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Race, Language, and Opportunities to Learn:  
The Mathematics Identity Negotiation of Latino/a Youth

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Abstract

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Decades of research document underperformance of Latino/a youth in mathematics, yet little is known about the day-to-day mathematics socialization of Latino/a youth. This research used qualitative case studies of two Algebra 1 classrooms and seven Latino/a focal students to document and describe two major influences on Latino/a youths' mathematics identities: their individual beliefs and their negotiation of identity in classroom settings. I proposed a three-tiered framework for mathematics identity drawing on students' self-concepts, sociocultural learning theory, and Critical Race Theory (CRT) to research the perspectives Latino/a students had about their own mathematics identities. This study focused on how Latino/a students described the role of language and race in learning mathematics, how Latino/a youth exhibited agency in their mathematics educations, and the role of different features of mathematics classrooms in negotiating their mathematics identities. Findings from students' perspectives suggest racial identity plays a role in the mathematics identity negotiation for Latino/a students in complex ways. Some students readily named stereotypes around Asian students as being high achieving, and then positioned Latino/as as lower achieving. Linguistic identity played a key role in how one pair of focal students in each classroom engaged in strategic partnerships and how they displayed agency—for one student in her own mathematics identity, and for the other student in an attempt to help her partner learn algebra. The findings from the classroom analysis suggest that attending to multiple aspects of classroom practice can provide insight into how Latino/a youth negotiate their mathematics identities in classrooms, and that the proposed aspects of classroom practice may be a useful analytic framework for classroom research. The findings contribute to important dimensions to attend to in the mathematics identity development and

classroom socialization experiences of Latino/a youth, and highlight the potential value of CRT in research on mathematics identity. The frameworks proposed could contribute to equity projects focused on the experiences of Latino/a youth and youth from other communities historically marginalized by schooling.

Keywords: identity, agency, classrooms, Critical Race Theory, Latino, Latina

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## INTRODUCTION

The sociopolitical turn signals the shift in theoretical perspectives that see knowledge, power, and identity as interwoven and arising from (and constituted within) social discourses. Adopting such a stance means uncovering the taken-for-granted rules and ways of operating that privilege some individuals and exclude others. Those who have taken the sociopolitical turn seek not just to better understand mathematics education in all of its social forms but to transform mathematics education in ways that privilege more socially just practices.

—Gutiérrez, R. (2010) *The Sociopolitical Turn in Mathematics Education*

This research is my attempt to take the “sociopolitical turn” described in the quote above from Rochelle Gutiérrez. Scholars like Gutiérrez, who strive to push conversations around equity toward examining who is privileged and who is marginalized, have had a significant influence on my work. Scholars who never back down from making explicit in their work the power dimensions related to race, language, gender, and other social identities have served as role models for me and have influenced my own research (Aguirre, 2009; Martin, 2009; Gutiérrez, 2010; Gutstein, 2006). I am also drawn to the work I do because of my own frustration about the lack of research on Latino/a students in mathematics education that both privileges their voices and critically examines the way they navigate their own mathematics learning.

My life as a Latina who positively identifies with mathematics and my experiences engaging in mathematics with mostly Mexican-immigrant Latino/a youth have surfaced equity issues which I bring to this research. I am an U.S.-born Peruvian with parents from Lima, Peru. I grew up in suburban neighborhoods in the United States where we were often the only Latino/a family. Late in high school I discovered that my love of math and skills in Spanish could be put to use tutoring younger kids. In college I participated in a one-year teaching fellowship in a classroom in Watsonville, CA, a city where a large portion of the school children are from Mexican migrant farm working families. When I started the teaching fellowship, I did not think I had a lot in common personally with the students I was working with in Watsonville, except for a common language with which to talk about mathematics. That common language, Spanish, even with our own communities’ idiosyncrasies, turned out to be a remarkably important connector. I even had the same surname as a couple of students, a reminder of the similar legacy of Spanish colonization that was perhaps one of the biggest connectors in our lives. And, maybe

most importantly, I had my own experiences of how my family had struggled to survive in this country which helped me to relate to some students who had similar circumstances. We were immigrants navigating for ourselves what it meant to be Latino/as in the United States. In similar ways, the students, myself, our families, were navigating for ourselves the different pieces of our own schooling experiences and how that impacted and was impacted by our own identities as students, as Latino/as, as whatever else mattered to our sense of self.

This dissertation contributes toward conceptualizing what matters when attending to the mathematics experiences of Latino/a youth. In this study I designed two frameworks for researching mathematics identity: one that concentrates on the conceptualization of mathematics identity itself, and the other that focuses on the layers of classroom practice that may have an impact on engagement, and through the way students engage which ultimately has an impact on their mathematics identities. The frameworks I offer and then use in this research study add to discussions in mathematics education about how to conceptualize mathematics identity in a way that takes into account the social identities of youth. In particular, this research is a response to a need to understand how linguistic and racial identities play roles in the mathematics identity negotiation of youth from communities that historically have been marginalized by institutions like schools.

Two high school Algebra 1 teachers in a highly diverse school opened up their doors of their classrooms to this research, and from two of their algebra classrooms seven Latino/a focal students participated across the 2010–2011 school year. The study focused on the perspectives Latino/a students held toward their own mathematics identities, especially the role of race or language in this negotiation, and the way they negotiated their identities over one unit of instruction in November 2011. The original intent of focusing on just one unit of instruction was to analyze any patterns in students' day-to-day engagement in their classrooms. The focus on one unit of instruction also allowed for a range of lesson types to be examined and provided a detailed capture of how students spent every minute of class time. Data sources that inform this study include student and teacher interviews from time points across the year; teacher and research audio recordings; student focus groups; classroom observations (video and

field notes); classroom task cards; and student work. During my time at this high school, I worked with most students in both classrooms on mathematics and volunteered in a study skills class where I had the opportunity to observe two focal students outside of their algebra class. Through working on homework with these two students, I was able to learn more about their mathematical thinking.

This dissertation is a unified study carved into three individual articles. Each section is conceptualized as an individual article, but because they are collected into a dissertation I make references to different sections within each section, and there is some repetition in content.

*Section 1: Latino/a Mathematics Identity as a Lens on Learning Mathematics—Literature and a Proposed Framework for Research*

This first section defines the problem of how little we know in mathematics education about how Latino/a youth come to see themselves as people who are good at mathematics and who want to pursue mathematics. This lack of research leaves educators in the dark about what impact schooling can make on both achievement patterns and motivation when it comes to Latino/a youth, and how Latino/a youth use multiple resources (in school, from home, across communities) to learn mathematics. The example included at the beginning of the first section illustrates that we lack the methodological tools as researchers and teachers to understand the complexities of the experiences of Latino/a youth. I argue that identity, though not without its drawbacks and methodological challenges, can be a construct that helps us gain insight into the complexities of experiences we wish to understand. I propose a framework for research of mathematics identity with Latino/a youth that draws on sociocultural learning theory, Critical Race Theory (CRT), including a particular sub branch of CRT called Latino Critical Theory (LatCrit). At the conclusion of Section 1, I propose three research questions to examine with this framework, which I then answer in the next two sections. The three research questions are:

1. What perspectives do Latino/a students have about their own mathematics identities, in particular how they describe the roles of language and race in learning mathematics?
2. How do these perspectives inform how students display agency in their mathematics education?

3. What role do different features of mathematics classrooms play in Latina/o students' negotiation of their mathematics identities?

*Section 2: Latino/a Students' Perspectives on Race, Language, and Learning Mathematics*

The second section examines student self-report data and analyzes the mathematics identities of these youth through the framework proposed in Section 1. This section draws out the role of CRT and LatCrit methodology to answer the first two research questions. The concept of *intersectionality* as a tenant of LatCrit is introduced as an important way to understand the way students talk about the role of race in their own identities, as well as how they understand it to matter for others. Findings suggest that racial identity matters in complex ways, and as other research suggests it can be difficult for high school students to articulate how race matters to their own identities. Some students readily named a stereotype around Asian students as being high achieving students and then positioned Latino/as as lower achieving students. Linguistic identity played a key role in how one pair of focal students in each classroom engaged in strategic partnerships. I argue that these strategic partnerships grew from the intersections of how two Latinas navigate their linguistic identities in the classroom and were ways they also displayed agency—for one student in her own mathematics identity, and for the other student in an attempt to help her friend learn math. These findings also highlight the potential of CRT in examining the mathematics identities of Latino/a youth.

*Section 3: Dimensions of Practice in the Negotiation of Latino/a Students' Mathematics Identities—Opportunities for Engagement in Two Algebra 1 Classrooms*

The third section focuses on the sociocultural level of mathematics in a particular context: the students' current mathematics classroom. This section addresses the third research question and introduces a framework for analyzing identity negotiation in classrooms through opportunities for engagement. Sociocultural learning theorists have argued that researching engagement is a way to study identity negotiation in a particular context (Nasir & Hand, 2008). I argue that attending to three key areas of classroom practices and looking for the opportunities for engagement within them is fruitful for understanding the way students navigate their mathematics identities in classrooms. These areas are (a)

the disciplinary context of mathematics, (b) the major social arrangements for engaging in mathematics, and (c) social breaches and reconciliation. Students' mathematics identity negotiation is at the intersection of who they are and how their teachers attempt to position them. Therefore conceptualizing the identity-in-context aspects of mathematics identity requires attention not just to whom the student is but also as whom the teacher or other students are attempting to position them. The findings suggest that attending to how opportunities for engagement are constructed through these three aspects of practice, and how students take them up or reject them, can be a useful way to gain insight into classroom structures that support successful negotiation of mathematics identities in classrooms. In particular for Latino/a youth, findings from these two classrooms suggest that the disciplinary context may constrain participation of emergent bilingual (EB) students if language barriers are not addressed, while social breaches should be carefully monitored for how they make the classroom a culturally welcoming place or not. These dimensions of practice are important dimensions to consider in conjunction with the major social arrangements, as these may help provide insight into how Latino/a students feel they can or cannot engage in mathematics with others, especially in high-risk situations such as speaking in front of the whole class.

In between discourses of Latino/a underachievement and policies that suppress or attack the heritage of Latino/a communities, such as the English-only policies in California and the anti-ethnic-studies policies in Arizona, there are real students making their way through the public school systems, and they can be hard to see through the statistics and media spin. The theoretical frameworks advanced in this research attempt to take into account the individual agency students display as they navigate these broader discourses of official languages and official histories, and stereotypes of school success or failure.

## **SECTION 1: Latino/a Mathematics Identity as a Lens on Learning Mathematics – Literature and a Proposed Framework for Research**

Samuel<sup>1</sup> was a high achieving Latino<sup>2</sup> student in Ms. Williams' Algebra 1 class. Having recently transferred from a school out of the district, he was mistakenly re-enrolled in algebra as a freshman, even though he had already taken and passed it as an 8<sup>th</sup> grader. He didn't mind the misplacement, saying it made his algebra class pretty easy. He also claimed he wouldn't take mathematics if school did not make him and added, "It's like you were saying before<sup>3</sup>, I'm just not a math person." Julieta was a Latina student in Ms. Williams' class who was not a high achieving student, but loved mathematics. She told me that mathematics was important for everyday life and her personal independence – to never have to rely on anyone else to figure out things for her. Julieta left school in April of the same year she was enrolled in Algebra 1, a student in danger of not graduating because of the lack of credits she had in US schools given her age. She left without her high school degree, and still loving mathematics.

These students' stories complicate traditional notions of achievement and underachievement. Julieta would be labeled an underachieving Latina, and Samuel might be recognized as higher achieving, but does not like mathematics. We might conclude from both students that they are unlikely to pursue high-level mathematics, and we might find institutional and personal reasons to explain the reasons each student might have. To make them more than statistics in the monolithic category of Latino/a, we have to look at the details of their lives that are consequential for their mathematics identities. We might ask them how they came to decide they are or are not "math people." We might also wonder how, if at all, did

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<sup>1</sup> All names are pseudonyms

<sup>2</sup> Latino/a is used in my study to denote people of Central and South American heritage in the United States. Though regarded as an ethnicity and normally termed Hispanic by the government, I follow the lead of CRT scholars like Lopez (1997) and mathematics educators like Martin (2009) and take Latino/a to denote a specific race of people who experience unique forms of oppression in the United States, even though they represent many nations and a plurality of experience. I recognize that terms such as Hispanic, Latino/a, Latin American, and others are used differently by scholars but for similar purposes – to identify a particular group of people in the US.

<sup>3</sup> Just prior to Samuel's first interview, I introduced the purpose of my study was to get at issues of how Latino/a students come to see themselves as mathematical people or not, and what implications that has for what they do in their mathematics classrooms.

experiences they had in their classrooms influence the kinds of conclusions they drew about their abilities, what mathematics is useful for, and what their own interests are in learning mathematics.

Julieta and Samuel are just two Latino/a students among the estimated 3.34 million enrolled in high school in the US (US Census Bureau, 2010). National statistics show Latino/a students have in the past and continue to trail their White and Asian peers in taking upper-level mathematics courses and performing well on standardized tests (NAEP, 2011; Tate, 1997). These statistics can position Latino/a students on the low end of a racial hierarchy of mathematics achievement, and devalue their potential as Latino/a people to contribute to society, solely because they are Latino/a (Martin, 2009). Ladson-Billings (2006) argued that instead of focusing on achievement gaps, we should consider education debts – the persistence of educational disparity over time given the overt racist practices of educators in the past and present. The idea of education debts calls our attention to how the institution of schooling has systematically marginalized many students from culturally, linguistically, and socioeconomically diverse backgrounds, increasing educational disparities. In addition, Gutiérrez (2008) argued that as researchers focus excessively on gaps, they lose the perspective of what actually goes on in classrooms, and the power-laden interactions in which Latino/a students' form lasting impressions of who can do mathematics, and who cannot. Attending to students' perspectives of their classrooms and what it means to learn mathematics addresses the problem of how under-informed mathematics educators are about the real experiences of Latino/a students that underlie the testing data. Attention needs to be paid to Latino/a students' socialization into mathematics if educators are to understand what impacts student achievement and persistence in mathematics.

Identity — who a person is within a given context (Gee, 2001) — is a useful construct to explore the socialization of students into being mathematical people. In his study on high achieving African American youth, Martin (2000) argued that a focus on identity allowed consideration of his participants' definitions of what it means to be African American in the context of learning mathematics. While scholars have studied and continue to research African American students' mathematics identities, few have taken up Latino/a mathematics identity as an explicit construct. I argue that a focus on identity

allows consideration of Latino/a students' definitions of what it means to be *Latino/a* in the context of learning mathematics. In turn, focusing on Latino/a mathematical identity highlights the intersection of who Latino/a students are as individuals, as products of a system of schooling, as well as advocates for their own mathematical destinies. These dimensions together paint a complex picture of Latino/a students as learners who bring resources from their home communities and previous schooling, while addressing dimensions of institutionalized racism as well as academic support that they encounter in classrooms.

In this section, I review the literature on mathematics classrooms and the engagement of Latino/a students, literature on identity as an analytic tool in mathematics education, and argue for a framework of mathematics identity to analyze the experiences of Latino/a youth in mathematics classrooms. This framework builds from Martin's (2000) work on mathematics identity with African American 7-9 graders, and is heavily informed by developments in sociocultural theories of identity, and Critical Race Theory (CRT) as well as Latino Critical Theory (LatCrit).<sup>4</sup> Then, I propose three research questions stemming from gaps in research with Latino/a youth and learning mathematics. The gaps I identify include a lack of literature that frames Latino/a youth as people with agency in their mathematics educations, a lack of research that includes the perspectives of Latino/a youth on their experiences learning mathematics, and a need for more research on how Latino/a students' participation in mathematics classrooms informs their mathematics identity negotiation. The proposed framework could help researchers examine the experiences of Latino/a youth from their own perspectives, as well as help researchers make sense of the classroom experiences of Latino/a youth.

### **Relevant Research on Latino/a Youth: Schooling and Learning Mathematics**

The marginalization that Latino/a youth can experience in schools is well documented in the literature (Gándara & Contreras, 2009; Gonzalez, 1997; Valenzuela, 1999). From an historical perspective, decades of unequal schooling and cultural exclusion are embedded in the histories of

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<sup>4</sup> Latino Critical Theory has been defined as a sub-branch of CRT (Solórzano & Yosso, 2001), and so I will use CRT to mean both CRT and LatCrit, and specify LatCrit when a particular scholar has identified it explicitly or to add emphasis to particular contributions from LatCrit.

institutions like public schools (Valencia, Menchaca, & Donato, 2002; MacDonald, 2004). Since the Treaty of Guadalupe Hidalgo in 1848, which made the indigenous and Hispanic students of the Mexican territories the official responsibility of the United States education system, Latino/a students have been made to feel culturally and linguistically inferior, suffering at the hands of school administrators and teachers (Valencia, Menchaca, & Donato, 2002). It is no surprise that deficit perspectives and practices that support institutional racism (some forms of tracking, for example), continue to be the reality for many Latino/a students (Oakes, 2005; Valencia, 2002). As they walk the halls or participate in class, Latino/a students can feel marginalized by choosing to speak in a language other than English at school (Suárez-Orozco, Suárez-Orozco, & Todorova, 2008). These historical and political contexts frame the experiences of Latino/a youth in schools, and so to analyze or understand the current state of Latinas/os' education requires a perspective that takes into account the social, political, and historical patterns of exclusion, degradation, and racism that permeate Latinas/os' education (Varley Gutiérrez, Willey, & Khisty, 2011, p 28).

High school settings pose particular challenges. Adolescence is an important time in a person's development, when important ideas about self are both navigated, resisted, and "thicken" over time (Wortham, 2006). Gándara and Contreras (2009) wrote that schools can feel unsafe for Latino/a youth, and that:

Even students who do not fear for their physical well-being can experience the psychological fear of being ostracized, marginalized, and excluded. Especially for adolescents, for whom the need to belong is so powerful, being excluded can be more painful and debilitating than being physically attacked. (p. 111)

They also point out that secondary teachers normally have very little time (seeing each student about fifty minutes a day) to develop authentic personal relationships with their students, so they are a serious disadvantage in breaking through the tough exterior that some Latino/a youth may have developed after years of feeling inadequate or marginalized in school. (p. 107)

Trends in marginalization of Latino/a youth have led some researchers to explore lessons from productive contexts for educating Latino/a youth. The research with Latino/a high school students and schooling has emphasized the role of connectedness. Valenzuela (1999), in her seminal ethnography of how a high school systematically marginalized second and third generation Latino/a youth in Texas, described the need for the Latino/a high school students in her study to feel connected to school and experience authentic caring. She argued that students needed to feel like school is a place where they belong before they can even begin to think about how they will get through a particular class. Gutiérrez (1999) chronicled how a high school with a high Latino/a population was helping all students succeed in mathematics through connecting with students in informal spaces (like between classes), and fostering cultural identities through practices such as encouraging bilingualism.

In higher education contexts, some scholars have argued for the utility of CRT to illuminate the experiences of Latino/a students. These scholars use the theoretical lenses of CRT and LatCrit to examine the experiences of Latino/a students as individuals who are part of a collective history of marginalization within the American school system, and who navigate broader discourses of oppression and resistance in their educations (Cammarota, 2004; Fernandez, 2002; Solórzano & Yosso, 2001; Perez Huber, 2010; Solórzano, 2001; Solórzano & Yosso, 2002; Wassell, Fernandez Hawrylak, & LaVan, 2010). Methodological tools from CRT, such as *counterstories* and *testimonio*, privilege the way individuals who belong to communities historically marginalized by institutions like schools describe their own realities. Their perspectives provide necessary counterstories to the dominant discourses of school failure and help counter stereotypes that Latino/a students are lazy or don't care about school. In addition, a tenant of LatCrit is that gender, race, language, and culture (among other aspects of social identities) should be explored as intersecting discourses in people's lives, and from this *intersectionality* we get more complete pictures of the way multiple forces shape the experiences of people of color (Yosso, Smith, Ceja, & Solórzano, 2009).

This research highlights how though situated historically as marginalized by schooling, Latino/a students can navigate school settings with success, and this progress is helped by how they feel they

belong, feel culturally supported, and feel listened to. Scholars who use CRT in their research highlight the potential promise of CRT in research with Latino/a high school students. I return to this point when presenting a framework for researching Latino/a mathematics identity.

### **Shifting the Discourse Around Latino/a Youth**

Early research on Latino/a students in mathematics education focused on the needs of limited English proficient and bilingual students as they faced challenges solving word problems, and resulted in recommendations that focused on vocabulary acquisition (Moschkovich, 2002). However, such a focus framed Latino/a students in the literature as foreign and in need of English skills, rather than attempting to understand the multiple identities Latino/a students brought to the classroom, and how they navigated both racial and linguistic identities as they learn mathematics. I also argue that a focus on the language barriers that students faced may have obscured the realities of Latino/a students who are not learning English, and made the racism or marginalization experienced in their mathematics educations invisible. The current sociopolitical turn (Gutiérrez, 2010) in mathematics education can be seen as filling a need to get past framing Latino/a youth and other youth from communities historically marginalized by school as deficient and instead focusing on how larger power dynamics are implicated in the way Latino/a youth experience learning mathematics.

Recent important contributions from scholars have been shifting the discourse around Latino/a youth's experiences in mathematics classrooms by framing Latino/a youth as people who bring resources to the classroom, who participate in multiple linguistic communities and use resources to navigate their mathematics identities. These scholars help counter deficit notions of Latino/a youth in mathematics by framing them as people with agency in their own educations, and who bring important life experiences to learning mathematics (Gutstein, 2003; Gutstein, Lipman, Hernandez, & Reyes, 1997; Moschkovich, 2002; Turner, Dominguez, Maldonado, & Empson, 2010; Turner, Gutiérrez, Simic-Muller, & Díez-Palomar, 2009; Varley Gutiérrez et al., 2011). In particular, Moschkovich (2002) argued for a

sociocultural view of Latino/a emergent bilingual (EB)<sup>5</sup> students. A focus on students as participants in multiple discourse communities counters deficit notions of Latino/a EB students as lacking English, and instead sets up their mathematics identities as people who bring resources to learning mathematics, such as ways of communicating in other discourse communities. A sociocultural view of EB students also allows for consideration of how their linguistic identities can function across settings, and the intersection of linguistic identities and mathematics identity, and how students who do not identify as learning English may still use more than one language when learning mathematics.

The shifting discourses around Latino/a youth in mathematics parallels developing interests in the field of mathematics education to use identity as a lens on learning. In the next section, I review research on three important ways identity has been conceptualized and researched in mathematics education. These studies mostly draw on sociocultural, situated, and other social theories of learning as becoming to document and describe mathematics identity.

