROM?
      1. State(s), City, Neighborhood / home area

II. SCHOOL BACKGROUND

a. LET'S TALK ABOUT YOUR SCHOOL EXPERIENCES.
   - **i.** WHAT HIGH SCHOOL DID YOU ATTEND?
   - **ii.** HOW WOULD YOU DESCRIBE YOUR HIGH SCHOOL ACADEMICALLY?
   - **iii.** HOW WOULD YOU DESCRIBE YOURSELF ACADEMICALLY AS A HIGH SCHOOL STUDENT?

III. HIGH SCHOOL MATH BACKGROUND

a. THINK BACK TO YOUR HIGH SCHOOL MATH COURSES.
   - **i.** WHAT WERE THEY LIKE FOR YOU?
   - **ii.** WHICH WAS TOUGHEST MATH COURSE? WHY?
   - **iii.** WHICH WAS YOUR FAVORITE MATH COURSE? WHY?
   - **iv.** FAVORITE MATH TEACHER? WHY?

b. OVERALL, HOW WOULD YOU DESCRIBE YOURSELF AS A *MATH* STUDENT? What experiences in high school support that description?

IV. TRANSITION FROM HIGH SCHOOL TO MSU

a. Think back to last summer/spring, before you enrolled at MSU.
   - **i.** PLACEMENT EXAM:
     1. When did you take the placement exam?
     2. Computer? Proctored?
     3. When you learned of the outcome, what did you think about it?

     [*Include students' comments on placement from questionnaire*]

V. OVERVIEW OF EXPERIENCE SO FAR IN MSU MATH

a. WHIM (What's happening in math class?)
   - i. So far, HOW ARE YOU DOING IN THE COURSE?
   - ii. How'd you do on the (last) exam(s)/ Major assignment/ homework/ quiz?
   - iii. What's going well for you in the class?
   - iv. What's not going so well for you in the class?
   - v. What would you change about your participation in class?
     1. Ask more questions?
     2. More attentive?
     3. …how you engage the course material outside of class?
   - vi. What changes in the course would help you in the course?
     1. To the pace of the course?
     2. Interacting with other students?
     3. Interacting with instructor?
     4. Other course resources (e.g., curriculum)?

I. WHIM

a. How is it going in math class, any major events since we last spoke?

b. Can you talk about a particular time in class when you were working with another student in class? Asking a question? How did you resolve the situation?
c. How'd you do on the (last) exam(s)/ Major assignment/ homework/ quiz?
d. What's going well for you in the class?
e. What's not going so well for you in the class?
f. QUESTIONS ABOUT MATH CONTENT FROM CLASS? PAST EXAM?

II. SCHOOL-LEVEL FACTORS

a. Institutional Resources
    i. Are you enrolled in any student service academic programs on campus (e.g., CAAP/CAMP/OSS/UGS)?
        1. How often do you interact with them?
        2. Does the program do anything to help you with your math course?
        3. How would you assess the impact of this program on your success at MSU academically? In your math course?
    ii. Have you visited the Math Learning Center?
        1. Gotten help? Do you remember a particular episode that you can talk about?
        2. How often do you go?
        3. How would you assess the impact of the MLC on your success in your math course?
b. Personal Resources at school-level
    i. How often do you study for this course? (hours/day?)
    ii. How does that compare to how much you study for other courses?

III. COURSE-LEVEL FACTORS

a. Can you describe your engagement in math class? That is, can you talk a little about your mindset when you're in math class?
    i. Are you focused?
    ii. Is it hard to focus?
    iii. What do you generally do in the classroom during a class session?
b. Can you describe episode in which you interacted with the instructor? The undergraduate TA?
    i. How often do you interact with the instructor?
    ii. How would you describe the instructor's teaching?
    iii. Would you say that the way that (Instructor) teaches agree with how you learn?
c. Interaction with other students
    i.
d. ALEKS

Math Experience: Past and Current

1. TELL ME A LITTLE BIT ABOUT YOUR LAST MATH COURSE in high school?
    a. **EST 5M**
    b. Achievement (Where you'd feel like you were successful) and sense of difficulty (Where did you feel like you were challenged and struggled?).
    c. **Outcome**, describe overall experience with the math, favorite topic, least favorite topic, teacher, students

2. What was POSITIVE about that high school math course experience? NEGATIVE? How did those things influence you?
    a. **EST 3M**
3. TELL ME A LITTLE BIT ABOUT YOUR HIGH SCHOOL MATH WHAT WAS SCHOOL LIKE FOR YOU (LIKE/DISLIKE), esp. your involvement? Motivation? General grades?
    a. **EST 5 Min.**
    b. *Favorite school teacher / subject / class? Least favorite? Why?*
    c. *Complete Sentence,* In school, I was the kind of student that…

4. How is it going so far in MTH 1825 COURSE?
    a. **EST 5M**
    b. **NOTE THINGS THAT AY RELATE TO HIGH SCHOOL.**
    c. **Content of the Class.**
        i. **What's your experience…**
    d. **Instructor. Personal/Practices**
        i. **What's your experience been like interacting with….**
    e. **Interactions with other students.**
        i. **What's your experience been like interacting with….about mathematics? Socially?**
    f. Positives? Negatives?
    g. Math content: Easy? Difficult? Grades?
    h. Grades reflect effort?
    i. Describe interaction with instructor?
        i. How would you describe the instructor's style of teaching?
        ii. Similar to any teachers you've had in the past?
    j. Describe interaction with other students?