### **Recent Research in Mathematics Identities**

Danny Martin's (2000) initial conceptualization of mathematics identity was significant in the field of mathematics education because of his contribution to theorizing and researching mathematics socialization as a *racialized* experience (Diversity in Mathematics Education Center for Learning and Teaching (DIME), 2007). He brought race to the center of mathematics identity. He also conceptualized of mathematics identity as developed over time through multiple contexts for socialization. Recently, Martin (2006) defined *mathematics identity* as:

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 or herself in the context of doing mathematics (i.e., usually

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<sup>5</sup> Garcia (2009) argues that the phrase emergent bilinguals is preferable to English Language Learner (ELL) or English learner (EL) because it recognizes the resources that students already have in a home language, and the fact that they are growing into knowing another language. Throughout this dissertation, I use emergent bilingual (EB) instead of ELL or EL.

a choice between a competent performer who is able to do mathematics or an incompetent performer unable to do mathematics, but often flowing back and forth). (pp. 206-207)

Martin's definition focuses on the way an individual comes to perceive him or herself as mathematically competent, over time and in different contexts. The phrase "use mathematics to change the conditions of their lives" could mean a number of things (such as use mathematics to change daily life, to secure a college degree to change quality of life, or to engage in civil activism). He also defines mathematics identity as contextual, though also deeply personal. Martin was concerned with how contexts influence the deeply seeded dispositions and beliefs that a person develops over time, a kind of "thickening" of who they are through socialization processes. Mathematics education scholars continue to research both the dynamic and the enduring aspects of mathematics identity (DIME, 2007). Many of these studies are informed by social theories of identity development and negotiation (Cain, Skinner, Lachiotte, & Holland, 1998; Davies & Harré, 1990; Wenger, 1998). Recent research in mathematics identity has concentrated on identity negotiation in relation to the classroom practice, discursive positioning as a form of identity negotiation, or the role of social identities (like racial, linguistic, socioeconomic, or gendered) in mathematics identity negotiation. The literature review in this section shows that though important conceptualization around identity has occurred in each of these strands, very little research attempts to understand these pieces of identity together. In particular, given Martin's important contribution, the field has much work to do in conceptualizing and researching particular intersections of identities that Latino/a students may be negotiating in school, such as their racial and linguistic identities.

#### *Mathematics Identities in Contexts*

Scholars who investigate how local contexts such as classrooms create particular opportunities to form mathematics identities have studied opportunities created by particular aspects of practice (such as norms, patterns in classroom discourse, how engagement is structured) and how they may lead to different mathematical identities and agency (Boaler & Greeno, 2000; Cobb, Gresalfi, Hodge, 2009; Gresalfi, 2009; Hand, 2009; Nasir, 2007; Nasir & Hand, 2008). For example, Boaler & Greeno (2000) interviewed students in two different calculus learning environments, one in which mathematics was

presented as many facts to memorize and apply to problems, and one in which mathematics was presented as a domain open for discussion and sense-making. Each classroom had different participation structures, with the latter classroom drawing on more discussion-intensive participation structures. They found that these qualitatively different ways of knowing mathematics across the two calculus classes accounted for how students identified or dis-identified with the domain of mathematics, with implications for whether they voiced decisions to continue studying high levels of mathematics or not. Cobb, Gresalfi, and Hodge (2009) conducted a contrasting case study to explore a framework they proposed for researching how identity is linked to the micro-culture of a classroom. They studied seventh graders in two classrooms, one algebra and one data analysis, where teachers used different participation structures. A key part of their conceptual framework on identity is this idea of normative identity, which is the identities students take on in relation to the norms of the classroom, both what it means to do mathematics and what it means to be in this classroom. One finding is that students in the data analysis class had more conceptual agency as part of their normative identity. This means that compared to their algebra classroom counterparts, they felt they had more mathematical authority within the mathematics they were learning. Even given the limitations of this study, especially the fact that it was comparing a data analysis class to algebra without acknowledging the body of research around how special a domain algebra is, the implications on the influence of learning settings on identity are interesting. Mainly, the interaction with what it meant to do mathematics and identity develop is important to note, because of a particular mechanism – norms. Latino/a students' identity negotiation has not explicitly been explored in relation to mathematical and sociomathematical norms – that is to say that the opportunities for engagement in classroom with particular mathematical norms have not been examined with Latino/a racial or ethnic identity in consideration, and the cultural ways of knowing or being that Latino students might bring to developing their normative identities.

Nasir and Hand (2008) focused on the opportunities for engagement afforded by two contrasting settings: a mathematics classroom and a basketball team. In their research, Nasir and Hand (2008) argued that for two African American male high school students, deep engagement across all three particular

aspects of a basketball “practice” was connected to the development of identities integrally tied to basketball. Conversely, “inconsistent” engagement in mathematics for these same boys lead to less opportunities for them to integrate the practice of mathematics into who they were becoming. They argue that opportunities for engagement are a promising way for researchers to understand the development of identities connected with or associated with practice, what they call “practice-linked identities.” (Nasir & Hand, 2008, p 147). However, their research did not explicitly engage the roles of these African American students’ racial identities in the formation of practice-linked identities. This suggests that though engagement may be a powerful way to understand students’ identity negotiation in particular settings such as classrooms, a more complete understanding of how students navigate their identities in relation to practices may require additional theoretical layers that provide explicit attention to racial, linguistic, or other social identities.

Few studies have focused in particular on how the disciplinary context, such as learning how to use mathematical tools to critique and address social injustice, may alter Latino/a youths’ relationship with mathematics (Gutstein, 2003; Gutstein, Lipman, Hernandez, & de los Reyes, 1997; Varley Gutiérrez, Willey, & Khisty, 2011). Gutstein's (2006) experience teaching and researching a pedagogy for social justice with Latino/a middle school students is also an example of how an alternative approach to mathematics pedagogy created opportunities for students to form new relationships with mathematics. His pedagogy involved a two-pronged approach to students being able to use mathematics to read the world (critique social injustice), and then use mathematical tools to take action and write the world (address the inequity.) A significant feature of his pedagogy was to shift what counted as mathematical knowledge – for example, political and real world contextual knowledge was now valuable in the classroom – and to shift the mathematical authority in the classroom from himself to distributed among all participants in the setting. At the end of the school year, some students wrote in their journals about how they had new appreciation for mathematics, or had come to see the utility of mathematics beyond the walls of school. Some students’ reflections may provide evidence that students felt mathematically empowered in ways they had not before. Gutstein (2006) wrote about how one important tenant of his pedagogy was to

cultivate the *cultural* identities of the youth in this classroom by helping them see, through mathematically rigorous projects, how they were situated as subjects and actors in the world, and as individuals with histories in larger social struggles. Other educators have undertaken work in a similar vein of teaching for social justice, and cultivating Latino/a students' cultural identities in the process (Turner et al., 2009). This research is an important reminder of the disciplinary context of mathematics to open up space for nurturing students' cultural identities, an under-explored area in mathematics research.

#### *Mathematics Identities as Negotiated through Discourse*

Recently, scholars in mathematics education have been attending to discourse and how discourse moves may shape or reinforce students' mathematics identities (Enyedy et al., 2008; Bishop, 2012; Turner, Dominguez, Maldonado, & Empson, 2010; Turner, Dominguez, Maldonado, & Empson, 2008). In the context of whole-class discussions, positioning theory and in particular discourse moves have been used to understand how students may participate in mathematics discussion to position themselves or others as smart (Bishop, 2012; Jansen, 2008), or how teachers attempt to position students as important mathematical thinkers through moves like revoicing or other discourse moves (O'Connor & Michaels, 1993; Turner et al., 2010; Yamakawa, Forman, & Ansell, 2009). One important reason to re-position students is to counter status issues in the classroom that may arise from status differences (Boaler, 2008; Cohen, 1986). As students make sense of their classrooms, they also decide who is good at mathematics and who is not. Equity scholars have called attention to how perceived status differences, such as the perception that someone is smarter than another student, can lead to status issues in the classroom (Boaler & Staples, 2008). Without intervention on status issues, some students may come to see themselves as not good at mathematics, and others may come to see themselves as more important and competent in mathematics. Among other methods, teachers can attempt to use their authority in the classroom to discursively position students as important thinkers and contributors to the collective endeavor of the classroom and in this way disrupt status issues. Over time, this may aid students in developing positive mathematics identities (Boaler, 2002).

Understanding how Latino/a students navigate their linguistic identities is especially important for understanding how students may attempt to position themselves discursively, or respond to the attempts teachers make to position students discursively. Turner, Dominguez, Maldonado & Empson (2010) drew on positioning theory and in particular discursive positioning to examine what particular discursive moves teachers could use to position EB Latino/a students as having mathematical authority during discussions in an afterschool mathematics club. They identified seven distinct ways that the teacher positioned students as agentive problem solvers and people with mathematical authority in the course of mathematics discussions, including privileging learning and communicating mathematics in Spanish, valuing a new strategy to solve a problem as a different contribution, positioning EB students as having a mathematical basis for his or her strategy, attributing a corrected, refined, version of strategy back to the EB student who initiated it, and clarifying ideas while maintaining the EB student in an agentive, problem-solving role. Though not a central piece of their analysis, they presented evidence from student interviews that the frequent use of these particular teacher discourse moves had positive impacts on many students' mathematics identities, with students reporting both enjoying the mathematical discussions and feeling like they came out of math club as a good mathematician. Though other features of math club may have supported the positive outcome for students in this study, the research still indicates how important public positioning of competence is for students' mathematics identities, and the range of talk moves a teacher might use to position EB Latino/a students as competent during whole-class discussions.

In small group settings, as researchers have responded to Cohen's (1994) call to unpack the "little black box" of what happens for students in small groups, discursive positioning and status have proven fruitful to help understand how students navigate peer to peer relationships. Bishop (2012) found in her study focused on the interactions of two sixth grade girls over time that patterns in the discursive moves of the two girls reinforce the view that one student was smarter than the other. Bishop (2012) found that both girls subscribed to a particular belief that one was better at math than the other, and this position was reinforced over time through actions they each took to ensure the "smarter" girl's ideas were pursued

most often in their group, among other signs of differential status leading to status issues. One important finding is that each student seemed to think that one of them being smart in mathematics and the other not was expected and typical of each others' characteristics, which may have contributed to the way they continued to position each other in the classroom.

In particular for Latino/a students, Zahner (2012) studied how two groups of bilingual Latino/a youth solved problems that required algebraic conceptual generalizations in an afterschool setting. He found that the group that engaged in more open-ended discussions marked by balanced relations of authority was also more likely to correctly solve a problem about generalizing an algebraic function, which the other group, marked by one student normally holding all the authority, did not often solve problems successfully. Zahner's work is important because it is a unique study focused on Latino/a youth that explores the performance results on how students negotiate authority in small groups, and indicates the positive potential for achievement in groups in which who is a worthy and important contributor to mathematics is distributed among group members. Still, much more research will need to be undertaken to understand how Latino/a youth navigate their mathematics identities in small group settings, and to understand the range of interaction patterns in small group settings that Latino/a students may find productive for their own engagement in mathematics.

#### *Roles of Racial Identities in Navigating Mathematics Identities*

Scholars who have explicitly looked at the role of race and ethnicity in mathematics identity development have found that racial and ethnic identities play a role in learning, both from the way teachers perceive of students, and the way students perceive of themselves and others (Martin, 2000; Nasir, 2007; Spencer, 2009). In Martin's (2000) study on mathematics identity and African American students, he interviewed 35 high achieving African American seventh, eighth and ninth graders. In his case-study profiles of seven of his participants, he discusses how their success is linked to "self-determination by opposition" - resisting dominant underachievement norms and negative labels from within the local African American community by succeeding academically and mathematically (Martin, 2000, p. 123). Thus, their identities as successful mathematicians are entwined with their identities as

African Americans. His research highlights the centrality of race and racial identities in the formation of mathematical identities among that particular population of students, with implications for the role race and racial discourses around success in mathematics may play for other students. In her study of African American students and achievement, Spencer (2009) found that the opportunities students have to develop positive mathematics identities are highly influenced by the attitudes and beliefs of the teachers, in what she calls a negotiation of internal and external forces. Researching middle school teachers in San Diego, she found that the teachers' view of students influenced the mathematical content they presented to students, disproportionately impacting learning opportunities for African American students in negative ways. Her analysis reveals that deficit views of students manifest in teacher talk during interviews, and in how teachers decide to approach teaching African American students.

Stereotypes around who can be successful in mathematics help re-affirm racial hierarchies of success in mathematics (Martin, 2009), and can contribute to underperformance of people who are interested in and knowledgeable in mathematics through "stereotype threat" (Steele, Spencer, & Aronson, 2002). Though broadly in researching schooling scholars have researched the role of racial and ethnic identities of Latino/a youth (for example, Barajas & Ronnkvist, 2007; Valenzuela, 1999), few studies in mathematics education have examined the intersections of racial identities with learning mathematics for Latino/a youth (Gutiérrez, 2002; Gutstein, 2003) and few with a methodology that privileges student voice (Jilk, 2011; Varley Gutiérrez et al., 2011). Gaps in the research for how race matters to Latino/a students in learning mathematics may be in part because race is difficult to describe in relation to your own learning, when the dominant racial script suggests race is not a barrier to anyone's ability to learn (Pollock, 2004).

One recent study used CRT methods and theoretical lenses to research the experiences learning mathematics of fifth grade Latinas. Varley Gutiérrez, Willey, and Khisty (2011) wrote about the counterstories Latina fifth graders have to add to research in mathematics education around how they make sense of their own experiences. One theme from their research is how the Latina students felt they were being short-changed in their classrooms in terms of the mathematics they were taught. They

critiqued their classrooms as lacking in rigorous mathematics, such as the request that one student made that her teacher show the class how to use pi to solve problems with circles. Not only could they critique the official curriculum, they also shared their feelings that their own bilingualism is an untapped resource in their classrooms, where the official language is English. This study is an important illustration of the utility of CRT for examining the mathematics identities of Latina youth, with implications for the utility of CRT with Latino youth. Important themes in the counterstories highlight the intersections of linguistic identity and mathematics identity, as well as how these Latina students critiqued their own opportunities to learn.

The review of research on mathematics identity shows that while many important studies have advanced theory in mathematics identity, there is still a lot of work to do in understanding how Latino/a youth navigate their mathematics identities, and the roles of racial, linguistic, and other social identities in this process. The research suggests that CRT, in addition to social and situated theories of learning, are potentially promising areas to add necessary perspectives from Latino/a youth and to bring the intersections of the discourses they navigate in their own educations to the surface. In the next section, I construct a framework for researching Latino/a mathematics identity that draws from promising research in the field on mathematics identity, and is heavily informed by CRT.

### **A Framework for Researching Latino/a Mathematics Identity**

The framework proposed here builds from seminal work on mathematics identity in Danny Martin's (2000) study of high-achieving African American students. His approach to mathematics identity serves as a foundation on which to layer important contributions from sociocultural learning theory and CRT in researching Latino/a students' mathematics identities (see Figure 1).

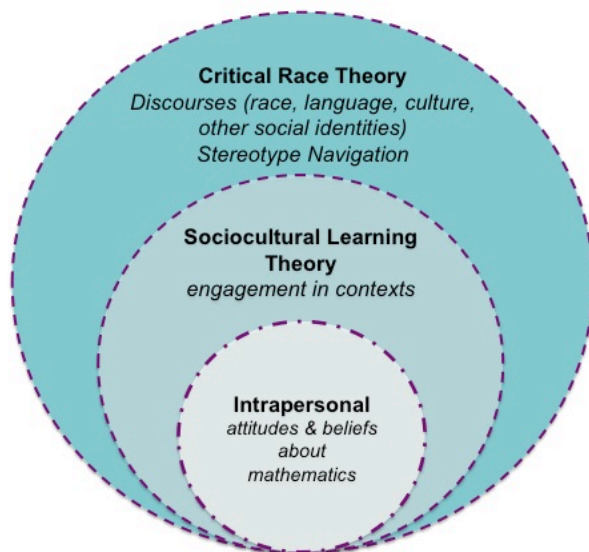


Figure 1: A Framework for Latino/a Mathematics Identity

*Level 1: Mathematics Socialization and Self-Concepts - Martin's Framework*

Martin (2000) constructed a multi-level framework from important themes that emerged from his analysis of researching academically successful African American youth in one school in a particular community in northern California. A central piece of his multi-level framework is that students' self-concepts are fundamentally important to how they navigate their identities, but that these self-concepts are developed over time and informed by multiple community and sociopolitical contexts. He proposed that African American student socialization into mathematics (ie identity development) may be impacted by distinct factors in the multiple contexts that each student navigates:

- 1) individual (or intrapersonal) factors, such as students' own developing sense of agency and self-concepts about mathematics ability,
- 2) the school context, where classes, teachers, and peers have an influence
- 3) the community context, including local views held by family members of the importance of mathematics, and positive or negative experiences family members may have had with mathematics, and
- 4) the larger sociopolitical context of education and mathematics success and failure among African Americans write large.

A key concept in his framework is that the contextual factors cannot be separated from the intrapersonal factors a student comes to take on. He wrote, “Mathematics socialization and identity formation, I claim, occur as an individual negotiates the contextual forces, opportunities, and constraints that he or she encounters, and that come to bear on that individuals’ mathematical development” (Martin, 2000, p 36). Martin argued that components of his framework are interactive, and that further research into how components relate is necessary to more fully understand the socialization processes of youth in mathematics.

Martin does not claim that his framework explains all aspects of mathematics socialization for African American youth, nor does he suggest that the framework is deterministic of outcomes for African American youth. Rather, he argued that at the individual level it was important to attend to how students displayed agency in their mathematics educations. In particular Martin argued that key areas of beliefs were important to understand how students perceived their mathematics identities: 1) beliefs about the instrumental importance of mathematics knowledge 2) beliefs about self as a mathematics learner, including goals and motivation to learn, and 3) relationships with peers and teachers, including perceptions of treatment from peers and key relationships for success. Implicated in Martin’s framework, though not explicitly addressed at the personal level, is also how students’ perceptions of themselves as learner are impacted by their racial identities. This is made more explicit in his later work, especially with African American parents reflecting on their experiences learning mathematics (Martin, 2006).

In constructing a similar framework to Latino/a youth, it would be remiss to leave out examination of their linguistic identities as well. Negotiating linguistic identities is an important area to explore with bilingual and EB Latino/a youth because of how youth draw on their linguistic resources (in Spanish and English) to learn mathematics and negotiate their identities in mathematics classrooms (Gutiérrez, 2002; Moschkovich, 2007; Varley Gutiérrez et al., 2011; Zahner & Moschkovich, 2011). I would also argue that linguistic identity negotiation is important to research for Latino/a youth who may identify as monolingual English speakers, as research suggests they may experience schooling in different ways than more recently immigrated bilingual students (Valenzuela, 1999).

Building off of Martin’s work, the proposed framework for researching mathematics identity begins from individual students perspectives on five aspects of learning mathematics that may give insight into how they are developing and negotiating their mathematics identities:

- 1) beliefs about the utility of mathematics knowledge\*
- 2) beliefs about selves as learners of mathematics\*
- 3) beliefs about the *role of race in learning mathematics*
- 4) beliefs about the *role of language (English and other) in learning mathematics*
- 5) beliefs about peer and teacher relationships in mathematics classrooms\*

Students’ perspectives on these five aspects of learning mathematics could provide the field with necessary insight into how Latino/a students perceive their own learning, and add to a lack of research on this area with Latino/a youth.

*Level 2: Contributions from Sociocultural Theory – Framing Mathematics Identity in Context*

Self-concepts are formed as students navigate mathematical contexts (Martin, 2000). But rather than focus strictly on a model that privileges internalization, recent research in mathematics identity suggests that a sociocultural view of learners as people who participate in and mutually sustain mathematical contexts may be a productive way to examine dynamic aspects of identity (Boaler & Greeno, 2000; Cobb, Gresalfi, Hodge, 2009; Gresalfi, 2009; Hand, 2009; Nasir, 2007).

Sociocultural theorists posit that learning is visible through shifts in participation in practices, and concomitant development in skills, knowledge, and identity (Lave & Wenger, 1991; Rogoff, 2003). Practices are organized in particular ways, have identifiable structures, and are also characterized by norms and conventions of participation. Because practices have aspects that are both global and local, they look different across learning settings. For example, two classrooms may both engage in teaching “mathematics” because they use the same curriculum, but one may be more discussion intensive and rely on different participations structures. What might be called “mathematics” (global) in both classrooms

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\* indicates was part of Martin’s (2000) framework

may be similar because of content, but are enacted differently (local), making the practices of mathematics different in each classroom.

Understanding a practice is key to understanding the opportunities for learning and identity development within it. This is because in sociocultural theory, identities are constructed at the intersection of the individual and social worlds. Both learning and identity are mediated through practice. Because of this, it can be hard to think about them as separate constructs. Wenger (1998) described how identity and learning are intertwined:

Because learning transforms who we are and what we can do, it is an experience of identity. It is not just an accumulation of skills and information, but a process of becoming-to become a certain person, or conversely, to avoid becoming a certain person....We accumulate skills and information, not in the abstract as ends in themselves, but in the service of an identity.” (p 215).

While identity and learning are deeply connected, is it useful to distinguish them to advance scholarship around the implications of identity in learning. In addition, other scholars provide evidence that not all learning is related to shifts in identity. In their study, Nasir and Cooks (2009) cited work by Leslie Herrenkohl and Jim Wertsch as examples of studies in which individuals appropriated culture tools, a type of learning, without taking them on internally, thus not impacting identity (see for example, Herrenkohl, 2001).

As indicated in the literature review, Nasir and Hand’s (2008) concept of “practice-linked identities” is useful to help frame how mathematics identity may develop or change over time in a mathematical context such as a classroom. Nasir and Hand (2008) identify practice-linked identities as “the sense that there is a connection between self and the activity.” Practice-linked identities are the identities that people come to take on, construct, and embrace, that are linked to participation in particular social and cultural practices (p. 147). In their study, “basketball” and “mathematics” were considered two types of practices. They wrote that it is the structure of practices themselves that afford different levels of engagement, and thus the development of different kinds of practice-linked identities. I take up their ideas of practice-linked identity as a basis for researching the sociocultural level of mathematics identity.

Nasir and Hand (2008) argued that practice-linked identities are fundamentally linked to opportunities for engagement. They wrote, “Practices, by virtue of their organization, norms, conventions, and structures afford different levels of engagement for participants, and thus differentially support the development of practice-linked identities” (Nasir & Hand, 2008, p. 147). Engagement is the mechanism through which to study relationships between people and practice, and in this case mathematics. Nasir and Hand (2008) defined three aspects of practice to study practice-linked identity in a particular context.

These three aspects are:

- 1) *opportunities to access to the domain of knowledge in the classroom* (answers the question: What opportunities does a student have to learn about the specific tasks and skills that provide access to mathematics?)
- 2) *opportunities to take on integral roles in the classroom* (answer the question: To what extent are participants held accountable for particular tasks in a practice, and to what extent are they expected to become competent and even expert in some skills or tasks?)
- 3) *opportunities for self-expression* (answers the questions: How can students be themselves, and make unique, valued contributions to class?)

By considering these three aspects of practice, Nasir and Hand (2008) argued that deep engagement across all three aspects in basketball is connected to the development of practice-linked identities in basketball. Conversely, “inconsistent” engagement in mathematics lead to less opportunities for students to integrate the practice of mathematics into who they were becoming.

In order to explore how practices afforded identities, Nasir and Cooks (2009) examined the identity resources in the practice of high school track. They drew heavily on the work of Cote & Levine (2002) who argued that individuals utilize resources as they construct identities in social settings. In the practice of track that they explored, Nasir & Cooks (2009) argued that three key categories of identity resources were made available to students on the team: material resources, relational resources, and ideational resources. The key ideas about all these resources is that they were made available in different ways through the structure of track, but not all track members took them up the same way. Examining the

presence of and differential offering of these types of resources in a mathematics classroom should also provide insight into how students take up, reject, or make available various identity resources. For example, how students interact with the material resources of task sheets or calculators would be one way to examine how their engagement with the domain of mathematics is being afforded, and examination of how they interact with peers is a way to see how they access relational resources<sup>6</sup>.

*Level Three: Intersections of Mathematics Identity, Race, Language, and Power*

Sociocultural theory of identity offers a way to think about how social sites mediate identity development, through close attention to norms, conventions, and participation. However, sociocultural theory itself is not complete for shedding light on the experiences of students of color in the public education system of the United States. A CRT perspective is necessary to challenge the dominant ideology that any educational space is race neutral, and illuminate power dynamics that colorblind perspectives obscure (Gutiérrez, 2010; Ladson-Billings & Tate, 1995; Perez Huber, 2010; Solórzano & Yosso, 2001). Martin (2009) wrote, “Dominant beliefs about who can do mathematics and who has opportunities to succeed in mathematics are informed by societal meanings for race and influenced by White-Other power dynamics” (p 297). These ideas are often constructed in an implied racial hierarchy, structured around the success of Whites and Asians, and underachievement of all other groups. Cammarota (2004) also found that when students have knowledge of dominant racial hierarchies they can engage in resistance, by doing well in school to challenge stereotypes. This is a necessary dimension of studying students of color, to acknowledge their agency in negotiating their identities. Clearly, even in the microculture of a math classroom, dominant beliefs that stem from students’ interpretations of what it means to be Latino/a as well as prevailing stereotypes about Latino/as in relation to school mathematics can play a role in the mathematical identity development of Latino/a students during the most mundane of

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<sup>6</sup> A complete framework for analysis of the sociocultural level is introduced in detail in section three of the dissertation. A parsing out of the sociocultural level was necessary to understand the particular context (their mathematics classrooms) in which the Latino/a focal students were negotiating opportunities to learn.

mathematics lessons. Consistent with a LatCrit lens, this layer of the framework informs a methodological approach to examining intersections of identities in the mathematics identity negotiation of Latino/a youth, and privileges their experiences as important sources of data from which to learn (Perez Huber, 2010; Solórzano & Yosso, 2001; Varley Gutiérrez et al., 2011).

The three-tiered framework proposed here is intended to be explored as three interactive layers on mathematics identity. It is at the intersections of these layers that we learn about who people are as mathematicians with particular beliefs and attitudes at a moment in time, or as people continuing to become the mathematicians they will be. The framework proposed here could be used to contribute to particular gaps in the literature on how Latino/a youth perceive their experiences learning mathematics, and how they navigate mathematical contexts such as classrooms.

### **A Proposed Research Agenda**

For Latino/a youth, there are many questions we may explore using such a framework. I propose two key areas for research. First, research needs to address the gaps in how Latino/a youth perceive their own experiences learning mathematics, and what they believe impacts their identity negotiation. Though research suggests students navigate stereotypes that impact their learning, we know very little about how students perceive these stereotypes and their subsequent impact on identity. This research would test the proposed framework as well as contribute to scholarly understanding of conceptualizing identity for youth from communities historically marginalized by school.

Second, we would want to look closely at how Latino/a youth negotiate their mathematics identities in classrooms. How do students enact particular identities, and for whom or in what conditions do identities “thicken” over time? How do mathematics identities shift in relation to the particular practices or mathematical content? Given the range of ways that scholars have conceptualized identity in the classroom (discursive, normative, practice-linked, etc.) there is a need for frameworks that attempt to make sense of the variety of identities in the classroom, and a need for these frameworks to attempt to bring together some of these big ideas. To contribute to research that addresses these gaps, I take up three research questions in the following articles:

- 1) What perspectives do Latino/a students have about their own mathematics identities, in particular how they describe the roles of language and race in learning mathematics?
- 2) How do these perspectives inform how students display agency in their mathematics education?
- 3) What role do different features of mathematics classrooms play in Latina/o students' negotiation of their mathematics identities?

The goals of pursuing these questions is to add to scholarship that documents mathematics identity of Latino/a students from the standpoint of research that values their perspectives and views them as people with agency, and to better understand how they navigate aspects of classroom practice that may or may not impact their mathematics identities and evolving sense of competence. My hope is that this research takes us steps in the right direction of learning from students like Julieta and Samuel, to understand how they came to see themselves as people with different relationships with mathematics, and how they will think of themselves in the future.

## **SECTION 2: Latino/a Students' Perspectives on Race, Language, and Learning Mathematics**

The underachievement of Latino/a students in mathematics is often framed as a testing outcome as though race were a determining factor, and rarely explored from the point of view of what Latino/a students experience in mathematics classrooms (Gutiérrez, 2008; Martin, 2009). Further, research that accounts for the experiences of Latino/a youth in mathematics classrooms rarely analyzes their perspectives as learners of mathematics, nor positions them as having agency in their own mathematics educations (Gutiérrez, 2008). In particular, while research and modern theories of learner identities suggest that language and race matter in development of mathematics identities for students who have been historically marginalized by systemic inequalities (Martin, 2007; Spencer, 2009; Turner, Dominguez, Maldonado, & Empson, 2010), the perspectives of Latino/a youth on these issues are rarely examined in research (notable recent exceptions on linguistic identity in (Gutstein, 2003; Moschkovich, 2002; Turner, Celedón-Pattichis, & Marshall, 2008; Turner, Gutiérrez, Simic-Muller, & Díez-Palomar, 2009; Zahner & Moschkovich, 2011), and even more rarely in ways that explore the plurality of experiences that make up the monolithic category of “Latino/a”. When it comes to Latino/a youth and learning mathematics, what we know from current research is an incomplete picture about how they navigate their mathematics identities, especially when it comes to articulating the roles of their racial and linguistic identities in their learning. This work may be especially timely in the midst of anti-immigrant legislation in Arizona and Alabama that position Latino/a people as illegal and a threat on this country (read: violent), raising questions about the kinds of stereotypes students must navigate as they pursue their mathematics educations.

In this section, I present findings on being a learner of mathematics from the perspectives of seven Latino/a focal students in two Algebra 1 classrooms. I analyzed interviews and focus group data using an analytic framework derived from the work of Martin (2000) and scholars who research Latino/a youth in culturally responsive ways (Gutiérrez, 2002; Moschkovich, 2002; Turner et al., 2010; Varley Gutiérrez et al., 2011; Zahner & Moschkovich, 2011), and scholars who use Critical Race Theory (CRT) and Latino Critical Theories (LatCrit) (Perez Huber, 2010; Solórzano & Yosso, 2001; Wassell,

Fernandez Hawrylak, & LaVan, 2010; Yosso, Smith, Ceja, & Solórzano, 2009). In this analysis, I privileged the voices of Latino/a youth (Varley Gutiérrez et al., 2011). I discuss implications from this research for mathematics researchers and teachers. This analysis explored the following research questions:

- 1) What perspectives do Latino/a students have about their own mathematics identities, in particular how they describe the roles of language and race in learning mathematics?
- 2) How do these perspectives inform how students display agency in their mathematics education?

Agency as used in this study is the initiative that students take in navigating their own education, given their personal goals, within the affordances and constraints of school. In this way, agency can be attributed to students through actions they take to change the circumstances of their own learning. However, as a sociocultural perspective underlies this work, individual agency is negotiated in particular contexts (Cain, Skinner, Lachiotte, & Holland, 1998). For example, students' relationships in classrooms with other students are clearly maintained by multiple factors (mutual engagement, mutual willingness to work, teachers structuring collaborative work time, etc.) However, the initiative taken by a particular student can still be documented. This documentation is also particularly necessary in the literature on Latino/a youth and mathematics, as we seek to understand the connections between how they make sense of their own experiences and how they feel empowered to act within them to learn mathematics.

### **Relevant Literature**

The analysis presented here draws from three important literature bases that inform the experiences of Latino/a students in learning mathematics. First, student voice is an important to literature base to understand how the experiences of youth are treated in research. Next, I review scholarship using Critical Race Theory (CRT) and Latino Critical Theory (LatCrit) methodology to research undergraduate and graduate student experience, and consider how this literature informs research with high school students. In addition, the literature on how racial identities have been situated in mathematics identities

guides this study, as well as research on how emergent bilingual<sup>7</sup> students and Latino/as proficient in multiple languages learn mathematics.

### **Student Voice and *Testimonio***

Scholars who focus on issues of urban education reform have argued that students' voices are necessary to inform processes that are consequential for youth, however, they are often missing or marginalized (Lopez, Wishard, Gallimore, & Rivera, 2006; Phillips, 2011; Rubin & Silva, 200; Taines, 2012). Taines (2012) found in her research with urban youth involved in school reform that students often bring up "trivial" aspects of school that matter most to them, such as school lunch and how clean the bathrooms are. These seemingly trivial comments indicate a much deeper evaluation of the school as an institution that did not see the students as having a right to good meals and clean bathrooms, and thus the students felt devalued (Taines, 2012). Her research is an example of how only by listening to the perspectives of students and unpacking their concerns do we gain necessary insight into their daily realities, and learn how they see the issues that educators and policy makers may perceive differently.

Some scholars who specifically engage in the work of listening to Latino/a students use the theoretical lenses of Critical Race Theory (CRT) and Latino Critical Theories (LatCrit) to examine the experiences of Latino/a students as individuals who are part of a collective history of marginalization within the American school system, and who navigate broader discourses of oppression and resistance in their educations (Camarota, 2004; Fernandez, 2002; Solórzano & Yosso, 2001; Perez Huber, 2010; Solórzano, 2001; Solórzano & Yosso, 2002; Wassell, Fernandez Hawrylak, & LaVan, 2010). Solórzano and Yosso (2002) have outlined what they call a 'critical race methodology' for education which focuses on the stories and experiences of students of color. They propose that the *counterstories* offered by students of color can be used as a tool for exposing, analyzing and challenging the majoritarian stories of racial privilege. A tenant of LatCrit is that gender, race, language, and culture (among other aspects of

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<sup>7</sup> Garcia (2009) argues that the phrase emergent bilinguals is preferable to English Language Learner (ELL) or English learner (EL) because it recognizes the resources that students already have in a home language, and the fact that they are growing into knowing another language. In this article, I use emergent bilingual (EB) instead of ELL or EL.

social identities) should be explored as intersecting discourses in people's lives, and from this *intersectionality* we get more complete pictures of the way multiple forces shape the experiences of people of color (Yosso et al., 2009). Fernandez (2002) analyzed the narrative of one Latino to understand resistance to schooling. Pablo, in college in the Midwest, grew up speaking mostly Spanish, in English-dominant settings with white teachers. Over multiple interviews while enrolled as a college student, he reflected on his experiences in high school. His perspective revealed multiple experiences of racism across his schooling experiences, including low expectations from his predominantly white teachers. Fernandez argued that, from a LatCrit standpoint, Pablo's negative experiences in school in part describe the initiative he took to spend his time the way he wanted, often seeking alternative engagement by cutting class. She frames this initiative as *resistance* to schooling practices. In his experiences, the intersectionality of his gendered and racialized identities as a Latino male, and how he was narrated by his teacher who held low expectations, contributed to his personal experience of marginalization, and as a result the agency he showed in resisting schooling by cutting class. The analyses of LatCrit scholars in education highlight student resistance to schools as institutions that were never designed to support their identities and cultures from the beginning, and how Latino/a students show agency in both how they succeed and how they may resist schooling practices. In this way, researchers who employ CRT and LatCrit lenses help to push back against deficit views of Latino/a youth by framing their activity as *productive resistance*, or resistance that has purpose that serve the individual needs of the student in the context of a system that was not designed with their best interests in mind. Despite almost twenty years since the publication of Ladson-Billings and Tate's (1995) outlining of a Critical Race Theory for education write large, CRT and LatCrit lenses on the narratives of Latino/a high school students' are underutilized in the literature on Latino/a youth in mathematics. CRT remains largely absent from classroom analyses. In particular, intersectionality as described in LatCrit has been missing in research on Latino/a mathematics identity.

### **Racial Identities in Learning Mathematics**

Within the field of mathematics education, scholars have documented the perspectives of students towards mathematics and how students navigate the perceived values of mathematics itself, and also larger discourses of who can be successful in mathematics (Barajas-Lopez, 2009; Boaler & Greeno, 2000; Jansen, 2008; Martin, 2000; McGee & Martin, 2011). However, as Esmonde (2009) wrote in a recent literature review, identity has been increasingly employed in research in the field of mathematics education but scholars have not dealt adequately with the role of socially constructed identities – either ignoring them or focusing on them as pre-determining factors in student learning.

Though broadly in the examination of schooling scholars have researched the role of racial and ethnic<sup>8</sup> identities of Latino/a youth (for example, Barajas & Ronnkvist, 2007; Valenzuela, 1999), few studies in mathematics education have examined the intersections of racial identities with learning mathematics for Latino/a youth (Gutiérrez, 2002; Gutstein, 2003) and few with a methodology that privileges student voice (Jilk, 2011; Varley Gutiérrez et al., 2011). Jilk (2011) is a notable exception. Her research focused on the mathematics identities of Latinas in high school. Focusing on the case of one student, Amelia, she situates salient identity as negotiated across multiple communities of practice. Using a narrative approach, Jilk discussed how Amelia's self-description as a "liberal," someone who willingly expressed her opinions and authored her own destiny, allowed her to choose to participate in the way mathematics was taught at her school because the practices aligned with this salient piece of her identity. Jilk argues that beyond the intersection of identity and mathematical practices was the fact that Amelia displayed agency in participating in her mathematics class, acting on the perceived intersections of her identity and the practices found in her classroom at Railside.

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<sup>8</sup> Whether the label "Latino" constitutes a racial, cultural, ethnic, or other identity has been debated over time in the United States, with scholars taking different positions. Scholars have been working through how to write about the intersectionality of multiple identities (gendered, political, historical, situated) that can describe the experiences of Latino/a people (Anzaldúa, 2000; Valle & Torres, 2000). Scholars concerned with this plurality note we have yet to capture the "fluid and transformable" essence of Latino/a identities (Estela Zarate, Bhimji, & Reese, 2005, p. 97). In this study, I use race and ethnicity where adopted by scholars in discussing their literature, but adopt the language of race in my own analysis (see Lopez, 1997).

Jilk's (2011) research is also a reminder that what is most salient to students about their identities may not be the neatly packaged macrolabels that are often of interest to us as researchers: gender, class, race, etc. However, there is still a need to understand how these dimensions are perceived by students as they negotiate their mathematics educations (Martin, 2009), because they have been documented to be real barriers to school success, motivational factors for academic achievement, and catalysts for social action such as school walk outs (McGee & Martin, 2011; Rivas & Chavous, 2007; Solórzano & Delgado Bernal, 2001; Steele, 1997). Scholars have documented the stereotypes that Latino/a students face in schools that serve to position them as violent, illegal, and alien (Solórzano, 1997) At the same time, stereotypes around Asian students' high achievement in mathematics simultaneously essentialize Asian students (Lee, 2009), as well as position Latino/a students as less-capable (Martin, 2009).

Martin's (2000) seminal study of successful African American students' mathematics identities and subsequent research publications are notable exceptions to a superficial use of race as a variable in research. Through interviews with high achieving seventh, eighth and ninth graders, Martin contributed to new insights into how students are socialized into being mathematics learners. He found that common across his students' experiences were how they spoke to a high level of achievement orientation, high levels of confidence in their own abilities in mathematics, and positive feelings for teachers. He also found that successful African American students aligned themselves with successful peers and were critical of peers who did not do as well in mathematics. However, he also found that as they navigated what success meant for themselves, they experienced alienation from some African American peers, who may not have known how to treat their high achieving friends. What Martin did was bring racial identity front and center to mathematics achievement, which was lacking in the field of mathematics education. His multilayered framework examining the multiple contexts that impacted African American students' socialization into mathematics, and pushed scholarship in mathematics identity to examine the historical positioning of students as people with racial identities who navigate racial stereotypes and racialized hierarchies of success.

Stereotypes around who can be successful in mathematics help re-affirm racial hierarchies of success in mathematics (Martin, 2009), and can contribute to underperformance of people who are interested in and knowledgeable in mathematics through “stereotype threat” (Steele, Spencer, & Aronson, 2002). Recently, McGee and Martin (2011) examined how Black mathematics and engineering college students navigate stereotypes of achievement in their academic programs. They note that despite a great deal of evidence that stereotype threat can negatively affect intellectual performance, “Little is known about how Black students in particular manage racial stereotypes,” including using them as motivating factors (p. 1349). McGee and Martin argue that as Blackness is constructed on students’ own terms, the navigation of stereotypes is not predetermined. Rather, students may use the knowledge of the negative stereotype as the impetus to display positive agency and defy it. In their study, Cory was an undergraduate in mathematics who planned to be a mathematics professor. He reported:

Even if they don’t say it [what’s this Black guy doing in this upper-level mathematics class], I think it to myself some times, I think it’s motivation for me to do better. I mean, when I walk into a class I’m like ‘oh yeah okay, now I get to prove something to these people.’ I mean basically it’s the motivation to myself. (p. 1367)

The research by scholars focused on African American students illuminates important intersections between large discourses of African American students achievement and the success of African American students in mathematics. There is a gap in similar research for Latino/a youth.

Gaps in the research for how race matters to Latino/a students in learning mathematics may be in part because race is difficult to describe in relation to your own learning, when the dominant racial script suggests race is not a barrier to anyone’s ability to learn (Pollock, 2004). In her ethnography of the multi-lingual and multi-ethnic California high school (called Columbus in her book), Mica Pollock (2004) elaborates on what she calls “the reality of race’s fluctuating relevance to [students] own relationships and lives.” (p. 47). Pollock’s (2004) detailed ethnography showed that neither adults or students consistently spoke to a singular way that race mattered in navigating school, rather race’s relevance to students’ lives was complicated. On the one hand, students may give canned colorblind perspectives of “we are all the

same” when asked directly how race impacted their lives or “race is important” canned response without elaboration. On the other hand, their everyday talk peer to peer, about peers, or to teachers revealed deviations from the racial scripts of how race is or is not supposed to matter. Though summarizing the complexities that took Pollock an entire ethnographic study to explore does not do her work justice, an important take away from this work is that race talk was complicated and situational for students and teachers, and conspicuously absent from teacher-to-student talk even though teacher-student conflict at times “felt” racialized (p. 61).

In my own previous research interviewing Latino/a high school youth (Zavala, 2009), I found that students were challenged to articulate how their racial identity mattered in the context of learning mathematics. Similar to Pollock (2004), my participants preferred to take personal stances that portray mathematics achievement as a whole as Colorblind (Bonilla-Silva, 2006), making statements such as, “My teacher doesn’t care. We all learn” or, “[Race] doesn’t matter. Like anyone can learn mathematics, you just have to want to learn.” The main idea was that race should not be seen as a barrier. One student described his racial identity in a more complex way, and also provides an example of how US-born status may intersect with racial identity as students navigate their mathematics identities. Andrew, an English-dominant, American-born Latino student with Mexican parents, prone to short explanations and self-described as sometimes “spacing out” in math class, described how in his school he negotiated feeling at times like a “white guy” when compared to dominant forms of “being Mexican” he perceived at his school:

Well, I don't show a lot of Mexican stuff, at all. Being Mexican, I *am* Mexican, but I just don't wear the Los Angeles t-shirts and baggy jeans and stuff like that, like all the Mexican do here. I'm just another type of Mexican, that looks like, I guess, a white guy. Yeah, like being a Mexican-American, but myself and mostly leaning towards the American part, I guess. (Andrew, Interview 4, January 2009)

In describing who he is as a Mexican-American, Andrew addressed intersections of “being himself” with racial identities and his identity as an American. He notices that he doesn’t look like what he perceives as

being the typical Mexican at his school, but still claims his Mexican heritage, refusing to choose and instead claiming both his Mexican and American identities, for which he evokes the dominant discourse that Americans are white. Andrew's case highlights how important intersectionality is as a lens on how Latino/a students make sense of their experiences as learners, with implications for the kind of research necessary to further understand intersections of racial identity and mathematics identity for Latino/a youth.

### **Linguistic Identities and Learning Mathematics**

It is well established in the literature on Latino/a students who are emergent bilinguals (EB) that when students work in their first language they can appear to be more engaged in mathematics, and have greater access to the mathematics (Gutiérrez, 2002; Gutstein, Lipman, Hernandez, & de los Reyes, 1997; Khisty, 1995; Moschkovich, 2002, 2007; Turner et al., 2010; Zahner & Moschkovich, 2011). In Rochelle Gutiérrez's (2002) study of a high school math department with a track record of success for Latino/a students, she found that part of the success of the department could be attributed to policies that promoted and fostered learning mathematics in Spanish for students who preferred it. She also found that other strategies typically present in elementary school classrooms, like having students work in groups, were also strategies for success in this high school. Her work is especially important because it's one of few studies focusing on how EB Latino/a youth learn mathematics in a high school setting. However, her participants, though bilingual, were English-dominant.

Moschkovich (2002) has also argued that rather than a view of Latino/a EB students as using two languages strictly to translate vocabulary from one language to another the field should take a sociocultural approach to learners as participants in multiple discourse communities. A focus on students as participants in multiple discourse communities counters deficit notions of Latino/a EB students as lacking English, and instead sets up their mathematics identities as people who bring resources to learning mathematics, such as ways of communicating in other discourse communities. A sociocultural view of EB students also allows for consideration of how their linguistic identities can function across settings, and the intersection of linguistic identities and mathematics identity.

Perhaps because of a focus on barriers to learning rather than differential access to discourse, scholars in math education who focus on Latino/a youth have yet to research the intersections of linguistic and mathematics identities for Latino/a youth who are English dominant. In related research, scholars have shown that bilingual students who may be highly proficient or dominant in English may still use Spanish as they engage in mathematics. Zahner and Moschkovich (2011), in their study of a sixth grade math class in which both teacher and students were bilingual but instruction was in English, documented the use of both Spanish and English in mathematics discussions between students. After considering evidence for five competing hypotheses as to why students engaged in small group discussion might still use two languages, including whether students switched to Spanish when they encountered “road blocks” in the task in English, they argue that there is the most evidence for a “bid for the floor” kind of hypothesis. For example, they found the use of “mira” or “’ira” (*look* and *watch*, respectively) as a way students assumed control of an explanation or explained their thinking, then continuing their utterance in either Spanish or English. This research also suggests that students may draw on hybrid linguistic identities, as a Spanish and English speaker, to negotiate their mathematics identities. However, questions remain as to how Latino/a students who may not speak Spanish at all perceive of the role of language in learning mathematics, for example if an English-only identity matters for them in multi-lingual classrooms.

Taken together, this body of research illustrates the importance of listening to Latino/a students’ perceptions of learning mathematics, and analyzing how they narrate their own experiences in learning mathematics. In particular, their voices have the potential to add to a lack of research that specifically focuses on how their racial identities and linguistic identities play a role in their mathematics identities. In the next section, I define mathematics identity and share a framework used to situate students’ identities in both the settings in which they are negotiated and broader discourses of power, race, and language.

### **A Framework for Latino/a Mathematics Identity**

Fundamentally this research builds on theories that allow examination of the intersections of self, place, and discourses of race and language. Since the focus of this article is student perspectives, I first

define mathematics identity, and then outline a framework for analyzing mathematics identity of Latino/as that foregrounds their experiences (See Figure 2). Martin (2006) defined *mathematics identity* as:

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 or 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 performer unable to do mathematics, but often flowing back and forth). (pp. 206-207)

In Martin's definition, mathematics identities are negotiated over time, which contributes to the socialization of students into seeing themselves as particular kinds of people in mathematics contexts. Mathematics identities are also a part of larger self-concepts, such as students' academic identities and overall sense of self. Sociocultural learning theory (SLT) is important to inform how students are socialized into learning mathematics and come to see themselves as certain kinds of people. SLT posits that learning is a process of becoming, and therefore identity processes are implicated in learning contexts (Wenger, 1998). Identity is negotiated in and across contexts through engagement (Hand, 2010; Nasir & Hand, 2008) and informed by broader discourses of meaning (Gee, 2001). For this analysis, SLT helps frame both the role of context in mathematics socialization, as well as how students describe negotiating their identities in the particular contexts of their current classrooms<sup>9</sup>.