5. How do you see SIMILARITIES between your description of high school math and 1825 now? What are some DIFFERENCES?
    a. **EST 4M**
    b. **BE FLEXIBLE: HAVE THEY MENTIONED THESE ALREADY? ARE THEY ANSWERING THIS QUESTION?**
    c. **LOOK FOR BOTH PARTS OF THE DIFFERENT?**
        i. TELL ME A LITTLE BIT ABOUT HIGH SCHOOL THAT WOULD EXPLAIN THAT DIFFERENCE.
    d. Look for factors and follow re: personal effect or influence.

6. How are you doing on the CURRENT CONTENT?
    a. EST 5M
    b. Challenges?
    c. Plans for improving those?
    d. DISCUSS A HW OR TEXT PROBLEM FROM PREVIOUS, RECENT ASSIGNMENTS?

7. How was Exam 1?
    a. EST 4M
    b. Describe the outcome?
    c. How would describe the exam DIFFICULTY?
    d. Did you feel PREPARED?
        i. Describe what you did to prepare?
            1. Resources? Tutoring? Office Hours? Peer Studying?
    e. What do you need to know MATHEMATICALLY to improve upon how you did on the exam?

8. Any **SPECIFIC EXAMPLES** from Exam 1?
    a. EST 10-15M

9. (OPTION) How are you doing with ALEKS?
    a. EST 3M

10. I've been asking you a lot of questions, do you have ANY QUESTIONS FOR ME?

Other Questions

INTERVIEW 1: PERSONAL HISTORY, MATH HISTORY, SCHOOL HISTORY, FIRST IMPRESSIONS OF 1825, COURSE & CAREER TRAJECTORY, MATHEMATICS LEARNING

Personal & School Histories (40)

1. *Name. [Insert Ice-breaker if needed; Favorite word; Least favorite word]*
2. Name and describe high school.
    a. Public/Private?
    b. Size? Student population?
    c. Hometown and description.
    d. School-home relationships? School-community relationships?
3. *[Ice-breaker, if needed] Favorite in-school moment? Favorite teacher?*
4. Describe yourself as a student.
    a. What was school like for you?
    b. Studious? Hard-working? Troublemaker? Content comes easy?
    c. Describe grades?

5. What was your favorite subject in high school? Why?
6. What math courses did you take in high school [refer to questionnaire, too, but ask to reiterate]
7. Did you like math in high school? Middle school? (N)Ever? Now?
8. Highest course available?
9. Friends: math courses taken? Same course as you? If not, why? If so, did you work together?
10. Study math at home? How many hours per night? Other subjects?
11. Work with others in school on math? Out-school?
12. What were your math teachers like in high school?
13. Think back to your favorite classes in high school. What was the classroom like (i.e. what did the room look like?) Describe. Math class? Students work together? Teacher talked most? What were you like in the classroom?
14. What was the most difficult math class you took? [If not class then "time" or period] Why was it difficult?
15. What did you do to overcome this period/class/test/moment?
16. What was your final year in high school like? Curricular (i.e. courses) and extracurricular activities?
17. When did you take the placement test? Where? Computer? Proxy?
18. What was it like to take the test? Remember your score? Reaction to score?
19. Projected Major?
20. Other courses? Other commitments not mentioned?
21. Time planned to devote to studying math each week.
22. Impressions of what this course is about.
23. Courses planned to take?
24. Math courses to take next?

Segue to Math "Pre-Test" (25) **MATH QUESTIONNAIRE 1.**

Selected items from MTH 1825/103 texts and exams to compose a pre-test of items that represent mathematical content that students will be expected to know and be able to do.

The next portion of the interview is meant to take stock of what you already know, as it relates to the content of the class. These are items from a sample placement exam, and they represent

- You may or may not recognize these problems.
- If you see a problem that looks unfamiliar, we can work through it together, after you have had a chance to work through all of the problems.

Discuss from "MTHItems.pdf": [7], [8], [9], [10], [24], [25]

Prompts:

1. How do you answer this problem?
2. Talk through the steps.
3. Have you seen a problem like this? Can you remember when?
4. Where did you learn to solve it like that?