However, SLT is not enough to examine the experiences of students of color in ways that account for how race may be implicated in their daily schooling experiences. I employ CRT, and in particular LatCrit, as theoretical lens on larger discourses of race and language that inform both the personal and contextual layer of my mathematical identity framework. CRT is particularly useful here to examine and challenge prevalent *Colorblind* (Bonilla-Silva, 2006) and "culturally neutral" (Ladson-Billings & Tate,

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<sup>9</sup> In the next section, the classroom level analysis, SLT plays a central analytic role and is therefore elaborated more in that section.

1995) assumptions of mathematics. A fundamental tenant of CRT is to re-contextualize seemingly a-historical or abstract accounts of persons of color within historical and political contexts that illuminate whose interests are being served, and for what purpose. The self-concepts students hold in relation to their mathematics identities are developed across multiple contexts, are situated in broader discourses of achievement and access, and are deeply seeded attitudes students have towards themselves and how learning mathematics works in general. A LatCrit lens on self-concepts helps frame the intersectionality of multiple identities with mathematics identities. In addition, multiple theoretical lenses are appropriate to examine complex phenomena such as identity through a CRT lens, as interdisciplinary work is a feature of a CRT/LatCrit approach.

For this study, I employed a specific stance within CRT to focus on the voices of Latino/a youth in my study: counter-storytelling (Delgado & Stefancic, 2001; Martin, 2007) which is similar to *testimonio* as described by LatCrit theorists (Perez Huber, 2010; Solórzano & Yosso, 2002). These methods have the same underlying intention: to privilege the experiences of people marginalized by institutions such as schooling within a US context. Adopting a CRT stance in this study helps frame Latino/a identity as a racial construct, not because its necessarily most salient to students, but to explore the diversity of experiences for students we tend to label as Latino/a.

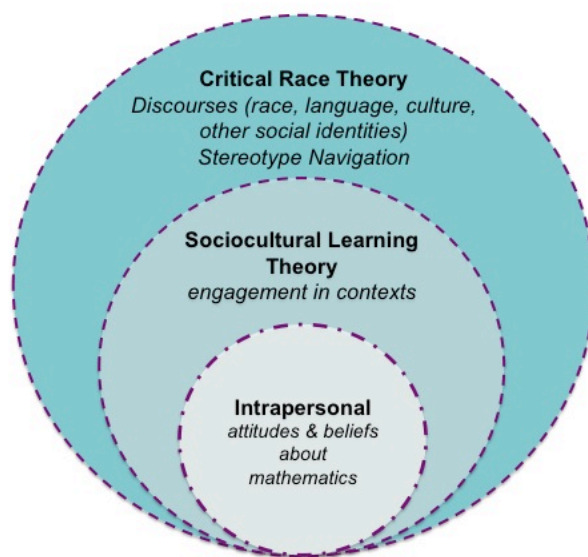


Figure 2: A Framework for Latino/a Mathematics Identity

## Methods

### Design

CRT and LatCrit scholars argue that narratives are important ways to understand the lived experiences of students who have been traditionally marginalized by inequity, and whose experiences are largely absent from scholarship (Cammarota, 2004; Fernandez, 2002; Solórzano & Yosso, 2001). As Solórzano and Yosso (2001) wrote:

CRT in education recognizes that the experiential knowledge of Students of Color is legitimate, appropriate, and critical to understanding, analyzing, and teaching about racial subordination in the field of education. In fact, critical race educational studies view this knowledge as a strength and draw explicitly on the Student of Color's lived experience by including such methods as storytelling, family histories, biographies, scenarios, parables, cuentos, chronicles, and narratives (Bell, 1987; Delgado, 1989, 1993, 1995a,b, 1996; Olivas, 1990; Carrasco, 1996). (p. 473)

Therefore, to answer research questions anchored in Latino/a students' experiences I employed a qualitative design based on the CRT and LatCrit methodologies of testimonio and counter-story. Though this analysis is part of a broader qualitative case study of two algebra 1 classrooms, in this analysis I privilege the student interview and focus group data, the data in which students' interpret their own experiences, and use other data sources to triangulate or add depth to students' experiences, not necessarily to contradict their self-narrated experiences.

This study took place at a multi-racial and multi-lingual school in an urban setting in the Pacific Northwest (OSPI, 2010). The students in this study represent an attempt to recruit all the Latino/a students in each of two class periods whose demographic composition of the class roughly approximated the racial data of the school (about 20% Latino/a). Ultimately, three Latino/a students in Ms. Williams' class and four Latino/a students in Mr. Anderson's class participated in this study. Only one or two additional Latino/a students in each classroom declined to participate.

Strategic essentialism is an important piece of this study, in that the attempt to recruit only Latino/a students represents an attempt to gather a group of people identified as similar in one way (all

Latino/a) to analyze the variety of experiences present and further the visibility of Latino/a youths' experiences in mathematics. In this way, I contribute to research that starts from a monolithic category in order to explore the real variety of experience within it. The variety in the cases is limited in some ways, such as how all students have Mexican heritage and all are either first generation or immigrants to the United States. In other ways, the cases here represent variation among Latino/a youth: years in the United States, EL (English Language) or SL (Spanish Language) proficiency, age, and continuity of education. Some data were not collected as they were not the focus of this research, such as whether immigrant students were previously schooled in rural or urban contexts, socioeconomic differences, family migration patterns, or a clear sense of the role students play in their home communities. This is not to say that this information does not matter, but rather the data provided are still rich and capture multiple dimensions of these Latino/a students as people who participate in multiple communities and who bring their histories with them into the classroom. In a national context of increasingly diverse schools, this set of Latino/a students who participate in mathematics classrooms that are multi-lingual and multi-racial settings have important insights to share about their experiences learning mathematics and ideas that impact their mathematics identities and ultimately math achievement.

### **Data Sources**

The data analyzed here are part of a larger study in two Algebra 1 classrooms whose data corpus includes teacher interviews, focal student interviews, two student focus groups, field notes from two classroom for 34 days of instruction between November 2010- and March 2011, as well as daily video from one unit of instruction (totally around 700 minutes of video-recorded classroom data for each classrooms) during November-December of 2010. For this analysis, I focused on the interview and focus group data of the 7 focal students.

The reliance on interviews as a way to access attitudes and beliefs is not without its problems. As well documented in the literature on research methods, interviews and focus groups are particular contexts in which participants play particular roles. In this study, I attempted to reposition myself as researcher with affinity to the group, by sharing my background, my commitments to equity in

mathematics education, and my language skills in Spanish as way to make a cultural bridge (Gay, 2010) between myself and my participants. This is not to say that I somehow managed to eliminate the power dimensions between myself as interviewer and students as interviewees, or newness of talking with young people about race, identity, and math (where else do they answer the kinds of questions I asked them?), but rather to suggest that establishing myself as aligned with the group in some ways helped establish rapport. In addition, as a participant-observer in their mathematics classrooms, I had additional ways to build rapport through engaging in mathematics together, or having time to informally converse. These interactions also gave me insight into students' mathematical competencies. In the case of the students who preferred to speak Spanish in their interviews, the fact that I could engage in Spanish with them allowed access into their expressions of selves as Spanish speakers, and I believe another way in which the interview context helped to capture beliefs and attitudes as more genuine than if I had tried to engage with them in English, or impossible to capture in the case of students who did not speak English.

Students' first interviews were during the recorded unit of instruction. Depending on students' individual language preferences, interviews were conducted in Spanish and/or English. These interviews focused on educational and personal history, attitudes towards mathematics, utility of mathematics, and descriptions of who could be good at mathematics. The second interview included stimulated recall (Gass & Mackey, 2000) in which students watched a short selection of classroom video (selected by the researcher) that featured the student participating somehow in a whole class discussion. The video launched discussion of what it means to participate in class, and students' impression of the teacher, the other students, and discussion of significant peer relationships and significant experiences within that particular classroom for that student. The second interview is where explicit discussions around language preferences were conducted with students who expressed a preference for Spanish as discussing their experiences in their classrooms brought language issues to the surface. For English-preferring or English-dominant students, the focus groups were settings where explicit attitudes towards language were explored as they did not raise language issues naturally in other interviews. I used my knowledge of language preference, immigration status, and age of participants to organize three focus groups: Samuel,

Anita, and Ignacio (students who mainly grew up in the United States); Rubén and Luis (the younger recent immigrant students); Marco and Julieta (older recent immigrant students). Only one student did not participate in a focus group due to leaving school (Julieta), and her partner (Marco) consequently completed the focus group protocol as a third interview. In the focus group setting we looked at a bar graph from the district indicating who received what kinds of grade based on ethnicity. The data was used as a way to discuss beliefs about race and racial stereotypes. We also watched a short selection of classroom video in which multiple distinct languages (English, Spanish, at least one distinct African language, and Tagalog in Mr. Anderson's class; English and Spanish in Ms. William's class) were being used at once as a way to discuss the role languages play in learning mathematics.

### **Analysis**

These data sources were used to write in-depth case reports of each focal student (Miles & Huberman, 1984), covering the following dimensions: educational history; experiences learning and attitudes towards mathematics; perceptions of the utility of mathematics; descriptions of who each student seemed to be in class; including their perception of particular roles each of them played; perceptions of how race; language, and culture matter or not in learning mathematics. To explicate findings across the focal students' self-concepts, I focus on themes that emerge from analysis of all seven focal students across five key dimensions of self-concepts:

- 1) beliefs about the utility of mathematics knowledge\*
- 2) beliefs about selves as learners of mathematics\*
- 3) Beliefs about the *role of race in learning mathematics*
- 4) Beliefs about the *role of language (English and other) in learning mathematics*
- 5) Beliefs about peer and teacher relationships in mathematics classrooms\* <sup>10</sup>

For analytic purposes, it is useful to tease out these dimensions as unique focal points for consideration, but that does not mean that they do not contain overlap or influence each other. Consistent with a LatCrit

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<sup>10</sup> a \* indicates it was part of Martin's (2000) original framework for level 1 of students' mathematics identity, the intrapersonal level.

lens, I looked for how these and other layers of identity intersected in the experiences of Latino/a youth as they described their perspectives on learning mathematics. For example, as elaborated in the findings section, this analysis revealed intersections between linguistic identity and peer relationships, and racial identities and beliefs about selves as a math learner.

Classroom fieldnotes and video were used to triangulate students' described self-concepts in relation to observations of who they were in their classroom. This triangulation was useful to illuminate a spectrum of alignment between beliefs and observable action in the classroom for students. Classroom fieldnotes and video were also used to help contextualize students' perspectives to add meaning to their observations. I also looked for continuity of perspectives across student interviews and focus group contexts so as to get a better picture of how contexts may have played a role in what beliefs or attitudes students expressed.

Following in the tradition of other scholars who examine the counter-narrative of marginalized students in mathematics (for example, Varley Gutiérrez, Willey, & Khisty, 2011), I present the collective voices of the Latino/a youth in my study and their beliefs about key aspects of mathematics identities. I also examine the case of two strategic partnerships to better understand how two students in particular enacted particular types of agency in their mathematics educations. A summary of identifying characteristics and notes on key findings discussed in the next section is in Appendix A.

### **Findings**

First, I share general findings around beliefs students held about themselves as mathematics learners, to add to the literature on perspectives Latino/a students hold about their mathematics abilities, and connection between mathematics and selves. Next, I present a more detailed analysis of the perspectives of the focal students around racial identities and linguistic identities intersections with mathematics identities. Findings on how attitudes towards the role of race in their own mathematics learning show that students mostly adopted a colorblind stance, though intersectionality of immigrant status, years in the US, understanding of family history, and other personal factors may have helped some students articulate how race matters in their own experiences learning mathematics. Findings around

language show that *linguistic identities* (connections between language and self) played a key role in how strategic partnerships were formed between EB and fully bilingual students. I also consider how in the case of one Latina (Julieta), initiation of a strategic partnership was a way she expressed agency in learning mathematics, and how in the case of another Latina (Anita) the agency she exerts to be important to her friend's learning is not acknowledged by him, though she also claims to work with this partner to benefit her own learning in addition to his. The findings from the cases of Julieta and Anita illustrate how intersections of multiple identities and experiences add depth and complexity to the experiences of Latino/a students as they negotiate their mathematics identities, and illuminate areas of productive resistance as they exhibit agency in their mathematics educations.

### **Mathematics, Goals, and Self**

Findings across the seven students' cases suggest that all students believe themselves to be capable of learning mathematics and that mathematics was important for their futures. These are important ideas to establish from the beginning, as Latino/a students' positive views of themselves as mathematicians and importance of mathematics remains under-documented in the literature. However, having faith in one's own capabilities is not the same as liking mathematics. Students varied in their attitudes toward mathematics. One student even said that he liked mathematics, but not his current math class (*Ignacio, Interview 1, November 2010*). In addition, students articulated two main uses of mathematics: 1) to get ahead, such as to get in college or 2) to use every day in your life.

Three students elaborated on particularly deep ties between their overall self-concepts and mathematics. Anita, who wanted to be an elementary school teacher, described mathematics as important for her to learn because she planned to teach it (Anita, Interview 1, November 2010). In this way, Anita situated a specific future goal as critical to why she needs to be a successful mathematics student. Marco was an older student in this study who had already graduated from a *preparatoria*<sup>11</sup> in Mexico. When asked why he likes mathematics he described how liking mathematics, persisting in it, and feeling good

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<sup>11</sup> *Preparatoria* is essentially High School in Mexico, and from my participant's reports covers 10<sup>th</sup> -12<sup>th</sup> grade since middle school is 6<sup>th</sup>-9<sup>th</sup>.

about himself for persisting in solving a problem where interrelated: “Me gusta sentirme si tengo una problema difícil, hacerlo y sentir o, puedo, yo puedo, yo se que yo puedo, y me hace sentir bien./ *I like to feel that if I have a difficult problem after I do it I can feel like oh, I can, I can, and I know that I can which makes me feel good about myself.*” (Marco, Interview 1, November 2010). Julieta described how being good at math was important for multiple activities in everyday life, and criticized her classmates for thinking that “los números representan pandilla/ *numbers are a bunch of fluff.*” She shared that in addition to liking math, learning math was very important for her overall sense of independence, including not having to rely on anyone else to control her own finances (Julieta, Interview 1, December 2010).

The findings here illustrate that to varying degrees mathematics was important to long-term goals Latino/a students had established for themselves, and in some cases deeply connected to students overall sense of self. These points of view provide some foundation to understand students’ perspectives on the roles of racial and linguistic identities in learning mathematics.

### **Colorblindness, Complexities, and Cultural Attribution in Latino/a Youth Perspectives**

The findings around race address suggest there was not consensus for how race matters in learning mathematics, but rather students articulated different view points and reasons from their own life experiences as to why they held particular views. In this group, there was a prevalence of a Colorblind (Bonilla-Silva, 2003) perspective at the individual level, with two-thirds of the focal students from whom there is explicit data about attitudes towards race expressing the opinion that race does and should not matter. Two students, who grew up in the United States, expressed more complex ideas of how race “does and doesn’t” matter in learning mathematics, linking racial identity to mathematics identity through motivation. Further, students expressed awareness of but did not necessarily challenge stereotypes around Asian students as smart in mathematics, describing Asian success as a function of observable cultural practices that Asian students exhibited. In particular, two recent immigrant students located and named racial stereotypes around school success in Asian Americans, insisting that Asian Americans deserved all the A’s they got because they studied a lot, whereas when it came to Mexicans it’s more about who has “*ganas/motivation.*”

*A Colorblind Perspective vs. Race “Does and Doesn’t” Matter*

Most students (4 out of 6) expressed a view that race does not and should not matter in mathematics achievement – rather it’s a matter of individual motivation. This perspective cut across the lines of who was a recent immigrant and who was born here, with all recent immigrants taking this stance and Samuel, born and raised in the Northwest, also aligning with this thinking. The way Marco explained it represents the sentiments of the students who also held this belief. In his interview, he explained that what matters most is that an individual student focuses and wants to learn:

Maria (I): ¿Eso es decir que si todos se enfocarán podrán sacar lo que quiere?

Marco: Pues, sí exactamente, pues todos somos iguales, todos tenemos el mismo capacidad, como dice el es como el dicho ‘querer es poder’, y si uno no quiere no puede, es imposible poder. Aunque tiene las más dificultades.

*I: You are saying that if everyone focused they could get whatever they wanted (grade)?*

Marco: Well, yes exactly, well we’re all equal, we all have the same capabilities, it’s like the saying that ‘caring is power’, and if you don’t care you can’t do it, it’s impossible to do it. Even the person with the most difficulties. (Marco, Interview 3, June 2011)

Marco’s expression of how everyone is equal, and has the same capacity, captures the way other students also felt, which privileged individual effort over contextual constraints such as navigating a racial hierarchy of success in mathematics (Martin, 2009). There are elements of meritocracy at work here in that his explanation does not take into account a critical perspective on schooling as an institution that has systematically marginalized Latinos. Marco’s own position as a nearly twenty-year old student in an algebra 1 classroom, even though he already has a high school diploma from Mexico makes his statement even more curious, until Marco’s reason for being in this classroom is revisited. He is already a high school graduate in Mexico who is about to graduate from an American high school, he’s enrolled in school here because he can and wants to learn English, and therefore he is enrolled in traditional high school classes such as algebra, that he’s good at and that he likes. Consider how Marco shared that his high school in Mexico was small, but of the thirty-something students who started the first year, “no mas

alcanzamos a graduar ocho/ *only eight of us graduated.*” (Marco, Interview 1, November 2010). He attributed his ability to graduate from high school in Mexico to his individual motivation, and the reason others dropped out because of not wanting it enough. He says in this statement that “caring is power,” which suggests that while individual effort is what counts the most, any individual who cares enough can be empowered to learn mathematics. When Marco’s words are examined in the context of his personal past success in school, his affinity towards mathematics, and his personal experience of being an individual who at the time was succeeding in school in the United States because of his own efforts, these multiple layers at work on his mathematics identity help contextualize his colorblind stance. He is a success story, a student who cares a lot and is engaged in mathematics, and that may situate his ideas of why the racial hierarchies don’t apply to how he perceives learning mathematics.

Anita and Ignacio had a different perspective that implicated their racial identity in their mathematics identities as sometimes mattering, and sometimes not. Their descriptions of how racial identity can motivate you to learn mathematics highlight an intersection of racial and mathematics identity not articulated by others focal students. I focus on Anita’s perspective here because she spoke up the most about her perspective in our focus group. Anita had moved from Mexico when she was six, and through her interviews and focus group sessions shared how she identified as a Mexican, with primarily Mexican peer groups, and how important it was for others to know she was Mexican and not American. She described herself as equally comfortable in English or Spanish. During the data collection school year, Anita went with her family to Mexico for almost four months, where she attended school with her cousins. We held these focus groups only weeks after her return. In our second focus group meeting, I asked the group about how language could be connected to a larger sense of self, and Anita shared that speaking Spanish is an important way she let’s people know she is Mexican, and letting her heritage be known is important to her:

I: So some people say that language is also how you express a part of your identity. Like choosing to speak in different language at different time.

What do you think about that?

Anita: Well sometimes when I meet new people, and most of the time they think I'm white, if I'm with a friend who speaks Spanish I try to speak Spanish so they recognize that I'm not white and they don't judge me by my cover.

(Anita, in Focus Group with Samuel & Ignacio, May 2011)

It is important to note that Anita feels she “passes” for white, and then uses language (Spanish) to communicate her racial identity. This is an interesting intersection of linguistic and racial identities in Anita's story. Understanding how Anita situates herself as a Mexican and how it's important that other people don't mistake her for white also helps situate the way she described how her racial identity intersects with her mathematics identity, though sometimes it matters more than others. In our second focus group meeting, we looked at achievement data sorted by ethnicity (see Figure 3) and then discussed how race could be related to achievement in mathematics:

Well, for me I feel bad about myself sometimes for not trying the best I can, and not really doing as well as I could be doing on quizzes and stuff, and that brings me back to thinking that I could end up like my mom or my dad or like my cousin like washing dishes or whatnot. And then it makes me try harder, but then I forget about it. And I'll go back down again. (Anita, in Focus Group with Samuel & Ignacio, May 2011)

Using a LatCrit lens, Anita's comments about family can be seen as layered onto what it means to be Latina, Mexican, in this particular family, with this particular history. The meaning of Anita's comments sits at the intersection of her family, their immigration status, and how they are racialized in the US. The connections Anita made in her descriptions are to opportunity and advantage, and connect to other ideas she brought up in her family of how an aunt's degree from a university in Mexico was devalued in the United States. In addition, she spoke of how she was very fortunate to have support from her family. She also spoke with an awareness that in this country (US) the way she identified as a Mexican meant she too could experience the devaluation, and ultimately dehumanization, that her family members experienced because they were Spanish-speaking Mexican immigrants. This re-affirmed the importance of how she needed to do well in mathematics, succeed within the system, to counter this possible outcome. In this

way, she raised ideas about the pressure to be a good student, including a good student of mathematics, to be better positioned in this country than her parents and her aunt have been so far. When asked about experiencing racism in their mathematics educations, Ignacio and Anita did not describe any of their own experiences. But Anita connected her own possible experience to the discrimination her family members had experienced being adult immigrants from Mexico in this country, suggesting she has thought about what her own potential experiences could be like. Therefore, she could feel that a stance towards her own racial identities that captures the increased and decreased situational salience describes her experiences learning mathematics.

### *Stereotypes and Racial Hierarchies: Asians and Latino/as*

When it came to racial stereotypes, of the students who completed the focus group protocol, none could think of a stereotype that applied to Latino/a or Mexican students related to academics. Rather, students named “we are illegal” and “that we’re violent” as the two dominant stereotypes of Latino/as. However, when looking at the district data on who got which grades, all students attributed this grade achievement to some cultural traits of the students. Marco, the older student who had already graduated from *preparatoria* (essentially, high school) in Mexico, speculated that Asian students got the most

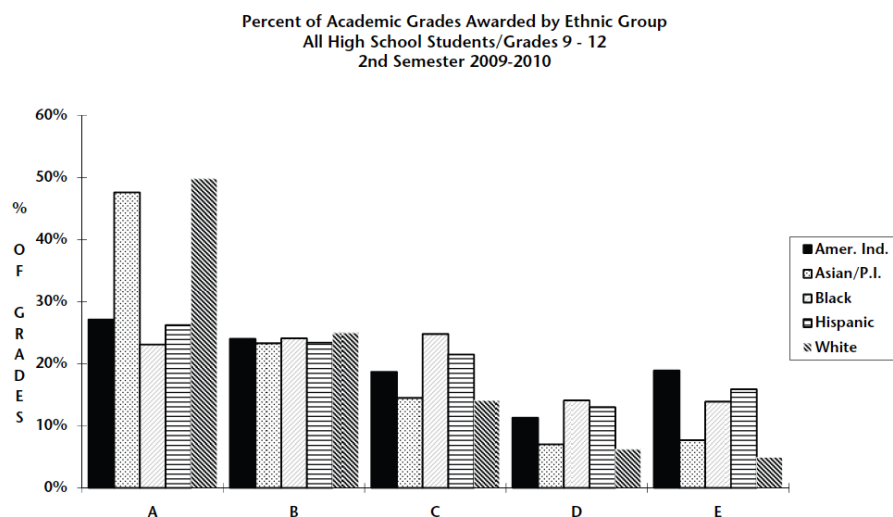


Figure 3: Grade Data by Ethnicity

A's because of their culture and "how they are brought up." In their focus group, Ignacio, Anita, and Samuel all offered ideas that maybe it had to do with how they study, and Ignacio said "They're known for that," suggesting that the stereotype was based on a history of observable patterns of achievement and an expectation for high performance.

Rubén and Luis, who had a focus group together and who co-constructed their ideas about how Asians are smart, juxtaposed Asian achievement with Mexican underachievement. During their focus group meeting, Rubén and Luis were looking at their districts grade distribution data by ethnicity above. After Luis noticed that the Asian bar in the A's was really high, I asked why he thought that was true. Rubén responded that it's because all the Asians are really smart, at which point I engaged them in an examination of this belief:

Luis: No, yeah, this is true.

I: Is it true or a stereotype?

Luis: Well, it's true.

I: But how did you learn that?

Luis: Well you can tell --

Rubén: -- Porque se van y andan con salen del bus leyendo. Andan comiendo y con sus papel escribiendo. / *Because they go they walk with they get of the bus reading. They go along eating and writing papers (at the same time)*

I: So all the Asians you know are very studious... Y nosotros? Cuál tenemos? / *and us? What (stereotypes) do we have?*

Luis: That we're violent.

*[Luis and Rubén laugh]*

I: That we're violent?

Luis: You can see it. We're violent. You'll never see us like that, up like the Asians  
*[points to the bar graph for As] (Rubén & Luis, Focus group, May 2011)*

As the discussion continued, Luis and Rubén laughed some more about how ridiculous the “violent” stereotype was, and thought it was not part of their own realities. Yet the exchange in the focus group calls attention to how what may be perceived as a stereotype around success (Asian students are smart) is perceived by these students as truth, and easily located in the monolithic category of Asian, which feeds the model minority myth. It could also be that because their own perspectives are situated in their experiences as young Mexican men who primarily socialize with other Mexicans, they may not be oriented towards thinking about collective oppression or struggle when their experiences suggest every Mexican is a different individual who makes their own choices. This position could support their beliefs that race is not some kind of determining factor in their experience. On the other hand, Luis re-asserts a group identity and makes a claim about Mexicans, or Latinos in general if you take my bid to address “us” into account, in which Mexicans are positioned as lower academically than Asians – “You’ll never see us like that, up like the Asians.” This statement also captures how in some way the racial hierarchies of success in mathematics were known to Luis, though he attributed the difference in performance not to contextual or historical factors related to schooling, but rather being a member of the ethnic group as a whole which implies participation in particular practices.

The findings around racial identities in learning mathematics suggest that students navigated racialized hierarchies of success, but attributed this success to cultural practices, and their own failure or success to caring enough or having enough motivation. For Anita and Ignacio, racial identities had a more complex role in this motivation process because of their knowledge of struggles their families had experienced in the US. Anita also brought up intersections of her racial and linguistic identities in how she lets people know she is not white, but Latina (specifically, Mexican.) In the next section, the role of language and linguistic identities is explored more.

### **Linguistic Identities, Agency, and Academic Partnerships: Contrasting Cases**

The English dominant students did not find language of instruction to be an important feature of their mathematics learning, though they could speak to how specific vocabulary was important to know to learn math, especially in their algebra classes where they were learning new language for the domain of

algebra. However, they did express that language was probably an issue for EB students, and offered that it's probably easier for you to learn mathematics in your first language as an explanation for why they could often hear more than one language in their math classes. For the EB students in this study, language certainly mattered for access to learning mathematics. Themes across their experiences suggest that not only is knowing the right words important to know what's being talk about in your class or in the book, but if you don't speak English correctly you may find math class to be a threatening place. Language also mattered in particular for how some students displayed agency in forming strategic partnerships for their own benefit or the perceived benefit of others. In this section, I first describe how a preference for learning mathematics in Spanish was described by two EB students in this study, and then go into more detail of the case of Julieta, who expressed strong feelings towards the English speaking students in her class while also acting on her preference to learn mathematics in Spanish, despite her teacher's preference that she learn more English. I analyze the way Julieta talked about a strategic partnership with Samuel to argue that she exhibited agency in her mathematics education by working with someone who could engage her linguistic and mathematics identities as the same time. I argue that engaging in mathematics in Spanish was a way she exhibited productive resistance, to keep learning mathematics on her own terms even though the teacher was trying to raise her academic English skills by having the language IAs work with her more in English. I contrast this case with Anita and Rubén, whose partnership in their mathematics class was initiated by Anita because she thought her friend Rubén, an EB student who did not qualify for services and therefore did not have the benefit of a language IA assigned to him, lacked independent work skills and needed her help. Their partnership seemed more one-sided, and rather than result in sustained engagement in mathematics, resulted in more regularly observed patterns of socializing during algebra class.

#### *Navigating Linguistic Identities: Exhibiting Agency in Learning Mathematics*

Marco, Julieta, and Rubén, three of the four recent immigrant students, said they preferred to learn mathematics in Spanish. The fourth recent immigrant student, Luis, expressed a preference to learn mathematics in English, though he could be observed in class using both English and Spanish. The

significance of learning mathematics in Spanish is given more clarity when situated in the linguistic worlds of the recent immigrant students, who mostly only spoke English at school, and no where else. Like other students in this study who had been in the United States three years or less, Marco did not speak English if he did not have to. His words summarized the way Spanish dominated the worlds of the recently immigrated students when he explained in his third interview (June, 2011), “I never speak in English. En la casa, puro español, en el trabajo, puro español, en la clase puro español. Hasta mi jefe, que habla español porque ha estado en España dos años. Solamente cuando hablo con los maestros. / *I never speak in English. In the house, pure Spanish, at work pure Spanish, in class pure Spanish. Even with my boss, who spent two years in Spain. It's only when I talk with my teachers.*” However, this did not mean that students did not recognize the importance of learning English. In fact, Marco’s whole purpose in being enrolled in school in the United States even though he had graduated from high school in Mexico was to learn English.

Though English was the official language of instruction, it was clear that at least three languages (English, Spanish, Somali) were spoken by students when engaged in mathematics in Ms. Williams’ class, and that at least four languages (English, Spanish, Tagalog, Somali) were spoken by students in Mr. Anderson’s class. But because English was the official language, the recent immigrant students reported that language was the most pressing issue in their mathematics achievement. Julieta’s perspective makes this point most salient. During her first interview in December, Julieta expressed her feelings as jealousy – connecting what she perceived as her own limitation to a strong emotion:

Julieta: Me siento, creo, creo que mas bien siento *jealous* ?

I: *Jealous*, sientes celosa?

Julieta: Sí, porque ellos que saben perfectamente bien el ingles no preguntan, y ellos pueden entender todos los problemas todas la palabras del libro de matemáticas, y yo no. Si yo fuera ellos yo me la pasaría leyendo matemáticas, pero no sé bien que significa algunas palabras, no puedo.

*Julieta: I feel, I believe, I believe that more than anything I feel jealous?*

*I: Jealous you feel jealous?*

*Julieta: Yes, because they know English perfectly well [and] don't ask questions, and they can understand all the problems all the words in the math book, and I can't. If I was them, I would spend my time reading about mathematics, but I don't know that well what all the words mean, so I can't.*

(Julieta, Interview 1, December 2010)

Julieta passionately identified accessing the mathematics content (*pasando leyendo matemáticas*) and asking questions as an advantage English speakers have over her, and criticizes them for not acting on their advantage. Her perspective is that these young English speaking students in the Algebra 1 class did not understand how well positioned they were to do something she wished she could, just because they grew up speaking English. It's important to juxtapose her jealousy with her preference to learn mathematics in Spanish. Since instruction and all materials are in English, Julieta's jealousy is partly a critique of how she cannot access mathematics in ways that they can, and they waste their advantage. On the other hand, a solution to Julieta's problem is to do mathematics in Spanish. This takes some creativity on her part because over time the teacher asks the language IA to only work in English with Julieta.

In Julieta's case, she was not willing to let English be the barrier to mathematics. She exhibited agency in seeking out a partner who could do math with her in Spanish. I describe this situation next, and then juxtapose with a strategic pair that did not have the same academic engagement: Anita & Rubén. In this way, both pairs are examples of how language is at the surface of learning mathematics for students in this study, however the perceptions of the students involved reveal complex dynamics underlie a practice we celebrate as "good teaching" (strategic partnering of students who speak the same other-than-English language.)

*Julieta and Samuel: Mathematics agency and productive engagement.* Julieta and Samuel were seated together in Ms. William's class, where students sat in groups of four with their desks pushed together. This is the case of an emerging bilingual student (Julieta) exhibiting agency by initiating a relationship with an English-dominant bilingual student (Samuel) who was instrumental in helping her

access mathematics while also supporting learning mathematics on her own terms in Spanish. Julieta named Samuel as important to her mathematics learning in our interviews.

Their partnership was significant for Julieta's mathematics learning because this partnership simultaneously supported her linguistic identity and her mathematics identity by giving her access to a particular form of participation: contributing to her small group. In the quote below, Julieta explained the importance of her relationship with Samuel, despite the presence of an additional adult assigned to work with her (the language IA). Here, she describes how since the language IA has stopped responding to her in Spanish she has started to talk more with Samuel:

Cada vez le pregunto (a la IA) y me contesta en inglés, y a mi me gustaría mas que me contestara en español para entender mejor [*pause – continues in English*] That's why, maybe I – le estoy preguntando más a Samuel que a ella porque Samuel me está respondiendo en español. Y por eso allí veo que no estoy practicando tanto y eso que ella que es maestra, pero es que ya no me da contestaciones en español, pero Samuel sí.

*Every time I ask the IA, and she responds to me in English and I would prefer if she would respond in Spanish to understand better (pause – continues in English) That's why, maybe I – I'm asking Samuel more than her, because Samuel is responding to me in Spanish. And for that I notice that I'm not practicing as much and I know she's a teacher, but she's stopped responding to me in Spanish, but Samuel does. (Julieta, Interview 2, February 2011)*

Later in the interview, when asked about whether Julieta thought she played a particular role in the class, she elaborated on how her partnership with Samuel was important not just for accessing mathematics content, but also how she felt like part of the community of the classroom. She described how she felt “no fuera del círculo, sino dentro” – not outside the circle, but instead inside:

Por ejemplo, um, preguntándole a las personas en español, y creo que así me sentía participando en el grupo, y tratar de ponerlo mas que puedo yo en atención para entender el problema, y sentirme no fuera del círculo, sino dentro.

*For example, um, asking the people in Spanish, and I believe that is how I feel I'm participating in the group, and trying to put all the attention that I can into understanding the problem, and feeling that I'm not out of the circle, but instead inside. (Julieta, Interview 2, February 2011)*

She describes “*preguntándole a las personas en español*” indicating that she feels she can speak in Spanish, and Samuel passes her ideas on to the group, and that’s a way she can feel she is participating and contributing to the group ideas. It is important to hear Julieta’s perspective, because she was often observed interacting with at least one other group member over how a particular problem was solved, but rarely if ever did Julieta initiate a solution strategy for the group. Without Julieta’s perspective, we might conclude from observations that she’s not participating enough on her own, but with her perspective we hear in her own words how she views the way she is participating as important to building the collective understanding of the group, and how she is participating is on her own terms, using her linguistic identity as a resource. It is important to underscore that Julieta is using her agency to initiate a strategic partnership to simultaneously maintain her linguistic and mathematics identities, which enables her to feel like a central participant in her small group, and arguably impacts her mathematics learning in positive ways.

It’s also important to note that Samuel, while not naming Julieta as someone important for his own math learning, described that he reciprocated Julieta’s efforts to do math together. He described their partnership as helping Julieta out, because she asked him to help. He spoke of the partnership primarily as him translating the tasks they were given in the class, that she would read it to herself first, engaging in self-talk in Spanish, then ask him questions and he would respond in Spanish. He pointed out in his interview that he’s done that kind of helping out frequently in his life, recalling translating for students when he was in elementary school. Samuel’s willingness to work with Julieta, even though he did not feel like he was benefiting from their collaboration, was important for Julieta, and Samuel was happy to help out. What Samuel does speak to is that this relationship may also have benefitted him, as his sustained mutual engagement with someone else could have also augmented his own learning experience.

I'm naming the pairing of Julieta and Samuel a case of mathematics agency with positive engagement – Julieta initiated a friendship that would benefit her mathematics education, and Samuel was willing and able to help her as needed, engaging in mathematics with her. She also saw a deeper benefit, connecting their partnership to how she was able to participate in group reasoning processes. It was the intersectionality of multiple layers of Julieta's identity in this case, how she liked mathematics, how she connected mathematics to a broader sense of self, her linguistic identity, as well as her initiative, that together capture her story as a student of mathematics. I contrast Julieta's mathematics identity and agency with Anita, whose identity negotiation was different.

*Anita and Rubén: Mathematics agency without sustained mathematical engagement.* Anita and Rubén were seated in the same group in Mr. Anderson's class. Unknown to the students, even with seat changes that seemed "random" Mr. Anderson kept the two of them seated near each other for most of the first semester. Rubén and Anita are an example of an academic relationship in which one student's efforts to academically engage the other are not reciprocated or recognized as important. Anita named Rubén as someone important in her math class during our interviews, but not for the same reasons Julieta did. Instead of seeing Rubén as important to her own learning, Anita instead named Rubén as someone who needed her help. These two students were friends outside of class, socializing in similar circles with Mexican and other Latino/a students. Recall that Anita was a student who articulated that it was important for her that people knew she was Mexican, that speaking Spanish was a way she let people know she was Mexican, and who expressed she was equally comfortable in English or Spanish. Rubén and Anita would often talk in Spanish together during class, both when socializing and when working on a math task (which was rare – more often, Anita worked on a task alone while Rubén listened to music). Neither one of them was frequently engaged in math, which is a contrast to Samuel and Julieta who were most of the time on task in their class. They knew many of the same people outside of class, and would often recount stories from the weekend on Mondays, such as something funny that happened during or after Rubén's soccer games or a story involving a mutual friend.

Rubén was an animated talker in Spanish, but would suddenly be silent and all grins when addressed by an authority figure in English, such as any teacher present or the volunteer tutor who began coming to class mid-November. Anita, on the other hand, would talk to the teacher on behalf of her small group. If asked about work she had completed with Rubén, Anita would talk to the teacher on their behalf. In this way, she engaged in socializing primarily in Spanish, and engaged with the teacher and in whole class discussions in English. When asked if she thought she impacted anyone's mathematics learning in her class, Anita responded like this:

Anita: Well I pretty much help Rubén, every single day. Cause you've seen him, he's always wearing his headphones. He never pays attention. And he gets called on, and he's like, what do I do? Like he looks to me, even if I'm across the room, he's like, he needs, he can't, he doesn't know how to work independently.

I: Oh, he doesn't. Okay.

Anita: So like right now that I'm sitting next to him I like pretty much try and help him out.

I: So a lot of your focus also is on working with Rubén, and –

Anita: Yeah

I: Okay. Um, and how do you feel about that?

Anita: Well, I don't mind really because I help myself too. Like, I like working with people more than independently. (Anita, Interview 2, April 2011)

It's important to notice Anita's use of words that align with her chosen future profession (teacher) in how she described Rubén, as not a joker or something so crass, but rather as someone who doesn't know how to work independently, and herself as someone who preferred to work with people. She perceived her friend as lacking skills to successfully engage in school. One thing to notice is that when she helped him, it was in Spanish. When they socialized, it was in Spanish. Though not ever framed explicitly as a deficiency or an advantage in her own words, Rubén's lack of English is something that Anita compensated for by translating math tasks into Spanish when she did not think Rubén was understanding

what he is supposed to do. She also did the talking on their behalf if the teacher asked them a question about a task they had been working on together. In this way, Anita drew on her linguistic identities, her friendship with Rubén, their personal history (which reinforced Anita's perception that Rubén was not competent), and her own mathematical competencies to be an important resource for Rubén in this classroom. She exhibited agency in drawing on her own identity as a competent student to be a resource for her friend, whom she perceived as needing her help.

Rubén, meanwhile, described Anita as a friend, but did not implicate her as someone who impacted his own learning. My analysis of this is that Rubén is someone who displays many talents at doing school, while avoiding looking like he's learning anything. For example, his ability to appear on-task when an adult is in proximity, or the way other Latino/a students in his study-skills class were willing to give him their work to copy to make sure he didn't get in trouble for not having an assignment, spoke to his expert navigation of school as a system, while raising questions as to what, if anything, Rubén was learning.<sup>12</sup>

Anita exercised agency by turning their friendship into what she thought was a necessary partnership for Rubén to learn in math class, from which she also benefited by having someone to work with. Anita was uniquely positioned to be someone important in Rubén's mathematics education, and yet her efforts went unrecognized and perhaps underutilized by Rubén. That is why I've named this peer relationship an example of academic agency without mutual sustained engagement – though the initiative was taken by Anita, the result was not something recognized as productive for learning mathematics. Rubén may have benefited, but from his perspective he didn't agree with Anita's perspective that their partnership was beneficial for learning mathematics. In addition, any benefits to Rubén were hard to see within the rest of the way he navigated his education. Rubén's expert navigation of schooling could still

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<sup>12</sup> In Section 3, I discuss Rubén's case in more detail, using a particular classroom interaction as an example of the multiple layers of identity that help makes sense of Rubén's mathematics identity negotiation in Mr. Anderson's classroom.

be seen as a way he exercised agency in his education, while not allowing conclusive evidence that the agency Anita exhibited lead to any meaningful engagement, as in the case of Julieta and Samuel.

### **Discussion**

The findings presented here help scholars in mathematics education understand the facets of math learning (identities, agency, and participation) that impact the mathematics education of Latino/a youth. Overall, this study showed that CRT and LatCrit were useful to understand the multiple identities that intersect in the lives of Latino/a youth and inform the agency they take in learning mathematics and negotiating their identities within mathematics contexts. Focusing on students' perspectives was also crucial to understand their lived experiences in the tradition of CRT and LatCrit scholars (Fernandez, 2002; Perez Huber, 2010; Sólorzano & Yosso, 2001). In particular, Julieta's case adds documentation to how students resist schooling practices in productive ways within their classrooms. What we learn across the cases is that race and language do matter in complex ways to how they become mathematical people, and that the variety of experience among Latino/a youth shows how the particular mathematics identities youth negotiate are impacted by racial stereotypes and their linguistic identities in relation to the official language of instruction. And yet, there is no one Latino/a experience – the perspectives of the Latino/a youth in this study add nuance and depth to our understanding of how Latino/a youth experience learning mathematics.

Taking a sociocultural approach to bilingual students in this case was useful to consider how they negotiate their mathematics classrooms and school. However, a CRT lens added attention to race and language in a way that goes beyond what sociocultural learning theory can explain about how students navigate membership and participation in mathematics contexts, to illuminate places where students engaged in productive resistance. This adds to the potential CRT may hold in addressing gaps in the research on mathematics identity as scholars grapple with how to treat socially constructed identities in mathematics contexts appropriately (Esmonde, Brodie, Dookie, & Takeuchi, 2009).

Findings around student perspectives on how racial identities matter in learning mathematics show that for Latino/a students, racial identity's salience is easier to notice in others, but may be harder to

articulate for your own experiences (Pollock, 2004). Taking students' perspectives as their understanding of how learning works, the dominant perspective in this small sample was that race does not matter for learning mathematics, while two students (Anita and Ignacio) who grew up in the United States described the role of race in their own educations as more complex, and tied to motivation. However, through discussion around stereotypes and lack of stereotypes, Latino/a students' perspectives of how racial identity played a role in learning mathematics surfaced. The students' perception of the "truth" behind Asian achievement stereotypes suggests that they were navigating the kinds of stereotypes in their lives that Martin (2009) argued re-affirms racial hierarchies of success in mathematics. The perspectives of these youth suggest there is more to explore about how students perceive of racial stereotypes of other racial groups' academic achievement, and how these stereotypes manifest as reality, potentially re-enforcing model minority myths about Asian students and academic inferiority of Mexicans for a new generation of immigrant youth. There is also a need to dig deeper into the implications for academic success that are suggested by navigating stereotypes of being illegal or violent. These stereotypes may not speak directly to Latino/a achievement in mathematics, however they perpetuate an image of Mexicans as violent and alien, rather than belonging and intellectually or mathematically resourceful (Solórzano, 1997). It is also important to notice that students may be resisting these stereotypes in ways that grow the plurality of what it means to be Mexican and learn mathematics, making new Discourses for Latino/as in mathematics (Zavala, 2009).

At issue here is also how to make sense of what students say they believe about race, with what we might observe as scholars in the field who conceptualize mathematics classrooms as racialized spaces (Martin, 2009), and research that suggests attitudes towards race matters in learning mathematics (Spencer, 2009). Are we wrong, and should we take the perspectives of youth as a sign that race really doesn't matter? In this study, it's important to notice that from the student perspective ideas of who can be successful *are* related to stereotypes around success in mathematics, namely positioning of themselves as lower than Asians – racialized dimensions of learning mathematics. As problematic as their perceptions of Asian students may be, they also insist that their own success is not predetermined by race.

Again, the complexities in talking about race that Pollock (2004) surfaces are important to makes sense of the ways students can both notice racialized patterns in others, while maintaining a colorblind stance for themselves. The students who hold views that race does not matter may find that is a practical stance to take because they do not necessarily have a way to engage deeper power issues that may be invisible to themselves in their mathematics classrooms, but that they may have experienced elsewhere.

Anita's stories of discrimination in her family and subsequent description of how her racial identity can sometimes matter exemplifies how a person might make connections between larger power dynamics and success in mathematics. She can speak frankly to the discriminatory experiences of people related to her, but has not articulated what this could mean in terms of her own experiences except that she should take advantage of her education. But one thing is clear in her articulation of race does and does not matter: her racial identity as a Latina influences her perception of herself as a mathematics learner in that it helps her position her academic success as necessary to avoid her family members' fate in the US. The way her racial identity seems to act as a resource for motivation to succeed is similar to the way McGee and Martin's (2011) participant, Cory, spoke of defying a stereotype in his math classes as an undergraduate. This is not unlike findings from other scholars who have found that race matters for youth in complex ways in high school (Esmonde, Brodie, Dookie, & Takeuchi, 2009; Fernandez, 2002; Pollock, 2004). As Pollock (2004) noted in her ethnography of Columbus High School, "Taking cues from youth, we can keep creating moments to talk about racial categorization as a human and contestable process, even while keeping race labels strategically available for analyzing social inequality" (p. 43). Race is implicated somehow, but in ways that may be contestable and hard to articulate at this point in their learning trajectories.