INTERVIEW 2: CONTINUED IMPRESSIONS OF 1825, CLASSROOM CLIMATE, COURSE & CAREER TRAJECTORY, MATHEMATICS CHECK-IN

General Check-in (5)

1. Acclimating?
2. Making friends?
3. How are you doing overall? In non-math courses?

Classroom climate (10)

1. So, how's it going so far in 1825?
2. If the semester ended today, what would your grade be? Satisfied?
3. If anything, what would you change about your experience in the class?
4. [If not doing well] Have you talked to [INSTRUCTOR] about this?
5. Have you talked with anyone else? Friends? Classmates? Academic Advisory?
6. Are you enrolled in CAAP? CAMP? Other such programs? Extracurricular activities?
7. Using the Math Learning Center?
8. Talk with others in class about math? [Incorporate field notes]

Continued Impressions (10 minutes)

1. What has been the most important feature of this class for you?
2. Any significant classroom moments, since we last talked? [Yes.] What was the mathematical topic? [If yes, What did the conversation entail?]
3. How is [Peer] doing in class? Are you still working with them in class? Outside of class?
4. [If needed] Do you still work with [Other Peer]?
5. Describe a particular episode that exemplifies how you work with [Peer]
6. Anything challenges so far in class? Course content?

[Include Notes/Questions from observations]

[Questions generated from Observations] (15 minutes)

Math Questionnaire 2: Rational Expressions. Factoring top and bottom to solve. (20)

Discuss: [Version of 24], [14] of "MTHItems.pdf", and versions of items generated from classroom. Mathematical items from homework? Recent quiz/test?

Prompts:

1. Can you talk about an episode in class when you first saw this problem?
2. Had you already done problems like these before? Can you recall an episode from high school in which you did problems like these? Courses? Ways to solve the problem?

INTERVIEW 3: MATHEMATICS CHECK-IN AND QUESTIONS ABOUT MATHEMATICS TRAJECTORY, HOME AND COMMITTEE LEVELS

Classroom Check-in (15)

1. How have things been going since we last talked? (GENERAL)
2. How have things been going in math class? Any particular episodes?
3. Performance on any particular assessments? Homework assignments?
4. Ask about [PEER] participant; interaction? Interactions with other students in-class?
5. Interactions with instructor?

Attitudes & Beliefs about math, school success, remedial math (10-15)

1. Overall, feelings about mathematics?
2. How much will math factor into career?
3. You "good at math"?
4. Are your friends "good at math?"
5. Are [Peers] "good at math?"
6. What's worst subject?
7. Favorite subject?
8. Where does math rank? Why?
9. Others around you like math? [Peers?]
10. Others support your feelings about math?
11. Anyone ever challenge feelings about math?
12. Family and math?

13. What does success mean for you and your life plans? That is, how does a college education figure into your long-term goals?
14. How does this course figure into your plans? Was it a surprise?

Other School-level factors (10)

1. How are other courses? Grades?
2. Any MTH students in your other courses?
3. Work with peers in other courses?

Math check-in: [Observations and Solicit questions about math content questions] *(15)*

INTERVIEW 4: COURSE-CAREER TRAJECTORY; OVERALL COURSE ASSESSMENT; OUTCOME PREDICTIONS

Check-in (15-20)

1. How are things going in math? Grades? Classroom participation?
2. Any looming issues in class before the end of the semester?
3. How are [peers] doing in class?
4. [Still] Passing? Not doing well?
5. What do you think is the source of their challenge? Your challenges? Challenges you see in the classroom?
6. How do their experiences compare to yours?

7. Have you used the MLC this semester? Instructor? (Experiences working with either)
8. Relationship with instructor?
9. Plans for end of the semester? Study schedule?
10. Give an overall assessment of your performance in course thus far.
11. Final grade prediction?
12. Feelings about that outcome?
13. How does it reflect your ability?
14. Does it reflect your effort?
15. [If passing] More math courses? [If not] Take the course again?
16. Changes to academic trajectory/plan?

MATH QUESTIONNAIRE 1. (30)

Discuss: "MTHItems.pdf"**: [1], [4]. [7], [9], [10] [13]. [14]**

REFERENCES

REFERENCES

Alexander, B.B. Burda, A.C., Millar, S.B. (1997). A Community Approach to Learning Calculus: Fostering Success for Underrepresented Ethnic Minorities in an Emerging Scholars Program. *Journal of Women and Minorities in Science and Engineering. 3*(3), 145-159.

Allen, W.R. (1992). The color of success: African American college student outcomes at predominantly White and historically Black public colleges and universities. *Harvard Educational Review, 62*(1), 26-44.

Appiah, K.A. (2005). *The Ethics of Identity.* Princeton, NJ: Princeton UP.

Apple, M.W. (1999). Do the standards go far enough? In M.W. Apple, *Power, meaning and identity: Essays in critical education.* New York: Peter Lang Publishing.

Apple, M.W. (1992). Do the standards go far enough? Power, policy, and practice in mathematics education. *Journal for Research in Mathematics Education. 23*(5), 412-431.