The findings around linguistic identities and mathematics identities suggest that Latino/a students may find ways to exhibit agency through peer relationships, to resist schooling practices in ways that appear productive for learning mathematics, from the students' perspective. From Julieta's perspective, engaging in mathematics in Spanish with Samuel allowed her to take on an *integral role* in her classroom, which Nasir & Hand (2008) describe as an important piece of engagement that allows for and maintains a

positive mathematics identity. At the same time, the way she exhibits agency to learn mathematics in Spanish can be seen as resisting the dominant stories of EB Latino/a youth in American schools – to learn English. While scholars have written about competing hypotheses as to why bilingual students would use Spanish and English to learn mathematics, very little has been documented about students actively resisting learning mathematics in English by by-passing the teacher and finding a competent peer. This strategy was productive resistance, because it kept Julieta learning. Her jealousy towards her classmates who spoke English but did not use it to participate in class was not about the ability to speak English, but rather about how she felt like a marginalized participant in a classroom where the language of instruction was English. She wanted to be a more central participant. Even though Julieta has an adult assigned to work with her, when that adult stopped working with her in Spanish or was not present, Julieta was creative to stay engaged. An important lesson to draw from Julieta's story is that she found her mathematics education worked best when she learned in the language of her preference, and she acted on that preference.

While Julieta's case makes language of instruction very salient, Anita's case suggests there is something more to explore about the intersections of race and language in how some Latino/a students may negotiate their mathematics identities. She and Rubén were friends who spoke Spanish whether socializing or engaging in math together. Anita spoke to how important it was that people knew she was Mexican, and how she mostly had Mexican friends. What role did this play in her mathematics identity negotiation, and in how she decided she needed to “help” Rubén? In this study, the data gathered do not speak to the intersectionality of race and language beyond how Anita articulated how language was a way to signal her racial identity. As the research on bilingual Latino/a students in secondary math settings suggests, students use multiple resources to learn mathematics (Gutiérrez, 2002; Zahner & Moschkovich, 2011), and one we may need to consider is how their racial and linguistic identities intersect to inform how they display agency in learning mathematics. The students who exhibited agency in forming key peer relationships had clear linguistic affinity, but they also had shared heritage. That is to say, those relationships were not formed with white or other Spanish-speaking students. Questions remain as to

how racial and linguistic identities are co-implicated in mathematics identity negotiation, and close attention to peer groups may be a way to understand how they both manifest in mathematics identity negotiation.

Questions also remain about what to make of the difference between Julieta and Samuel as a case of *mathematics agency with sustained mathematics engagement* versus a different quality of interaction in Anita and Rubén's case. It is difficult to dis-entangle the positive outcomes from Julieta that came from Samuel's willingness and qualifications to work with her. A sociocultural perspective also focuses our attention on how their interactions overtime were co-constructed, and so the mutual engagement in common purpose produced something positive for Julieta, and which Samuel seemed fairly neutral about. In Anita and Rubén's case, they didn't share a vision to accomplish the mathematics – Rubén's position was that he was doing fine and didn't see Anita as a resource, whereas Anita saw herself as playing a big and necessarily role for her friend to make sure, even if he didn't learn, that he at least knew what was going on. Again, though the cases are contrasting, many features of the students' identities and social histories (such as friendship or lack of previous friendship) are at play. It's not as if we could swap Samuel and Anita, the two positioned as helpers, and expect the same outcomes. Rather, there is something for researchers to learn from how students use their agency in their mathematics educations to achieve their goals. For a student like Rubén, whose productive mathematical agency is harder to see in a classroom, the agency he displays may become more visible across the multiple communities in which he is a participant (Hand, 2003).

### **Conclusion**

The findings presented here add depth and complexity to the experiences of students who we might see as all being affiliated by the label *Latino/a*. Their variety of experiences, and differences in how agency is enacted, give us insight into what matters to them about learning mathematics. Their perspectives are key to understanding what they believe are important aspects of becoming different kinds of mathematical people: people with goals and people with promise. Given the unique history of racism against Mexican, Central, and South American peoples in the United States, and the current attack on

immigrants in Arizona and Alabama, there is an academic imperative to continue examining the multiple influences on how Latino/a youth come to see themselves as successful mathematics people, and not leave the racial and linguistic discourses out of our research. Within the monolithic category of Latino/a we find a range of experiences with languages other than English, and a range of ways of identifying racially, ethnically, and culturally. Critical Race Theory and Latino Critical Theory can provide an important perspective on the experiences of young people learning mathematics to add depth and texture to how we as educators and teachers understand their mathematics identities.

### SECTION 3: Dimensions of Practice in the Negotiation of Latino/a Students' Mathematics Identities — Opportunities for Engagement in Two Algebra 1 Classrooms

Enter room 164, a mathematics classroom in a multi-lingual, multi-racial, urban high school. It's 12:05 p.m. on November 9 at the start of the second half of a long block period of instruction in Mr. Anderson's Algebra 1 class. Rubén, a freshman who moved to the United States from Mexico three years ago, sits with his table group in the corner, with one earbud discretely placed in his ear away from the front of the class, while he tells his friend Anita, seated diagonally across the table, about what happened this weekend. He talks quickly in Spanish, animated, with gestures and expression, laughing at his own jokes, and she smiles back, half focused on her math notebook. The class is working on a matching activity: match a table, to a graph, to an equation. A volunteer tutor comes by and asks Rubén in English if he knows what he's supposed to do, and Rubén says no. She stays next to him to work on the activity together.

Towards the end of class, nearly 45 minutes later, students are supposed to be working with a partner to write a story that matches a linear graph. Rubén has both earbuds in, and punches numbers into a calculator. Across the room, the teacher works with one group of students while the volunteer tutor works with another. When I, a bilingual Latina researcher stop by Rubén's table, I see that he has written an equation to match his graph, but hasn't written a story to go with it. I watch as the teacher approaches the table. The teacher asks in English if Rubén and his partner have a story to match the linear graph on the table between them, gesturing to indicate they should both be focused on the same paper. Matt, the white male student seated across from Rubén who does not speak Spanish, was assigned to be his partner for this activity, and he tells the teacher they haven't written it down because he can't tell if the slope should be going down or up. The teacher says, that's a very good question, and points to Rubén saying, "How did you do it?" Rubén shrugs. The teacher points to his equation, where he has written  $y = 3 - 1x$ , which matches the graph. "You used an equation to do it," he says. Rubén nods. I ask, "How did you know to make the slope negative?" Rubén hesitates, says "por la, um um um, porque, um, um, um..." at which point the teacher, seeming to notice the time, walks to the front of the class to call the class together. Without further prompting, Rubén answers me in Spanish, "porque va abajo/*because it goes down.*" The teacher begins a countdown for whole class discussion. I quickly translate what he said for his white male partner, who writes something down on his paper. Five minutes into the whole class discussion, two students have shared their stories by coming to the front of the class, putting their work under the document camera and talking about what they did, then fielding questions from the teacher or other students. The teacher says, "I would like to ask Rubén and his partner to come up and lead us in the discussion you were having about your paper." Rubén does not move. Another student says, "We only have three more minutes." The teacher says that's fine, asks again. His partner says, "Do you still want me to come up?" The teacher says, "You can, but I'm asking Rubén." His partner makes a kind of half-gesture to get up, motions with his left hand towards the front of the room with his eyes on Rubén, as if to ask *shall we go up?* Rubén stacks the papers in front of him neatly, and puts his head down on the table. The teacher waits a few seconds, and then says to the class "Alright, they had a good discussion. We'll maybe come back to it tomorrow. We don't have time for the exit ticket I don't think." Students pack up and leave.

Why doesn't Rubén go up to the front of the class with his partner? What should we make of Rubén hedging when the teacher is near, then sharing his thinking clearly in Spanish with me? How does knowing more about Rubén as a person, and his classroom as a context for engaging in mathematics help us understand what's going on for Rubén in this moment? This article explores these kinds of questions by examining the structures in two Algebra 1 classrooms that impact Latino/a students' engagement in mathematics, and consequently their identity negotiation. In this section, I answer the following research question:

What role do different features of mathematics classrooms—the disciplinary context, social arrangements for engagement, social contracts and social breaches—play in Latina/o students' negotiation of their mathematics identities?

This research question emphasizes features of the classroom as a starting point to explore learning mathematics at the intersection of classrooms and people. In this way, this research sits within larger equity projects that counter deficit notions of Latino/a students and instead seeks to better understand how Latino/a students experience schooling (Valencia, 1997; Valenzuela, 1999). In this section of the dissertation I argue that Rubén's experience in that moment can be understood as situated in how he navigates multiple aspects of practice in this particular classroom. Simply saying Rubén does not know enough English would be framing him as deficient, and would not tell the whole story. Rather, understanding particular features of Rubén's classroom and how he, his classmates, and his teacher come together to do mathematics in this space adds depth to this moment. These features include the content and organization of the mathematics in the classroom (disciplinary context), the norms and patterns that shape how participants engage in mathematics (social arrangements), and whether the classroom is a place students feel they belong or not (influenced by social contracts and breaches).

In the first section I review recent research on mathematics classrooms that informs what aspects of practice matter when analyzing how students come to see themselves as competent mathematics people. Across the literature, I highlight important studies in research on Latino/a youth and research that makes power dynamics around language and race salient to how we research classrooms as racialized

spaces (Martin, 2009). I then present an analytic framework for researching mathematics identity negotiation in classrooms that draws heavily from sociocultural learning theory and is informed by Critical Race Theory (CRT). It is designed to provide analytic guidelines for the sociocultural level of mathematics identity presented in the first and second sections of this dissertation. This framework focuses on the disciplinary context of mathematics, the major participation structures in the classroom (social arrangements for engagement), and social breaches and reconciliation. I use this analytic framework to investigate the opportunities for engagement in two Algebra 1 classrooms, and how the Latino/a focal students in my study navigated these opportunities. Together, the findings suggest that a multi-dimensional view of the classroom, such as the one proposed here, has potential to increase our understanding of how Latino/a students negotiate their mathematics identities in mathematics classroom. I argue that the analytic framework for the classroom level is important for making sense of the multiple layers of mathematics identity, and adds explanatory power for what may be going on in particular interactions for Latino/a youth in their mathematics classrooms.

### **Mathematics Classrooms are Complex Places: Relevant Literature and an Analytic Framework for Identity Negotiation in Mathematics Classrooms**

There is no doubt that when studying mathematics classrooms there are many aspects to consider. Whether framing a classroom as a community of practice, as an activity system, or as a discourse community, researchers make choices in the end of what slice of this complex space they will study – focusing on particular phenomena while maintaining the complexity necessary to capture it. In this section, I start from sociocultural theory to define what I mean by practice and frame the way I will be looking at classrooms: as mathematical contexts in which students and teachers co-create and navigate opportunities to engage in mathematics. Next, I review literature on the role of disciplinary contexts, major participation structures, and classroom communities which together account for how these different pieces of classroom practices influence the kinds of opportunities for engagement that influence mathematics identity negotiation for Latino/a students.

### **Mathematics Identities and Theoretical Lenses for Mathematics Classrooms**

Sociocultural theorists posit that learning is visible through shifts in participation in practices, and concomitant development in skills, knowledge, and identity (Lave & Wenger, 1991; Rogoff, 2003). Practices are organized in particular ways, have identifiable structures, and are also characterized by norms and conventions of participation. Because practices have aspects that are both global and local, they look different across learning settings.

Recently many scholars in mathematics education have taken up research in mathematics identity to better understand students' opportunities to learn and persistence in mathematics, as well as explore the roles of racial and linguistic identities in mathematics identities for students from diverse backgrounds, though not all scholars define it or operationalize it in the same way ((DIME) Diversity in Mathematics Education Center for Learning and Teaching, 2007; Boaler & Greeno, 2000; Cobb, Gresalfi, & Hodge, 2009; Horn, 2008; Bishop, 2012; Jilk, 2007; Nasir & Hand, 2008; Nasir, Hand, & Taylor, 2008; Sfard & Prusak, 2005). These scholars focus on different aspects of practice to understand how students negotiate classrooms and take up or reject opportunities for engagement. In particular, Martin's (2006) definition of mathematics identity is useful to capture the way identities develop over time and are negotiated in and across mathematics settings. He defined *mathematics identity* as:

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 or 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 performer unable to do mathematics, but often flowing back and forth). (pp. 206-207)

Martin's definition captures the idea that identities are negotiated over time and may look different in different contexts as people see themselves as mathematically competent in relation to particular mathematics contexts. But there is also a part of mathematics that are more stable self-concepts – the “deeply held beliefs” about who someone is in relation to mathematics.

Nasir & Hand (2008) conceptualize how people relate to practice as *practice-linked identities*. They wrote that practice-linked identities are “the sense that there is a connection between self and the activity.” Practice-linked identities are the identities that people come to take on, construct, and embrace, that are linked to participation in particular social and cultural practices (p. 147). They argued that practice-linked identities are formed through engagement. They drew on Furrer & Skinner’s (2003) definition for engagement as “active, goal-directed, flexible, constructive, persistent, focused interactions with the social and physical environment (Nasir & Hand, 2008, p. 145). Practices, by virtue of their organization, norms, conventions, and structures afford different levels of engagement for participants, and thus differentially support the development of practice-linked identities (Nasir & Hand, 2008, p. 147). They defined three aspects of practice through which to study engagement that potentially leads to practice-linked identities. These three aspects are:

- 1) *opportunities to access to the domain of knowledge in the classroom*: What opportunities does a student have to learn about the specific tasks and skills that provide access to mathematics?
- 2) *opportunities to take on integral roles in the classroom*: To what extent are participants held accountable for particular tasks in a practice, and to what extent are they expected to become competent and even expert in some skills or tasks?
- 3) *opportunities for self-expression*: How can students be themselves, and make unique, valued contributions to class?

In their research, Nasir & Hand (2008) argued that for two African American male high school students, deep engagement across all three aspects in a practice of “basketball” is connected to the development of practice-linked identities in basketball. Conversely, “inconsistent” engagement in mathematics for these same boys lead to less opportunities for them to integrate the practice of mathematics into who they were becoming, and therefore less practice-linked identities.

Sociocultural theories of identity offers a way to think about how social sites mediate identity development, through close attention to norms, conventions, and participation. However, sociocultural theory itself is not complete for shedding light on the experiences of students of color in the public

education system of the United States. A Critical Race Theory (CRT) perspective is necessary to challenge the dominant ideology that any educational space is race neutral (Ladson-Billings & Tate, 1995; Yosso, Smith, Ceja, & Solorzano, 2009). Martin (2009) wrote, “Dominant beliefs about who can do mathematics and who has opportunities to succeed in mathematics are informed by societal meanings for race and influenced by White-Other power dynamics” (p. 297). These ideas are often constructed in an implied racial hierarchy, structured around the success of Whites and Asians, and underachievement of all other groups. Cammarota (2004) also found that when students had knowledge of dominant racial hierarchies they could engage in resistance, by doing well in school to challenge stereotypes. This is a necessary dimension of studying students of color, to acknowledge their agency in negotiating their multiple identities.

Clearly, even in the microculture of a math classroom, dominant beliefs that stem from students’ interpretations of what it means to be Latino/a as well as prevailing stereotypes about Latino/as in relation to school mathematics can play a role in the mathematical identity development of Latino/a students during the most mundane of mathematics lessons. In the previous article, I elaborated on how both racial and linguistic identities impacted the sense of agency Latino/a students felt they could display in their own learning and in the learning of others in their algebra classrooms. The classroom analysis here is undertaken with these findings in mind. Engagement in these classrooms is also examined from the point of view of how opportunities for engagement are undertaken within larger discourses of racialized achievement and localized agency students display.

To summarize, the classroom as a particular context for engaging in mathematics can impact student identity through the kinds of opportunities for engagement afforded in relation to the domain, taking on integral roles, and self-expression. An analysis of classrooms as racialized spaces and how these spaces matter for students historically marginalized by schooling, such as Latino/a youth, could be well informed by CRT in addition to sociocultural learning theory.

Next, I review literature on aspects of mathematics classrooms that impact engagement, and in keeping with the focus of this research review research that suggests 1) disciplinary contexts can impact

opportunities for engaging with mathematics, and some non-traditional context have been productive for Latino/a students' mathematics identities 2) small group settings and whole class discussions are distinct settings for engagement for students, and especially Latino/a students who are Emergent Bilingual (EB) students, and 3) how the overall climate of the classroom (social contracts, and breaches in such contracts) can make some students feel that they can be more central participants, while marginalizing others.

### **The Role of Disciplinary Context: Shaping the Domain**

The *disciplinary context* includes the formal mathematical knowledge of interest for the class, and is the platform through which mathematics gets worked on. For example, algebra as a domain of knowledge may make for a different disciplinary context than what is probably expected in a geometry class, but it is not just the difference in the disciplines that makes up the disciplinary context, rather what it means to do algebra in a particular classroom is also dependent on other factors that together make up the disciplinary context. By adopting the term disciplinary context the curriculum, the decisions teachers make about the curriculum, and the important features of the particular domain of knowledge (such as algebra) can be accounted for within the same structure. Teasing out each dimension is not the focus of this study. However it is necessary to account for the disciplinary context as a whole because of the potentially different kinds of engagement it may support.<sup>13</sup>

The disciplinary context is important to attend to because it influences how students engage with mathematics, and in addition may create barriers for engagement. At the middle and high school levels, teachers may pose multiple problems that pertain to particular real world contexts, in which case the disciplinary context would be the real-world contexts and the way these contexts support engaging in mathematics. Boaler (1993) wrote that the general motivation for doing mathematics in particular

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<sup>13</sup> For example, in a study of 220 high school teachers, researchers found that impact of reform oriented instructional practices on student learning was mediated by curriculum. They concluded that the relationship between use of reform-based instructional practices and student achievement is moderated by the "content and organization of the course," which suggests the need to consider how the particular mathematics domain and curriculum as implemented provide a platform for instructional practices (McCaffrey et al., 2001).

contexts (such as “real world contexts”) is to both motivate students and to support transfer of mathematics skills to real world situations. She critiques this stance, saying that the contexts students are most often presented to consider have unrealistic constraints or no relevance to their lives. In addition, mathematical contexts are never culturally neutral, and normally privilege the experiences of some dominant cultural group (Tate, 1994). Recently, equity scholars have argued for funds of knowledge approaches and other re-envisioning of disciplinary contexts for mathematics because of the power to change students’ relationship with mathematics by changing the disciplinary context to favor students’ ways of knowing (Civil, 2007). In particular, consider how very different the domains of mathematics may seem in a classroom in which the disciplinary context supports a view of the power of mathematics to critique social inequity (Gutstein, 2007), versus a disciplinary context that supports mathematics as a tool to manipulate naked numbers (which is more typical in classrooms). Scholars argue you cannot separate the content from how students engage with the content – that is, they mutually constitute the experience of doing mathematics (Gresalfi, 2009; Lampert, 2001). The disciplinary context can support or constrain opportunities for engagement namely by influencing what counts as competent mathematical thinking in relation to the domain of mathematics, and who gets positioned competently as a result (Hand, 2003).

### **Social Arrangements: Small Group Work and Whole Class Discussions**

The disciplinary context provides a platform for engagement in mathematics, and *social arrangements* are the major participation structures in which students engage in mathematics. Social arrangements are another means through which the domain of mathematics can be accessed with consequences for the way students perceive mathematics and therefore themselves as mathematics learners. In particular, Boaler and Greeno (2000) argued that differential participation and persistence in mathematics was related to how students perceived the domain of mathematics – as open for creation and discussion, or as an established body of knowledge to assimilate. In the discussion intensive classrooms in their study, students were more likely to report a desire to persist in mathematics when mathematics was

presented as open for debate. In addition, different social arrangements also present different opportunities for students to take on integral roles and participate in forms of self-expression.

Two major social arrangements have been identified in the literature as unique contexts for student engagement: small group settings (including partner work) and whole-class discussions. Interaction with others in and across social arrangements involve person to person talk that helps position students as particular kind of mathematical people over time (Gresalfi, 2009; E. Turner, Dominguez, Maldonado, & Empson, 2010; Yamakawa, Forman, & Ansell, 2009). Though discursive practices may be similar across each social arrangement, each setting provides particular risks or challenges to participation for students, as much as they provide particular rewards or pay offs.

### *Small Group Settings*

Research on how students participate in small groups suggests that small group settings afford distinct opportunities for student-to-student collaboration, while also reifying status differences among students (Boaler, 2008; Esmonde, 2009; Bishop, 2012). Status differences may be problematic because they impact students' perception of competence: high academic status students are seen as more competent than others, while re-enforcing students' perceptions that as low status students they are not competent (Boaler, 2002). Status differences can be reinforced and become obstacles for learning in small and whole group contexts through who talks the most and whose ideas are focused on the most. Research in Complex Instruction suggests that when facilitated successfully (including implementation with departmental support) groupwork can be a powerful tool for equity in classrooms and minimize status issues that arise from status differences among students (Boaler & Staples, 2008). Minimizing status issues can result in broader distribution of who is competent in the class, and allow for students to take on integral roles for each others' learning as they see classmates as important resources for doing mathematics.

Working in groups can also have drawbacks or pose risks for students. In their study of when groups worked well, Esmonde, Brodie, Dookie, and Takeuchi (2009) found that students thought interactional styles, mathematical abilities and friendships were important factors to consider in whether a

group worked well or not. Students reported the negative affects of friendships on groupwork, expressing pressure to socialize, and that when they tried to work with friends they don't often get anything done. This was in tension for students with the need to have good relationships with people to work with them, though it seems that if someone's relationship was purely social it could be hard to transform it into a productive work relationship in the classroom. Bishop (2012) also described in her study with sixth grade girls that while the friendship itself was not central to how each student positioned herself differently in relation to mathematics, two students who were very good friends had many ways in the classroom that they reinforced different and consequential academic status between the two of them. They subscribed to a particular belief that one was better at math than the other, and this position was reinforced over time through whose ideas were pursued most often in their group, among other signs of differential status leading to status issues.

In particular for Latino/a students, Zahner (2012) studied how two groups of bilingual Latino/a youth solved problems that required conceptual generalizations in an afterschool setting. He found that the group that engaged in more open-ended discussions marked by balanced relations of authority was also more likely to correctly solve a problem about generalizing an algebraic function, which the other group, marked by one student normally holding all the authority, did not often solve problems successfully. Zahner's work is important because it is a unique study focused on Latino/a youth that explores the performance results on how students negotiate authority in small groups. In the previous article, findings from students perspectives showed that Julieta, an EB Latina student in this study, valued the small group setting because she could learn mathematics in Spanish with her partner, whereas whole group discussions were in English, which may have been harder for her to access.

The research on small group settings suggests that concurrent to and even through mathematics engagement, peer-to-peer status issues are being negotiated. Students may take on integral roles to each other in these settings, as other students position them as authorities, necessary helpers, experts, or resources for their own learning. At the same time, peers may position each other as having lower academic status for any number of reasons. Further, academic status issues may be superceded by issues

arising around social status for students who are good friends and find it challenging to engage in mathematics together.

### *Whole Class Discussions*

Whole class discussions are social arrangements in which status and discursive positioning play particularly consequential roles for student identities (Lampert, 2001; O'Connor & Michaels, 1993; Turner et al., 2010; Yamakawa et al., 2009). Among other sources, students get messages of what it means to be a good student, who is smart, and where they fit into the classroom as a learning community from how their ideas are *revoiced* (O'Connor & Michaels, 1993) during mathematics discussions, how their contributions are seen as valuable or not to a discussion, as well as how they position themselves as active contributors or passive participants during discussions. These messages can be, but are not necessarily related to actual mathematical competence, but as scholars have shown can also be related to teachers' perceptions of student competence (Moschkovich, 2007; Spencer, 2009), teachers' willingness to characterize students' contributions as competent, or oppositional (Hand, 2009), and whether students' preferred language of participation aligns with the dominant language in the classroom (Enyedy et al., 2008; Turner et al., 2010). Turner, Dominguez, Maldonado & Empson (2010) drew on positioning theory and in particular discursive positioning to examine what particular discursive moves teachers could use to position EB Latino/a students as having mathematical authority during discussions in an afterschool mathematics club. They identified seven distinct ways that the teacher positioned students as agentive problem solvers and people with mathematical authority in the course of mathematics discussions, including privileging learning and communicating mathematics in Spanish, valuing a new strategy to solve a problem as a different contribution, positioning EB students as having a mathematical basis for his or her strategy, attributing a corrected, refined, version of strategy back to the EB student who initiated it, and clarifying ideas while maintaining the EB student in an agentive, problem-solving role. Though not a central piece of their analysis, they presented evidence from student interviews that the frequent use of these particular discursive moves had positive impacts on many students' mathematics identities, with students reporting both enjoying the mathematical discussions and feeling like they came out of math club

as a good mathematician. The power of participating in whole group discussion is that a student's relationship to mathematics can be shifted through multiple events over time in which they are positioned as competent. In this way, displays of competency in front of the whole classroom are important over time for the mathematics identity development of Latino/a youth.

### **Connectedness, Social Breaches, and Classroom Communities**

What makes a classroom welcoming or unwelcoming? Studies at the school level have found that as institutions, schools can be welcoming and unwelcoming places for students from different backgrounds, especially for immigrant students (Gitlin, Buendía, Crosland, & Doumbia, 2003; Valenzuela, 1999). Mathematics classrooms are also places where students can feel welcome and unwelcome. Feelings of marginalization or not belonging are not always overt or racialized, but rather can be also about the expectations of the kinds of cultural practices that may clash (Hand, 2009). And at the same time, students navigate racial stereotypes and hierarchies of achievement that may manifest corporeally in their classrooms as feelings of marginalization, and impact their achievement (Martin, 2006; McGee & Martin, 2011; Solórzano, 1997; Steele, 1997). Mathematics classrooms are racialized spaces where students and teachers navigate their own racial identities, and the racial identities of others (Martin, 2009; Spencer, 2009). In particular for Latino/a youth, students navigate stereotypes that position them as less competent, "violent," and "alien" (Martin, 2009; Solórzano, 1997).

Prior research with Latino/a high school students and schooling has emphasized the role of connectedness. In many ways, this idea relates to mathematical identity, since a construct like practice-linked identity emphasizes the connection between students and mathematics. Valenzuela (1999) described the need for Latino/a high school students to feel connected to school and experience authentic caring, so that they feel like school is a place they belong before they can even begin to think about how they will get through mathematics class. Gutiérrez (1999) chronicled how a high school with a high Latino/a population was helping all students succeed in mathematics through connecting with students in informal spaces (like between classes). Gutstein (2006) used the context of critical mathematics to cultivate *cultural identity* among his Latino/a and African American students, which is a form of feeling

connected to a larger community of people through symbolic solidarity in struggle and sometimes real local activism.

In the previous article I discussed how some Latino/a focal students in this study subscribe to stereotypes around success of Asian students as real consequences of success derived from the culturally practices in which they engage: studying all the time, reading books everywhere, eating lunch while they walk down the halls with books. These essentialized notions of Asian students are problematic for Asian students and for Latino/a students, but may have a real impact on students who perceive of themselves as less competent when in classrooms with Asian students. This particular aspect of stereotype negotiation has not been explored in the literature.

Though differential power dynamics such as those associated with racial hierarchies of achievement are not always salient in mathematics classrooms, ruptures in social contracts, such as bullying or arguments between teachers and students, can bring power dynamics to the surface of classroom interactions. These ruptures are not often reported in research on mathematics classrooms, but are important to pay attention to when they occur to understand how they impact the sense of community or safety in the classroom. As is typical, teachers normally introduce the rules that become classroom norms for participation. As these norms are negotiated through talk and posturing over time, particular social patterns are established that create social contracts between people in the setting (Goffman, 1981). As Hand (2009) wrote, classrooms are places where particular cultural practices are more valuable than others, which can marginalize some students who do not identify with the dominant culture in the classroom. When these social contracts are breached, such as in a power struggle between a teacher and student, the consequences can be detrimental for students in the classroom who may feel marginalized by the display of events. In her study of how opposition is co-constructed by teachers and students in a de-facto low-track classroom, Hand (2009) argues that the presence of a *polarized* participation structure, rather than a *flexible* participation structure, helped set the stage for the creation of an *oppositional* participation structure. In a flexible participation structure, broader ways of students' cultural ways of being outside of class are acceptable as ways of being in the classroom, whereas a polarized structure

typically has narrowly defined acceptable ways of being and is typically constrained by rules the teacher dictates. Flexible participation structures mean students and teachers negotiated competence in the classroom, whereas polarized structures constrain what it means to be competent, as well as who can be competent. Hand (2003) argues that polarized participation structures may lead to oppositional ones. In addition, her study suggests that students low perceptions of mathematics identities and lack of access to authentic mathematical practices (sense-making and conceptualization instead of procedural knowledge) also set the stage for an oppositional environment.

### **Dimensions of Practice that Matter for Researching Latino/a Mathematics Identities in Classrooms**

Collectively the research shows that the kind of identities students can construct in relation to mathematics depends on opportunities to engage in the particular domain of mathematics in the classroom, how that domain is presented, and opportunities for students to be themselves while at the same time take on integral roles for other peers and in the collective goals of the classroom as a whole. This research also suggests that though status and positioning are negotiated in both small group and whole class settings, each participation structure presents different kinds of risks and rewards for participation. Further, as student navigate their classrooms their perceptions of whether they are the

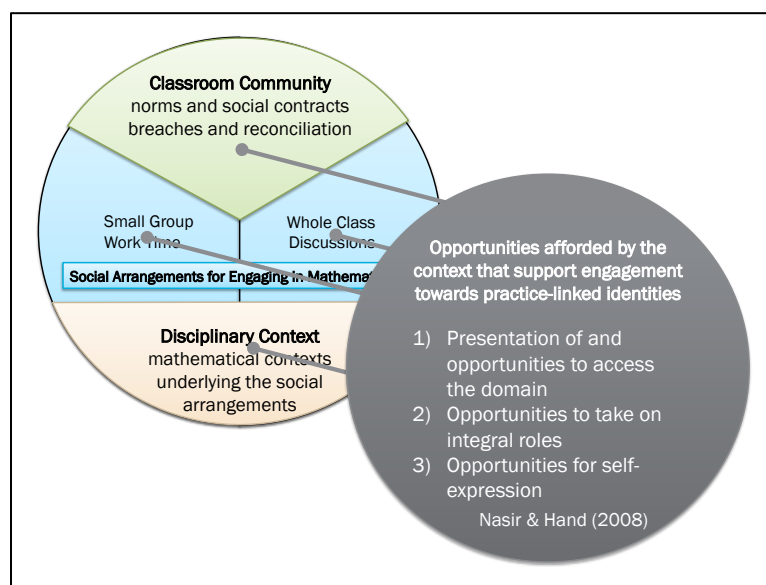


Figure 4: A Framework for Analyzing Mathematics Identity Negotiation in Classrooms

“right” kind of people to be doing mathematics (influenced by stereotypes or stereotype threat) play a significant role in how they decide they belong or not, with consequences for their mathematics identities.

The framework proposed for studying the opportunities for engagement in a mathematics classroom builds from the research reviewed above. In particular, the framework proposes to look at the disciplinary context, two major social arrangements, and breaches and reconciliation, through Nasir & Hand’s (2008) framework for engagement. This framework provides a guide for the analysis of the sociocultural level of mathematics identity shared in the previous two articles, and is informed by CRT as well as how students narrate their experiences. The framework focuses on the opportunities for engagement in three areas that together characterize the opportunities students have to develop practice linked identities: access to the domain, integral roles, and self-expression. In the next section I outline the methodology for this study, including how the framework was used in the analysis to examine each piece of practice for the way opportunities for engagement were constructed, and then how students negotiated those opportunities.

### **Methods**

To analyze experiences of students in classrooms settings, I drew on qualitative case study methodology (Merriam, 1998) to examine two reform-oriented discussion intensive algebra 1 classrooms. This study privileges the experiences of Latina/os (Solórzano & Yosso, 2002) to better understand their identity negotiation in mathematics classrooms.

### **Setting**

The two classrooms are discussion-intensive, multi-lingual, multi-racial settings in the most diverse high school (Southside High School) in this urban school district in the Pacific Northwest (32% white, 25% Black, 20% Hispanic, 18% Asian, 2% Pacific Islander, 2% Native American, 1% Other.) The participating teachers were two of three algebra teachers at Southside High School. Both teachers taught two sections of algebra 1 and two sections of another mathematics class. The Algebra 1 teachers had

common planning time, which lent to the coherence of mathematics objectives and tasks across classrooms.

### Participants

After recruiting the two teachers, we collectively decided which of each of their two Algebra 1 classes to focus on. Then seven Latino/a focal students were recruited out of ten Latino/a students consented to participate. The recruited focal students represent an attempt to recruit all the Latino/a students in each class at the time the study began<sup>14</sup>. The cases here represent variation among Latino/a youth: years in the United States, status as an emergent bilingual or monolingual English speaker, age, and continuity of education. Students also share some characteristics, such as all are either first-generation or immigrant youth, and all have Mexican heritage. Some data were not collected as they were not the focus of this research, such as whether immigrant students were previously schooled in rural or urban contexts, socioeconomic differences, family migration patterns, or a clear sense of the role students play in their home communities. A table with pertinent focal students characteristics is below.

Table 1: Characteristics of Focal Students

Teacher	Name	Grade/ Age	Previous Schooling	Interview Language
<i>Ms. Williams</i>	Marco	12/ 19	Mexico: graduated from preparatoria. Second year in US high school	Spanish
<i>Ms. Williams</i>	Julieta	11/ 19	Mexico: through secundaria, on and off. Second year in US high school	Spanish
<i>Ms. Williams</i>	Samuel	9/ 15	US Pacific NW	English
<i>Mr. Anderson</i>	Ignacio	9/ 15	US Los Angeles/ Pacific NW	English
<i>Mr. Anderson</i>	Anita	9/ 15	US Pacific NW	English
<i>Mr. Anderson</i>	Rubén	9/ 15	Mexico: primaria <sup>15</sup> . Middle School in Pacific NW	Spanish
<i>Mr. Anderson</i>	Luis	11/ 17	Mexico: on and off. Third year in US high school	English/Spanish

<sup>14</sup> Though two new Latino/a students joined Ms. William's class partway through the unit, they were not recruited into the study because they had not been present for a large chunk of instruction.

<sup>15</sup> *primaria* is approximately elementary school, *secundaria* is like middle school, and *preparatoria* is like high school in Mexico.

## **Data**

For this analysis, I focus on classroom data collected from one unit of instruction spanning November 3 to December 6 of 2010 in two algebra 1 classrooms. This resulted in 15 days of fieldnotes and videos in Ms. Williams' classroom (755 minutes of video), and 16 days in Mr. Anderson's classroom (710 minutes of video). Snow, holidays, fire drills, and teacher sick days partially account for why the unit spread out over 5 weeks and differences in total minutes of video gathered per class (45 additional minutes in Ms. Williams classroom). This school used a block day schedule, which meant that students attended an extra-long 100 minute period one day a week, and 50 minutes periods three other times during the week. Though the expectation on teachers was that they should cover twice as much material in a 100-minute period, this was not the case. By their own reporting, Mr. Anderson and Ms. Williams rarely moved through all the material they had planned for these "double periods." Every class period is counted as one lesson in my analysis, whether it is a fifty-minute period or 100 minute period. In addition to the videos and fieldnotes, student and teacher interview data reflecting attitudes and beliefs about various aspects of mathematics learning and teaching are used to triangulate or at depth to the observational data analysis. I collected task cards and other curricular materials for every lesson, resulting in eight distinct task cards across the unit, one review packets, and other materials such as exit tickets and warm up hand outs. The limited number of task cards represents both how teachers spent multiple days on some tasks, and also that rather than provide a task card the teacher would post the problem on the overhead and students were to copy it (this happened more towards the end, putting up tables of values for students to figure out if they represented a linear relationship or not.) At the end of the unit, I collected all classroom students' unit tests (before the teacher scored them) as a measure of how students were displaying knowledge by the end of the unit.

## **Analysis**

Consistent with qualitative methodology, data analysis began during data collection through researcher journaling and analytic memos. These memos and journal entries were useful to guide initial analysis on emergent themes impacting students' negotiation (Charmaz, 2003). For example, early

reflections thematically point to the role of navigating language (language of instruction, language the IA engages you in, language and peer groups) for the EB Latino/a students, and my perceptions of the way disconnections seemed prevalent for particular EB students during whole class discussions. Post data collection, task cards, videos and fieldnotes from each lesson were used to create a map of the trajectory of mathematics across the unit by examining the explicit mathematical goals for each lesson (often written on the board in class, or on the top of task sheets), and the mathematics expectations on students (emergent from what the task calls for). This map was used to construct the disciplinary context in which students and teachers engaged in mathematics in their classrooms. An overview of the unit derived from this map is presented in the findings section.

Next, all classroom videos were coded for major features of how class time was spent. Every minute of instruction was coded for the kind of social arrangement (individual work time, small group work time, whole group discussion, or other) and further classified by whether it was related to a warm up activity or major task of the day, or exit tickets (the most frequent activity coinciding with individual work time in both classes). During this process, attention was also paid to the general climate of the classroom across all moments. Particular moments of big social breaches were flagged for further analysis, such as bullying episodes in Mr. Anderson's class, and particular interactions between Ms. Williams' and one of her students that seemed to disrupt the social order in the classroom. This analysis resulted in frequency counts and distinct patterns in how class time was divided among major social arrangements in which students engaged in mathematics, and moments of social breaches to return to for further analysis.

I then selected six lessons from each classroom to look for patterns in interactions and participation using the lens of my analytic framework and Grounded Theory (Strauss & Corbin, 1997). The initial six lessons were selected because they represented a range of activities in the unit and had points where the mathematics context shifted (such as launching a new context) or where mathematical ideas reached conceptual milestones (such as the day the explicit rule for a linear equation was introduced after multiple lessons focusing on recursion.) I open coded classroom lessons using Studicode

(qualitative analysis software for video data). I coded for participation of focal students in both small group and whole class settings. Because of the limited video data focused on the whole class, the small group coding was also informed by fieldnotes, where I had noted who was working on mathematics when, and where I recounted particular conversations with students around mathematics or other topics (such as general attitudes towards math or algebra in particular.) Using Studiocode, I noted the details in the fieldnotes in coded episodes to add more depth to my analysis of videos. Studiocode was also useful to generate and confirm patterns in which students were engaged in mathematics, or socializing. Because of the limited video data of small groups working, these two codes became particularly important to understand what students typically did in math class.

As I coded, an initial coding scheme focused on characterizing student and teacher's engagement (both productive mathematical and other observable non-mathematical) in class was refined and checked back against previously coded videos. (See sample codes in Appendix B). After coding the initially selected six lessons, I reviewed emergent themes across all the video data, focusing on opportunities for engagement in whole class discussions and small group work time, and emergent critical events that impacted the classroom community (social breaches and reconciliation). This analysis was aided by Studiocode's "timeline" feature which allowed me to select and watch all instances with a particular code to better understand patterns in student engagement or teacher moves. For example, I reviewed episodes coded for teachers positioning students competently during whole class discussions to analyze for which teachers this was a particular feature of their practice, and how they did it. These themes were documented in analytic memos. The frequency counts from teachers' codes in this analysis were also used to count what codes were most frequently applied to teachers during whole class discussion.

The themes that emerged from the initial video coding were checked against the rest of the unit's videos in a two-step process. First, emergent patterns in who participates in whole-class discussions and how they participate (voluntary, non-voluntary, elicited by the teacher) were checked against all the video coded as whole-class discussions. This analysis resulted in confirmation that students exhibited consistent behavior in the classroom, with few exceptions, and that teachers exhibited particular patterns as well,

with few exceptions. This analysis also indicated that students did not necessarily participate in the same way across social arrangements. For example, a student may have been inconsistently engaged in mathematics during small group work time, but then exhibited fairly consistent engagement during whole class discussions, as is the case of Luis in Mr. Anderson's class. Second, emergent patterns in small group from the initial six video analysis were checked against all episodes coded as small group work time and compared with fieldnotes as necessary (such as when camera angles make it hard to see what was happening for particular focal student). This again confirmed stable patterns in how students' engaged in small group work time with few exceptions. Exceptions to patterns in participation were noted in analytic memos as well, and inform the findings.

Finally, student and teacher interview data was analyzed for connections and consistencies between the emergent findings in the video analysis and how students' explained their participation and factors that impacted their participation in class. Because language and knowing what to do in class was a salient issue for EB students, I again reviewed the task cards and videos of how EB students in Ms. Williams' classroom<sup>16</sup> initially engaged in tasks during small group work time to look for connections in how access to the domain of mathematics was supported or barred by the task cards as a central piece of the curriculum in the class.

### **Overview of Classroom Contexts**

Before moving on the findings, it is useful here to provide short sketches of Ms. Williams' and Mr. Anderson's classrooms to add more context to the analysis of opportunities for engagement in their classrooms. The two classrooms had certain similarities. A typical day included starting with a warm up, discussing the warm up as a class, launching the main task (or first task on block days), providing a block of time for students to work in groups, bringing the class together for a discussion about the task, possibly an exit ticket, and finally dismissal. On block days, another task might have followed the first task

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<sup>16</sup> I elected to review how they engage in tasks in Ms. Williams' class because her two EB focal students exhibited consistent patterns of engaging with the mathematics, while in Mr. Anderson's class the engagement was less consistent, and made it harder to understand the influence of the task card on engagement.

discussion and then be followed by another whole class discussion. In Ms. Williams' class, she sometimes brought the whole class together for a short discussion to address a sticking point in the task before sending students back to working on it. There are other features to note about each teacher's classroom as well.

*Ms. Williams' Classroom*

Ms. Williams was an older, white, female teacher, who had been teaching for twenty-four years at the time of this study. She credited her Masters program with influencing how she thinks of learning mathematics a social process, and the importance of building on prior knowledge:

I kind of always was jumping at the research that says you know kids learn in a social environment, kids learn when they can talk to each other, kids learn when they're doing math, as opposed to memorize and maybe a connection would be made, maybe not. Kids learn when there's lots of connections to their own life, to what they can see, what's intuitive what they understand. Kids learn what you build on their knowledge, that they don't come as empty slates. That they come knowing a whole bunch of math it's your job to try to help them see what it is.

(Ms. Williams, Interview 1, November 2010)

She described her ultimate goal for students in her class as:

To have them look back and also look to see how they've grown as a student of mathematics. Not just a student, but a student of mathematics. Thinking that I've gained some skills, I'm more confident now about math, especially about algebra, than when I walked in, and some kids walk in here pretty afraid of algebra, I will say that. Um, and I'm hoping those kids in particular walk out feeling at the very least not intimidated by it...About being able to sit down and have the skills to at least begin tackling the problem with the mindset yes I can do this maybe I won't be able to get it immediately but I know that if I put the time and effort into it I will get it eventually.

(Ms. Williams, Interview 1, November 2010)

Students were seated in seven groups of 3-4 students each, with four desks pushed together. The teacher would sometimes move students around if members of their group were absent so that students were rarely seated alone.

Students in the class spoke many different languages at home, as I learned through getting to know them. In the classroom, English and Spanish were used by students frequently, and less frequently Somali. Two particular bilingual Spanish-English Language Instructional Assistants (IAs) were present twice a week to work with students who qualified for EL services: Marco and Julieta. One IA spoke Spanish with students while working on math, and one who would work almost exclusively with Julieta switched to only responding to her in English a few lessons into the unit. Ms. Williams' had asked the IA to speak only in English to Julieta because she believed Julieta needed more opportunities to develop academic English. Because of the presence of the language IA, Ms. Williams would sometimes not check on Julieta, an oversight on her part, she said in her end of semester interview, that she would do differently if she had the chance to do it again.

Ms. Williams taught with urgency, with a "no time to waste" attitude, often reminding students of the expectations for the kind of people they should be in her classroom, and calling out off-task behavior to get students back on track. She responded quickly to off-task behavior and student-to-student antagonism with a zero-tolerance policy.

#### *Mr. Anderson's Classroom*

Mr. Anderson was a white male with longish hair, beard and glasses in his early thirties. Mr. Anderson was new to the school, having taught 8<sup>th</sup> grade mathematics at a nearby middle school for the last three years. This was his fifth year teaching. Mr. Anderson spoke Russian, and spoke in his interview about important multilingualism is and how undervalued it is in our society. Mr. Anderson described how a standards-based system formed the foundation for how he framed goals for his students, and how addressing the needs of every student is one of the reasons he needed to rely on groupwork:

And so my goal is to work with each student as much as I can to make sure that they're getting to the point where they can demonstrate mastery, wherever they started. Um, I need to target some

students more for individual help. Um, and I need – and with that is part of the reason why the Complex Instruction is so important, because um when you are able to use your peers as resources, then I can really focus my energies to the students that *need* my help rather than the students that are *asking* for my help. (Mr. Anderson, Interview 1, November 2010)

Like Ms. Williams, Mr. Anderson spoke about how he had elements of Complex Instruction (Cohen, 1986) in place (such as how students sat in groups, students were assigned roles but were not enforced, and students were encouraged to use each other as resources), but stopped short of characterizing his classroom as doing Complex Instruction. His classroom had eight tables, and normally he had seven table groups of 3-4 students. Sometimes students would leave their assigned seats and make new table groups. Mr. Anderson did not consistently move them back to their seats, but rather would wait and see what the outcome of the new group meant for being on task. On task groups were left to their work, allowing Mr. Anderson to circulate and then settle with particular table groups needing his attention.

Multiple languages were consistently used to make sense of mathematics in this classroom, including English, Spanish, Tagalog, and Somali (other African languages may have also been spoken at times by the six students from Africa or with African heritage in this class.) A bilingual English-African language IA (or possibly multi-lingual, unspecified, but included Somali) was present twice a week. He most often sat with an older African student, though he sometimes gathered more EB African immigrant students at his table. Even though the language IA was there, Mr. Anderson would also be sure to come by their table and monitor their progress.

Mr. Anderson's style contrasted with Ms. Williams. He always spoke in calm, measured tones. Nothing students said or did provoked an overly emotional reaction. If a student crossed a line, such as when Jim spontaneously insulted a classmate's intelligence by shouting something loud and derogatory across the room, Mr. Anderson immediately calmly and firmly told Jim to go outside and wait for him. Discipline in the classroom was most of the time re-orienting students to being on track, whereas serious infractions were handled in the hallway teacher to student, or sometimes with multiple students and the teacher. Mr. Anderson also let student input guide the pace and direction of many whole class

discussions. He had no problem making the whole class wait while he pressed a student to share an idea. This could create tension between the students who just wanted him to get to the point, and Mr. Anderson's dedication to, at least attempting, to position students as competent through whole class discussions.