Asera, R. (2001). Calculus and Community: A History of the Emerging Scholars Program. New York: College Board.

Attewell, P., Lavin, D., Domina, T., Levey, T. (2006). New Evidence on College Remediation. *The Journal of Higher Education. 77*(5), 886-924.

Bamberg, M. (2010). Narrative analysis. In H. Cooper (Ed,), *APA handbook of research methods in psychology* (3 volumes). Washington, DC: APA Press.

Bamberg, M. (2004). Talk, small stories, and adolescent identities. *Human Development, 47*, 366-369.

Bassarear, T. (1986). Attitudes and beliefs about learning, about mathematics, and about self which most seriously undermine performance in mathematics courses. Paper presented at the *Annual Conference of the New England Educational Research Organization*. Rockport, ME. (ERIC Document Reproduction Service No. ED 299147)

Battista, M.T. (1994). Teacher beliefs and the reform movement of mathematics education. *Phi Delta Kappan. 75*, pp.

Berinsky, A.J. (2004). *Silent Voices: Public Opinion and Political Participation in America*. Princeton, NJ: Princeton UP.

Berry, R.Q., III. (2005). Voices of success: Descriptive portraits of two successful African American male middle school mathematics students. *Journal of African American Studies, 8*(4), 46-62.

Bettinger, E. & Long, B.T. (2005). Addressing the needs of under-prepared college students: Does college remediation work? (NBER Working Paper No. 11325). Cambridge, MA: National Bureau of Economic Research.

Boaler, J. (2002). The development of disciplinary relationships: Knowledge, practice, and identity in mathematics classrooms. *For the Learning of Mathematics. 22*(1), 42-47.

Boaler, J. & Greeno, J. (2000). Identity, agency, and knowing in mathematical worlds. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning* (pp. 171-200). Westport: Ablex Publishers.

Bogdan, R. & Biklen, S. (1998). *Qualitative Research for Education.* Needham Heights, MA: Allyn & Bacon.

Bonsangue, M.V. (1994). An efficacy study of the calculus workshop model. *CBMS Issues in Mathematics Education. 4,*117-137.

Carter, D. (2007). Why the Black kids sit together at the stairs: The role of identity-affirming counter-spaces in a predominantly White high school. *Journal of Negro Education, 76*(4), 542-554.

Carter Andrews, D. (2009). The Construction of Black High-Achiever Identities in a Predominantly White High School. *Anthropology & Education Quarterly. 40*(3), 297-317.

Cobb, P. (2004). Mathematics, Literacies, and Identity. *Reading Research Quarterly. 39*(3), 333-337.

Cobb, P., Gresalfi, M., Hodge, L.L. (2009). An interpretive scheme for analyzing the identities that students develop in mathematics classrooms. *Journal for Research in Mathematics Education. 40*(1), 40-68.

Cross, Jr., W. E., & Fhagen-Smith, P. (2001). Patterns of African American identity development: A life span perspective. In C. L. Wijeyesinghe & B. W. Jackson III (Eds.), *New perspectives on racial identity development: A theoretical and practical anthology* (pp. 243-268). New York: New York University Press.

Davies, P.G., Spencer, S.J., & Steele, C.M. (2005). Clearing the air: Identity safety moderates the effects of stereotype threat on women's leadership aspirations. *Journal of Personality and Social Psychology, 88*(2), 276-287.

De Tocqueville, A. (2004). *Democracy in America.* (A. Goldhammer, Trans.). New York, NY: Penguin. (Original works published in 1835 and 1840).

Du Bois, W.E.B. (October, 1926). Criteria of Negro Art. *The Crisis, 32*, 290-297.

Fullilove, R.E. & Treisman, P.U. (1990). Mathematics achievement among African American undergraduates at the University of California, Berkeley: An evaluation of the Mathematics Workshop Program. *The Journal of Negro Education. 59*(3), 463-478.

Grubb, W.N. (2001). From black box to Pandora's box: Evaluating remedial/developmental education. *CCRR Brief*. Number 11. New York, NY: Center for Community College Research, Teachers College, Columbia University. Retrieved December 15, 2006 from http://www.uic.edu/cuppa/gci/about/bios/documents/The%20Potential%20of%20Commu nity%20Colleges%20.pdf

Guinier, L. & Sturm, S. (Eds.) (2001). *Who's Qualified?* Boston, Beacon Press.

Gutiérrez, R. (2008). A gap-gazing fetish in mathematics education? Problematizing research on the achievement gap. *Journal for Research in Mathematics Education. 39*(4), 357-364.

Gutiérrez, R. (2007). (Re)Defining Equity: The importance of a critical perspective. In N.S. Nasir & P. Cobb (Eds.), *Improving Access to Mathematics: Equity and Diversity in the Classroom* (pp. 37-50). New York: Teachers College Press.

Gutiérrez, R. (2002). Enabling the practice of mathematics teachers in context: Toward a new equity research agenda. *Mathematical Thinking and Learning. 4*(2&3), 145-187.

Hammack, P.L. (2008). Narrative and the Cultural Psychology of Identity. *Personality and Social Psychology Review. 12*(3), 222-247.

Hill, R.O. (unpublished). On the Transition in Mathematics from High School to Michigan State University. Retrieved on December 5, 2010 from http://math.msu.edu/~hill/

Howe, R. (1998). The AMS and mathematics education: The revision of the "NCTM Standards." *Notices of the American Mathematical Society. 45*(2), 243-247.

Hoyt, J.E. & Sorenson, G.T. (1999). Promoting academic standards? The link between remedial education in college and student preparation in high school. *Department of Institutional Research & Management Studies*. Retrieved from: http://www.uvsc.edu/ir/research/hsfinal.pdf

Ignash, J.M. (1997). Who should provide postsecondary remedial/developmental education? *New Directions for Community Colleges*. (100), 5-20.

Jacobson, E. (2006). Higher placement standards increase course success but reduce program completions. *The Journal of General Education. 55*(2), 138-159.

Jackson, K. & Remillard, J. (2005). Rethinking parental involvement: African American mothers construct their roles in the mathematics education of their children. *School Community Journal, 15*(1), 51-73.

Johnson, M.L. (1984). Blacks in mathematics: A status report. *Journal for Research in Mathematics Education. 15*(2), 145-153.

Jones, L.V., Burton, N.W., Davenport, E.C., Jr. (1982). *Mathematics achievement levels of black and white youth.* (Rep. No. 165). Chapel Hill, NC: University of North Carolina, L.L. Thurstone Psychometric Laboratory.

Jones, L.V., Burton, N.W., Davenport, E.C., Jr. (1984). Monitoring the mathematics achievement of black students. *Journal for Research in Mathematics Education. 15*(2), 154-164.

Juzwik, M.M. (2006). Situating Narrative-Minded Research: A Commentary on Anna Sfard and Anna Prusak's "Telling Identities". *Educational Researcher. 35*(9), 13-21.

Kamii, M. (1990). Opening the algebra gate: Removing obstacles to success in college preparatory mathematics courses. *The Journal of Negro Education*. 59(3), 392-406.

Kilpatrick, J. (1990). Change and stability in research in mathematics education. *The Mathematics Educator. 1*(1), 31-35.

Kilpatrick, J. & Reyes, L.H. (1984). Editorial. *Journal for Research in Mathematics Education. 15*(2), 82.

King, A.E.O. (2006). Impacts of incarceration on African American families: Implications for practice. In O. Harris & R. Robin (Eds.), *Impacts of Incarceration on the African American Family.* (pp. 167-180). New Brunswick, NJ: Transaction Publishers.

Kirst, M. (1998, September 9). Bridging the Remediation Gap. *Education Week. 18*(1), 52-76.

Labov, W. (2001). Uncovering the event structure of narrative. In D. Tannen and J.E. Alatis (Eds.), *Linguistics, language, and the real world: Discourse and beyond.*

Georgetown Round Table on Languages and Linguistics. Washington, DC: Georgetown University Press.

Labov, W. (1972). *Sociolinguistic Patterns.* University of Pennsylvania Press.

Labov, W. & Waletzky, J. (2003). Narrative Analysis: Oral Versions of Personal Experience. In C.B. Paulston and G.R. Tucker, *Sociolinguistics: The Essential Readings* (pp. 74-104). San Francisco: Wiley-Blackwell.

Ladson-Billings, G. (1997a). It doesn't add up: African American students' mathematics achievement. *Journal for Research in Mathematics Education. 28*(6), 697-708.

Ladson-Billings, G. (1997b). It doesn't add up: African American students' mathematics achievement. In C.E. Malloy & L. Brader-Araje (Eds.), *Challenges in the Mathematics Education of African American Children.* Proceedings of the Benjamin Banneker Association Leadership Conference. Reston, VA: NCTM.

Ladson-Billings, G. & Tate, W.F., IV. (1995). Toward a Critical Race Theory of education. *Teachers College Record, 97*(1), 47-68.

Lazarick, L.L. (1997). Back to the basics: Remedial education. *Community College Journal. 68*(2), 11-15.

Lee, S. J. (1996). *Unraveling the "model minority" stereotype: Listening to Asian American youth*. New York: Teachers College Press.

Lee, J. (2002). Racial and ethnic achievement gap trends: Reversing the progress toward equity? *Educational Researcher, 31*(1), 3-12.

Lerman, S. (2000). The social turn in mathematics education research. In J. Boaler (Ed.), *Multiple Perspectives on Mathematics Teaching and Learning.* (pp. 19-44). Westport, CT: Ablex Publishing.

Lesik, S.A. (2006). Applying the regression-discontinuity design to infer causality with non- random assignment. *The Review of Higher Education. 30*(1), 1-19.

Linde, C. (1993). *Life Stories: The Creation of Coherence.* New York: Oxford UP.

Lindquist, M.M. (1993). President's report: Tides of change—Teachers at the helm. *Journal of Research in Mathematics Education. 24*(5), 467-476.

Lubienski, S.T. (2002). A closer look at Black-White mathematics gaps: Intersections of race and SES in NAEP achievement and instructional practices data. *Journal of Negro Education. 71*(4), 269-287.

Lubienski, S.T. (2008). On gap-gazing in mathematics education: The need for gaps analysis. *Journal of Research in Mathematics Education. 39*(4), 350-356.

Lubienski, S.T. & Bowen, A. (2000). Who's counting? A survey of mathematics education research 1982-1998. *Journal for Research in Mathematics Education. 31*(5), 626-634.

Lubienski, S.T. & Gutiérrez, R. (2008). Bridging the gaps in perspectives on equity in mathematics education. *Journal for Research in Mathematics Education. 39*(4), 365-371.

Malcom, S. (2008). Forward. In J. Margolis, *Stuck in the Shallow End: Education, Race, and Computing.* Cambridge, MA: MIT Press.

Malloy, C.E. & Brader-Araje (Eds.). (1997). Proceedings from the Benjamin Banneker Leadership Conference: *Challenges in the Mathematics Education of African American Children.* Reston, VA: NCTM.

Malloy, C.E. & Jones, M.G. (1998). An investigation of African American students' mathematical problem solving. *Journal for Research in Mathematics Education. 29*(2), 143-163.

Martin, D.B. (2009a). Researching race in mathematics education. *Teachers College Record, 111*(2), 295-338.

Martin, D.B. (2009b). Liberating the production of knowledge about African American children and mathematics. In D.B. Martin (Ed.), *Mathematics Teaching, Learning, and Liberation in the Lives of Black Children* (pp. 3-36). Florence, KY: Routledge.

Martin, D.B. (2009c) (Ed.). *Mathematics Teaching, Learning, and Liberation in the Lives of Black Children.* Florence, KY: Routledge.

Martin, D.B. (2007a). Beyond missionaries or cannibals: Who should teach mathematics to African American children? *The High School Mathematics Journal*. *91*(1), 6-28.

Martin, D.B. (2007b). Mathematics learning and participation in the African American context: The co-construction of identity in two intersecting realms of experience. In N.S. Nasir and P. Cobb (Eds.), *Improving access to mathematics: Equity and diversity in the classroom* (pp. 146-158). New York: Teachers College Press.

Martin, D.B. (2003). Hidden Assumptions and Unaddressed Questions in *Mathematics for All* Rhetoric. *The Mathematics Educator*. *13*(2), 7-21.

Martin, D.B. (2000). *Mathematics Success and Failure among African American Youth: The Roles of Sociohistorical Context, Community Forces, School Influences, and Individual Agency.* Mahwah, NJ: Erlbaum Associates.

Martin, D.B. (1998). Mathematics socialization and identity among African Americans: Community forces, school forces, and individual agency. Unpublished doctoral dissertation. University of California, Berkeley.

Martin, D.B. & McGee, E.O. (2009). Mathematics Literacy and Liberation: Knowledge Construction in African American Contexts. In B. Greer, S. Mukhophadhay, S. Nelson-Barber, & A. Powell (Eds.), *Culturally responsive mathematics education* (pp. 207-238) London: Routledge.

Matthews, L.E. (April/May, 2005). Towards Design of Clarifying Equity Messages in Mathematics Reform. *High School Journal*, 46-58.

Matthews, W. (1983). Coloring the equation: Minorities and mathematics. *Journal for Research in Mathematics Education. 14*(1), 70-72.

Matthews, W. (1984a). Introduction. *Journal for Research in Mathematics Education. 15*(2), 83.

Matthews, W. (1984b). Influences on the learning and participation of minorities in mathematics. *Journal for Research in Mathematics Education. 15*(2), 84-95.

Matthews-Lopez, J. L. (1998). Mathematics placement testing: Is it really necessary? (ERIC Document Reproduction Service No. ED 457 165).

McGee, E. (2009). *Race, Identity, and Resilience: Black College Students Negotiating Success in Mathematics and Engineering*. Unpublished doctoral dissertation. University of Illinois at Chicago.

Means, J.H. (1959). Contribution of Negroes to national mathematics magazines. *The Journal of Negro Education. 28*(1), 81-83.

Meyer, M. (1989). Equity: The missing element in recent agendas for mathematics education. *Peabody Journal of Education. 66*(2), 6-21.

Millar, S.B., et al., (1996). *A Community Approach to Learning Calculus: Fostering Success for Underrepresented Ethnic Minorities in an Emerging Scholars Program.* LEAD Center, University of Wisconsin Madison.

Miller, M.L. (2009). *Slaves to Fashion: Black Dandyism and the Styling of Black Diasporic Identity.* Durham, NC: Duke University Press.

Mills, C.W. (1997). *The Racial Contract.* Ithaca, New York: Cornell University Press.

Moreno, S.E., Muller, C., Asera, R., Wyatt, L., Epperson, J. (1999). Supporting minority mathematics achievement: The Emerging Scholars Program at the University of Texas at Austin. *Journal of Women and Minorities in Science and Engineering. 5*(1), 53-66.

Morrison, T. (1993). *The Bluest Eye.* (2nd Ed.). New York: Random House.

Moses, R.P. & Cobb, C. (2001). *Radical Equations: Civil Rights from Mississippi to the Algebra Project*. Boston: Beacon Press.

Moses, R.P., Kamii, M., Swap, S.M., & Howard, J. (1989). The Algebra Project: Organizing in the Spirit of Ella. *Harvard Educational Researcher. 59*(4), 423-443.

Nasir, N.S. (2002). Identity, goals, and learning: Mathematics in cultural practice. *Mathematical Thinking and Learning. 4*(2-3), 213-247.

Nasir, N.S. & Cobb, P. (Eds.) (2007). *Improving Access to Mathematics: Equity and Diversity in the Classroom.* New York: Teachers College Press.

National Council of Teachers of Mathematics. (2000). *Principles and Standards for School Mathematics.* Reston, VA: NCTM.

National Council of Teachers of Mathematics. (1989). *Curriculum and Evaluation Standards for School Mathematics.* Reston, VA: NCTM.

National Research Council. (2001). *Adding It Up: Helping Children Learn Mathematics.* J. Kilpatrick, J. Swafford, and B. Findell (Eds.). Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

National Research Council (1989). *Everybody Counts: A Report to the Nation on the Future of Mathematics Education.* Washington, DC: National Academy Press.

Nelson, H.L. (2001). *Damaged Identities, Narrative Repair*. Ithaca, NY: Cornell University Press.

Oakes, J. (1990a). Opportunities, achievement, and choice: Women and minority students in science and mathematics. *Review of Research in Education. 16*, 153-222.

Oakes, J. (1990b). *Multiplying inequalities: The effects of race, social class, and tracking on opportunities to learn mathematics and science*. Santa Monica, CA: RAND Corporation.

Oakes, J. (1985). *Keeping Track: How Schools Structure Inequality.* New Haven, CT: Yale University Press.

Ortiz-Franco, L. (1981). *A synthesis of selected research at NIE in mathematics education related to minorities.* Washington, DC: National Institute of Education, Learning and Development Unit. (ERIC Document Reproduction Service No, ED 210 154).

Phillips, E. & Lappan, G. (1998). Algebra: The first gate. In Larry Leutzinger (Ed.), Mathematics in the Middle (pp. 10-19). Reston, VA: National Council of Teachers of Mathematics, 1998.

Powell, L. (1990). Factors associated with the underrepresentation of African Americans in mathematics and science. *The Journal of Negro Education. 59*(3), 292-298.

Purdie-Vaughns, V., Steele, C.M., Davies, P.G., Ditlmann, R., Crosby, J.R. (2008). Social Identity Contingencies: How Diversity Cues Signal Threat or Safety for African Americans in Mainstream Institutions. *Journal of Personality and Social Psychology. 94*(4), 615-630.

Rech, J.F. (1994). A comparison of the mathematics attitudes of Black students according to grade level, gender, and academic achievement. *The Journal of Negro Education. 63*(2), 212-220.

Redovich, D. (2003). [Review of the book *Increasing Access to College: Extending Possibilities for All Students*]. *Teachers College Record. 105*(1), 50-54.

Reys, R.E. (2000). Doctorates in Mathematics Education—An acute shortage. *Notices of the American Mathematical Society*. *47*(10), 1267-1270.

Reys, R.E. & Dossey, J.A. (Eds.). (2008). *U.S. Doctorates in Mathematics Education: Developing Stewards of the Discipline.* Providence, RI: American Mathematical Society; Washington, D.C.: In cooperation with Mathematical Association of America.

Reys, R.E., Glasgow, R., Teuscher, D., & Nevels, N. (2007). Doctoral programs in mathematics education in the United States: 2007 status report. *Notices of the AMS. 54*(10), 1283-1293.

Rouche, J.E. & Hurlburt, A.S. (1968). The open-door college: The problem of the low achiever. *The Journal of Higher Education*. *39*(8): 453-56.

Rutherford, F.J. & Ahlgren, A. (1990). *Science for all Americans.* New York: Oxford University Press.

Schoenfeld, A.H. (2000). Purposes and methods of research in mathematics education. *Notices of the American Mathematical Society. 47*(6), 641-649.

Schoenfeld, A.H. (2002). Making mathematics work for all children: Issues of standards, testing, and equity. *Educational Researcher. 31*(1), 3-15.

Scheurich, J.J. & Young, M.D. (1997). Coloring epistemologies: Are our research epistemologies racially biased? *Educational Researcher. 26*(4), 4-16.

Secada, W.G. (1995). Social and critical dimensions for equity in mathematics education. In W.G. Secada, E. Fennema, and L.B. Adajian (Eds.), *New Directions for Equity in Mathematics Education.* (pp. 146-164). New York: Cambridge UP.

Secada, W.G. (1989a). Agenda setting, enlightened self-interest, and equity in mathematics education. *Peabody Journal of Education. 66*(2), 22-56.

Secada, W.G. (1989b). Educational equity versus equality in education: An alternative conception. In W.G. Secada (Ed.), *Equity in education*. London: Falmer Press.

Secada, W.G. & Meyer, M. (1989). Needed: An agenda for equity in mathematics education. *Peabody Journal of Education. 66*(2), 1-5.

Senk, S.L. & Thompson, D.R. (Eds.) (2003). *Standards-based school mathematics curricula: What are they? What do students learn?* Mahwah, NJ: Lawrence Erlbaum Associates.

Sfard, A. (2008). *Thinking as Communicating: Human Development, The Growth of Discourses, and Mathematizing*. New York: Cambridge University Press.

Sfard, A. & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. *Educational Researcher. 34*(4), 14-22.

Soliday, M. (2002). *The politics of remediation.* Pittsburg, PA: University of Pittsburgh Press.

Solórzano, D.G. & Villalpando, O. (1998). Critical Race Theory, marginality, and the experiences of students of color in higher education. In C.A. Torres and T.R. Mitchell (Eds.), *Sociology of Education: Emerging Perspectives* (pp. 211-224). Albany, New York: State University of New York Press.

Stage, F.K. & Kloosterman, P. (1995). Gender, beliefs, and achievement in remedial college- level mathematics. *The Journal of Higher Education*. *66*(3): 294-311.

Stanley, C.A. (2007). When Counter Narratives Meet Master Narratives in the Journal Editorial-Review Process. *Educational Researcher. 36*(1), 14-24.

Steele, C.M. (2010). *Whistling Vivaldi: And other clues to how stereotypes affect us.* New York: W.W. Norton & Company.

Steele, C.M. (1999). Thin ice: Stereotype threat and Black college students. *Atlantic Monthly, 248, 44-54.*

Steele, C.M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52,* 613-629.

Steele, C.M. & Aronson, J. (1995). Stereotype threat and the intellectual test performance of African Americans. *Journal of Personality and Social Psychology. 69*, 797-811.

Steele, C.M., Spencer, S.J., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In M.P. Zanna (ed.), *Advanced in experimental social psychology.* San Diego, CA: Academic Press, *34*, 379-440.

Stiff, L.V. & Harvey, W.B. (1988). On the education of Black children in mathematics. *Journal of Black Studies. 19*(2), 190-203.

Stinson, D.W. (2006). African American Male Adolescents, Schooling (and Mathematics): Deficiency, Rejection, and Achievement. *Review of Educational Research. 76*(4), 477-506.

Stinson, D.W. (2004). *African American Male Students and Achievement in School Mathematics: A Critical Postmodern Analysis of Agency*. Unpublished Doctoral Dissertation. University of Georgia.

Strutchens, M. (1990). Underachievement and underrepresentation of Black students in mathematics: A categorized list of references. *The Mathematics Educator. 1*(1), 16-20.

Tate, W.F. (1997). Race-ethnicity, SES, gender, and language proficiency in mathematics achievement: An update. *Journal of Research in Mathematics Education, 28,* 652-679.

Usiskin, Z. (2004). A significant amount of algebra. Nieuw Archief Voor Wiskunde. 5/5(2), 147- 151.

Usiskin, Z. (2007). Do we need national standards with teeth? *Educational Leadership. 65*(3), 38-42.

Weisstein, E.W. “Isomorphic.” From *MathWorld*—A Wolfram Web Resource. Retrieved on April 18, 2011 from http://mathworld.wolfram.com/Isomorphic.html.

Williams, J., Black, L., Hernandez-Martinez, P., Davis, P., Pampaka, M., Wake, G. (2008). Repertoires of Aspiration, Narratives of Identity, and Cultural Models of Mathematics in Practice. In M. César & K. Kumpulainen (Eds.), Social interactions in multicultural settings. Rotterdam, the Netherlands: Sense Publishers.

Williams, S. (2005). Roots and branches. *Journal for Research in Mathematics Education*. *36*(5), 402-403.

Williams, S. (2006). A focus on curriculum. *Journal for Research in Mathematics Education. 38*(1), 2.

Wilson, P.S., P. Mosquera, J.C., Strutchens, M.E., Thomas, A.J. (1994). *Annotated Biliography of Multicultural Issues in Mathematics Education*. Retrieved April 1, 2007 from http://math.coe.uga.edu/Multicultural/MEBib94.html

Wu, H. (2001). How to prepare students for algebra. American Educator. 25(2), 10-17.