### *Student Perceptions of Their Classrooms*

The students' perspective helps situate the findings from the classroom as they may provide insight into how students navigate opportunities for engagement. The focal students in both classes reported that they liked their teachers, that they thought their teachers knew a lot of math, and that they respected their teachers. They spoke of these relationships as very "normal," with no particularly good or bad things to say about the teachers. However, some focal students in both classrooms also commented that class wasn't normally very interesting. Ignacio, a student in Mr. Anderson's class, was the most outspoken about how he didn't like his algebra class, saying the work was kind of easy and that the class is "always work, work, work. ...in that class like what I feel is that it's work all through all of it and like you can't have fun at any time" (Interview 2, February 2011). Anita, also in Mr. Anderson's class, thought more could be done to make class interactive and interesting, and referenced activities her fifth grade teacher had used, like "around the world" or other activities (Interview 2, May 2011). Even Marco and Julieta, two students in Ms. Williams's class who were positively identified with math, critiqued how class could be boring. After watching a short video clip of her class in November, Julieta suggested that while her teacher, Ms. Williams, was certainly helping the students learn, she said, "Pero creo que yo opino que es una manera muy, uh, ordinario de hacerlo y tal vez eso es porque los estudiantes se aburren. .. yo digo todos los días debería hacer una cosa diferente/ *I think that it's a very ordinary way to do it, and I think that's why the students get bored. I think that every day she should do something different*" (Julieta, Interview 2, February 2011). Julieta's comment was about how mathematics could and should be made more interesting. She also continued by suggesting her teacher should interact with students differently, describing how the teacher could be more "amigable/friendly" with the students and try to cultivate relationships with them more. But in his second interview, Marco also added that students in the

class didn't respect the teacher enough (Interview 2, January 2011). Their two perspectives are a good reminder that productive relationships in the classroom are co-created between teachers and students.

### **Findings**

The findings show that coordinating the multiple layers of classroom practice alongside layers of mathematics identity adds insight to the ways that Latino/a youth take up some opportunities for engagement, while resisting or refusing to engage in others. The Latino/a students in this study navigated each social arrangement differently: sometime to learn mathematics and position themselves as mathematically competent, and sometimes to participate in self-expression that was not connected to mathematical work. In Ms. Williams' classroom, the focal students found productive ways to negotiate their identities within the major social arrangements, while in Mr. Anderson's classroom Latino/a youth rarely took active participant roles, with consequences for their ongoing mathematics identity development. The underlying mathematics work in both classrooms, the disciplinary context, was another important layer to consider because of the way language issues were made salient through the ways tasks were given to the class. One critical trajectory of conflict and reconciliation is considered in Mr. Anderson's classroom in which cases of bullying were brought to a head, explicitly addressed with the class, but may have still remained influential in the choices Latino/a students make to not speak during whole class discussions. I argue that such episodes should not be ignored in the research on mathematics classrooms, but rather explored for the impact they may have on the community of learners, especially if such critical episodes could potentially alienate students who already feel marginalized.

#### **The Disciplinary Context and Opportunities to Access the Domain**

The disciplinary context served an important function in supporting or constraining students' opportunities to access the domain. As the main platform underlying the social arrangements (small group work time and whole class discussions), the disciplinary context supported opportunities for broadening what counted as productive mathematical contributions during whole class discussion and small group work times, because most mathematical tasks were presented in particular real-world context. In particular, the disciplinary context allowed for broader forms of participation in whole class discussions

for EB Latino/a focal students, but also at times presented a linguistic barrier as students first needed to understand the mathematical context.

The algebra teachers adapted the tasks that formed the disciplinary context of the classrooms from the Discovering Algebra book, chapter 3: Linear Equations. Across the unit, students explored linear relationships in five curricular contexts. A birds-eye view of the whole unit of instruction shows how the contexts over time were constructed to develop students' ideas about linear relationships. First, students explored recursive relationships in three contexts (toothpick patterns, time-distance traveling contexts, motion sensors and "walks"), then brought big ideas in recursive rules together by writing

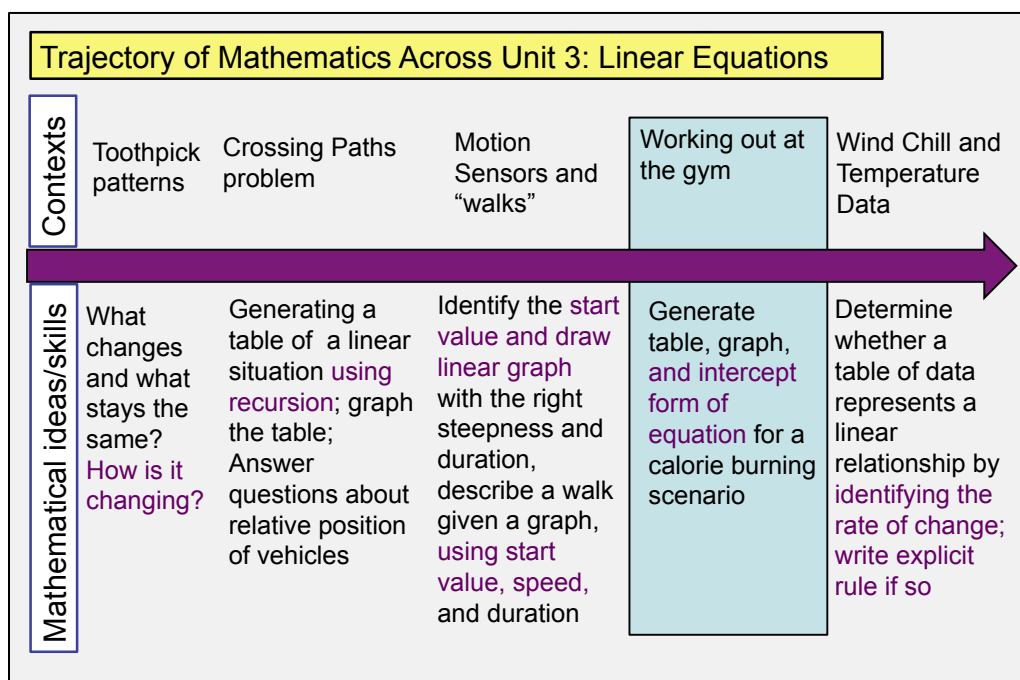


Figure 5: Trajectory of Mathematics Across Unit 3

explicit rules (the calorie burning scenario, identifying start values, and rate of change), and finally having to decide whether a situation was linear (the wind chill factor data), and if so being able to identify rate of change and write an explicit rule. See Figure 5 for the approximate trajectory of mathematics in this unit.

The everyday language used to explore the everyday phenomena in the curricular contexts appeared to support a broad access to the domain of mathematics as students could participate in whole-class discussions by talking about their understanding of the context, and the teachers could help bridge

the contextual knowledge with formal algebraic knowledge. Though teachers had important distinctions in how they lead whole-class discussions, a pattern across both classes is that contributions around understanding important features of the curricular contexts were taken as legitimate and important contributions to whole class discussions. This pattern emerged from analysis of the whole-class discussions and how teachers responded to any contributions made by students. For example, early in the unit, the crossing paths context required students to understand that a vehicle traveling south and starting at the Mackinac Bridge had an initial value of 220 and its position got closer to zero over time, whereas a vehicle starting at Flint and going north had an initial value of zero and its position got closer to 220 over time. The algebraic concepts that are important features of the real world context are the initial value, and the speed in a particular direction. With these two pieces of information, the students could generate a table of values or a graph to show where and when these vehicles would cross paths. In Ms. Williams' classroom, shortly after distributing the task card, the first whole class discussion she had around this task was making sense of what the starting locations (cities) of the vehicles meant for the purposes of generating recursive rules for the vehicles (initial values.) Students shared what they knew about the situation to help make a picture that supported their understanding of how to generate the recursive rule for each vehicle.

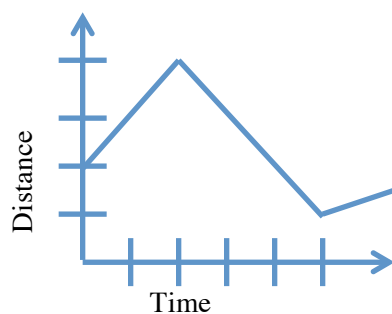


Figure 6: A Walk (Warm-up Activity)

In Mr. Anderson's classroom, the combination of mathematical contexts and visual representations supported the participation of Luis, and EB student, during this unit of instruction at least once by affording an opportunity for a gesture to be a valid mathematical contribution. In this classroom

excerpt, a whole group discussion is happening after the warm up, which was to describe the “walk” from a given linear graph (reproduced above in Figure 6). The teacher is going through table by table to describe the walk from the graph. He gets to Luis’ table:

T: Table 5, what does the walker do next?

*(waits 8 seconds. Luis looks up at the board, with pencil in hand. Table mate who usually talks for their group turns to look at Luis, looks back at board.)*

T: So which part of the graph are we talking about now?

*[Luis raises his left hand, brings it down quickly in a slightly diagonal motion towards his right hand, then back to resting his hand on the table.]*

T: Yeah, it’s this part right here, right?

*[Teacher traces the part of the graph that slopes downward, similar motion Luis used]*

T: So how can we describe what happens on this part of the graph?

*[Luis continues to look at the board, but does not answer the teacher’s question.]*

T: What did we do for the last question? We needed to know the what?

(Mr. Anderson’s class, Video 1, November 16, 2010).

By taking Luis’s contribution as valid, the teacher contributes to discursive, public positioning of Luis as a competent mathematical thinker, and then stays with Luis as a potential contributor to the rest of the discussion. These kinds of interactions over time are important for someone like Luis, who has previous negative experiences with algebra (have failed the previous year) but also speaks to his self-reported statement that his teacher believes he is good at math. As the research reviewed earlier suggests, opportunities to participate in whole-class discussions have potential to impact Luis’s self-perception over time, and this opportunity was supported by the disciplinary context and the ability to take Luis’ gesture as participation in discussion.

However, the disciplinary context also posed particular challenges to EB students in the class. The primary access students had to making sense of the mathematical contexts in both classes was the launching discussion before small group time to work on the task, and the task card the teacher

distributed. After that, students collaborated with language IAs or other students to get started. Eight task cards collected that accounted for most of the major classroom time across this unit (See Appendix C for task card names and associated contexts). The language of the task cards was English. In addition, these task cards had substantial stories or lengthy directions to understand to complete the tasks.<sup>17</sup> Teachers also put the objectives and norms for interactions on the task cards. This meant that on the one hand student had all the information they needed to both do the mathematics and engage in group work together, but this also meant that the task cards were text-heavy and students had to negotiate the linguistic complexity to reference directions and guidance.

While the task cards were written so that the mathematical activity was couched in a story, or in the case of the toothpick tasks situated in a mathematical modeling activity, students first needed to understand the context and important features of the mathematical context that they were working in. Once the teachers were done launching the tasks, tasks cards were the main source of information for the problem context and how to complete the task successfully<sup>18</sup>. For the EB students, there was an extra layer of sense making to begin to access the task that was not just about making sense of the cultural references in the context, as it may be for the English proficient students in the class, but also about making sense of the intersections of the context, any cultural references in the context, and translating it into words that make sense for themselves. The EB students in this study reported in interviews that the big issues for them with language in the mathematics classroom was that if you don't know the words, you don't know how to do the problems (see Appendix A). In particular, Julieta described in her first interview how she wished they would give more time to the students for whom English is not a first language because these students, like her, needed more time to understand the work:

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<sup>17</sup> Analysis for the linguistic complexity of the tasks cards was not undertaken in this study, as it is not a focus of the research, but rather a finding emerging from the experience of the focal students. However, Abedi and Sato (2007) provide guidelines for linguistic analysis of assessment items that may be useful to unpack the particular linguistic challenges for EB students that these task cards presented.

<sup>18</sup> Ms. Williams and Mr. Anderson varied in how they launched tasks, though most of the time they were briefly introduced with a purpose and with expectations for the product made clear. An indepth analysis of how teacher launch tasks is not undertaken here.

Julieta: Hay veces en que usar la otra lengua, que hablo pero no hablo perfectamente bien, como me atranco, y tengo que preguntar mas para saber.

I: Okay. Entonces el tiempo es importante para aprender.

Julieta: Mas que nada tienen que dedicar mas tiempo para las personas que ingles no es su primera lengua, por que no van a entender rapidamente. O que tambien podrían, no se, gente de su misma lengua para explicarles mejor.

*Julieta: There are times when using another language, that I do speak but don't really speak perfectly well, that I freeze up, and I have to ask more to know.*

*I: Okay. So time is important for learning.*

*Julieta: More than anything they have to give more time for the people for whom English is not their first language, because they won't understand quickly. Or maybe also, I don't know, people who speak the same language so they can explain to them better.*

*(Julieta, Interview 1, December 2010)*

The way Julieta described how she and other people for whom English was not their first language needed more time indicates that she was navigating an additional demand on her mathematical engagement that was linguistic. The linguistic demands may have in and of themselves created an additional layer that barred opportunity for engagement. In addition, Julieta is a student who in the previous section of the dissertation we learned a lot about her mathematics identity and intersections with her linguistic identity as a Spanish speaker. Her suggestion to have someone there to help with the students in their first language is a strategy that would also help cultivate her linguistic identity in the classroom, and in this way also support her mathematics identity. The way Julieta exhibited agency to support her own mathematics learning by working with Samuel was discussed at length in the previous dissertation section.

The findings from the disciplinary context suggest that while the mathematics-in-context approach increased domain access by broadening the linguistic and sense-making resources students could use to do mathematics, questions remain about how the linguistic challenges of the tasks may have

challenge EB students' abilities to take on integral roles in their classrooms. Some contexts may have created higher engagement as evidenced by students' on-task behavior, but the mechanism as to why there was higher engagement was not always clear. It would seem that mathematics in particular contexts may have not in and of itself expanded opportunities for engagement to students who are typically in the margins, especially students who are already marginalized by the language of instruction (such as students who may prefer to learn mathematics in Spanish). But this underlying layer of the whole classroom as a context is important to consider for the kinds of opportunities to access the domain, take on integral roles, and self-expression that are afforded in the two dominant social arrangements: small group work time and whole class discussions.

### **Different Engagement in Social Arrangements: Small Group Work Time and Whole Class Discussions**

The opportunities for engagement in the two dominant social arrangements were taken up differently by the Latino/a focal students. Findings suggest that the focal students in Ms. Williams class found that they could enact productive mathematics identities (through accessing the domain, taking on integral roles, and participating in forms of self-expression). In Mr. Anderson's class the focal students' engagement tended to be less productive and Mr. Anderson engaged in much more intentional attempts to position the focal students as competent mathematicians. A key difference in the two classrooms is that focal students in Ms. Williams' class may have engaged productively in social arrangement because small group and whole-class structures aligned with the kinds of opportunities they were looking for to learn mathematics, when analyzed in relation to their self-descriptions as mathematics learners. On the other hand, the consequences for non-participation may have been bigger in Mr. Anderson's classroom where the development of Latino/a students' mathematics identities could have benefited more from consistent productive engagement.

The classroom task analysis shows that instruction in both classrooms was roughly split into two major social arrangements for learning: small group work time or whole class discussion. (See Table 1 below for breakdown of class time across the unit). Both teachers also had time when the explicit

expectation was individual work time, for exit tasks in both classes and a new routine introduced during the unit for warm ups in Ms. Williams class that five minutes of individual think time come first.

The fact that so much time in each class was spent in these two distinct social arrangement for learning also aligned with how teachers felt that learning was a social endeavor, and so to support their students they needed to facilitate access to the domain through interactions with others. Ms. Williams’ described her philosophy as following constructivist thinking, and that learning is social (Interview 1, November 2010). Mr. Anderson also described his teaching philosophy as, “A lot of it comes from Vygotsky, in terms of scaffolding, in terms of zone of proximal development... I believe in the social construction of knowledge and so I try and create situations where my students can work with each other to talk about the mathematics and come to common understandings” (Interview 1, November 2010). Both teachers self-reported that because learning was social, they needed to create a learning environment that fostered collective sense-making.

Table 2: Percent Time Spent in Major Social Arrangements in Both Classrooms

<b>Social Arrangement (Percent of total time)</b>					
<b>Teacher</b>	Individual Work Time	Small Group Work Time	Whole Class Discussions	Other <sup>19</sup>	Total Coded Classroom Minutes
<i>Ms. Williams</i>	10	40	45	5	755
<i>Mr. Anderson</i>	2	51	47	0	710

The small group time was also where the language IAs often present in each classroom would work either one-on-one with particular EB students, or with a small group of students. Patterns in the video data suggest that their role was restricted to the small-group context, and that language IAs rarely supported students in participating in whole class discussions. The only notable exception is in Mr. Anderson’s class, where an older Somali EB student was called on to share an idea, and the language IA quickly and quietly helped him formulate his answer. On the video, the teacher uses wait time, then asks a

<sup>19</sup> Other time in Ms. Williams’ classroom accounted for housekeeping conversations (cleaning out table folders, organizing notebooks, moving students to new table groups, etc.)

follow up question to another table, then comes back to the EB student, who by that time is ready with an answer that's he's worked out using an African language and English with the language IA.

### *Opportunities Afforded in Small Group Settings*

A finding from this study is that the small group setting created opportunities for students to take on integral roles for each other's learning, and created possibility for self-expression as students engaged in peer-to-peer talk using informal language, and languages other than English. In both classrooms, small group work time as a particular social arrangement for engaging in learning mathematics was intended to provide access to the domain through collaborative sense-making, or for those who worked alone to engage in mathematics productively in those ways. During this time, teachers would circulate and work with particular students one on one, or engage the whole small group. Still, with only one or two adults in the classroom, students were left alone during large portions of small group time. Peer to peer relationships appeared to produce productive mathematical engagement for some students during this time and not for others. Patterns exhibited across both classrooms suggest that students often socialized with their own table groups or others during small group work time, even while engaged in the mathematics.

An interesting contrast between the two classrooms is how small group work time was leveraged by the Latino/a focal students. In particular, the small group setting appeared to be a more productive space for two students in Ms. Williams' class to work together, and one student to work alone. In Ms. Williams' classroom, the small group setting was integral for how Julieta, an older student whose agency in the classroom was discussed at length in Section Two, thrived in the small group setting not because she took on an authoritative role, but rather because she could work with a bilingual student, Samuel. Their partnership allowed her access to the domain of mathematics through mutual engagement in the task. On the video, Julieta and Samuel are frequently observed focusing together on the task card. Julieta often ran her finger along the page as she read the task card aloud translating as she went, which allowed Samuel to listen to what Julieta thought the card was saying and agree or correct as necessary. Sometimes

Julieta would stop and ask Samuel to translate a word for her, or ask for clarification of what the task suggested she should do. Samuel could translate the task, and Julieta and him could co-analyze the work.

The way Samuel and Julieta interacted allowed Samuel to take on an integral role in the small group context, and be a resource for Julieta. This was important to her, because engaging with her small group was how she felt most connected to the classroom as a community. As argued in Section 2, the perspective Julieta had on the importance of engaging with her small group was that it was her access to playing a role for the class. It seems that in Ms. William's class, the small group context was where Julieta and Samuel could take on integral roles.

The small group setting also opened up space for Julieta to express herself using the language of her choice – Spanish. For Julieta, this is an important form of self-expression because her linguistic identity is connected to her mathematics identity. The small group setting as a particular social arrangement allowed for Julieta to take the space she needed to engage productively in mathematics, and both reinforce and shape her identity as a competent, math-loving Latina. It's important to note in Julieta's case that her experiences in this setting were very positive, even though she was not performing at where she should have been to meet standards by the end of the year as evidenced on her final unit test.

In Mr. Anderson's class, the small group work time, which was roughly half of the instructional time in his class, did not appear to be as productive a space for focal students as Ms. Williams' class. Patterns in the video analysis suggest that two Latino/a focal students, Anita and Rúbén, were frequently engaged in off-task behavior in Mr. Anderson's class during small group work time (socializing, drawing, doing other work), and less-frequently engaged in mathematics, either alone or with their group. Luis did not necessarily start a task, but could keep working in a task once started on it by an adult, and Ignacio tended to not be engaged in mathematics or socialize. Ignacio was in a group with two students he didn't really know, one of whom was an African American student who preferred to work by himself, and who was named in focal student interviews as someone smart in the class; the other was Luis. Ignacio would often sit quietly and simply do nothing, until an adult would engage him. Luis would similarly sit quietly staring at the task card, or drawing, or started on a particular task, like making a table, would punch

numbers into his calculator and do the table. Other students in Mr. Anderson's class would consistently use small group work time differently, to complete math tasks. These are typical things we might witness in any mathematics class.

Though small group time was space for peer-to-peer sense making and accessing the domain, for students like Anita and Rubén who were good friends outside of class, their social roles outside of class may be more salient in class. I posit that their friendship may have made it hard for Rubén to see Anita as someone important to his math learning, even though Anita named herself as someone important for Rubén. While she exhibited agency in taking on a particular role of a helper to Rubén, in the small group context their social roles may have seemed more salient. In his second interview, after watching a short clip of his classroom and commenting on what he noticed about students in the class, I asked Rubén what he thought his roles was in the class. He said, "Platicar/ *to chat*," then laughed, and continued, "No, pero sí hago mi trabajo/ *No, but yes I do my work*." The way Rubén described how he navigated small group settings is to both chat with his friend, and get his work done. This fit into his navigation of school work as well, and how Rubén was very skilled at making sure his work was turned in without always doing it in class.

In addition, there is some evidence in Luis and Rubén's interviews that they may have also been challenged to view their peers as resources instead of the teacher. While Anita spoke to how other students in the class were important for her learning, the two more recent immigrant students named the teacher as most important. When asked who is most important for him in his classroom for his learning, Rubén said,

El maestro, por que es él que explica y cuando él es lo que lleva las papeles y todo lo que necesitas, y si necesitas algo mas, él te lo lleva, o nada mas le preguntas a él y le dice donde está.  
*The teacher, because he explains everything to us and he's the one who brings us the papers and whatever you need, and if you need something else, he brings it to you, or you just ask him and he tells you where it is.*

(Rubén , Interview 2, January 2011)

Luis also named the teacher as important, but explained the teacher was important because he gives out the grades, and that has an impact on your future (Luis, Interview 2, February 2011). Rubén's and Luis's perspectives seemed to focus on the administrative and authoritative role of the teacher. What we don't know is how their ideas that the teacher was the most important person in the classroom impacted the way they engaged with others in the class. Their ideas suggest that the teacher is the best access to the domain of mathematics, as the gatekeeper of grades and the supplier of materials you need to access the task. This could impact how they perceived of small group work time, which could have impacted the way they allow others to take on integral roles or not in their educations, as well as their sense that they do not need to take on an integral role for others because the teacher is the biggest role in the class. Though in Rubén's case he had Anita as a person keeping tabs on him, for Luis a perception of the authority of the teacher and respect for teacher's knowledge could explain why he didn't engage in mathematics with table partners as much, even though he was seated with two students who had relevant mathematics skills, but fell into patterns of doing mathematics during small group time when a teacher was with him. This made small group work time important for Luis' engagement in mathematics, but only when an adult initiated the work with them, and the teacher could certainly not always be with just him during small group time.

#### *Opportunities Afforded in Whole Class Discussions*

As described in the literature review, whole-class discussions are important settings for public positioning and reinforcement that someone is a good mathematician with important ideas. Publicly sharing thinking is also a way to access the teacher and other students who can help a person think through and refine her ideas. The major finding here focuses on the way that the teachers created opportunities for students to take on integral roles, and the way these opportunities were taken up or rejected by the focal students. The finding suggests that students' self-concepts and prior experiences are important to understand for how they navigate this level of their mathematics identity, including their perceptions of the classroom as a safe place to speak in front of the class or not. The theme in Mr. Andersons' class was that Latino/a focal students more often than not resisted being positioned as

important mathematical thinkers, while in Ms. Williams' class one particular student, Marco, took on an integral role to the class through whole-class discussions. Findings from Mr. Anderson's classroom also suggest that during whole class discussions students were negotiating their mathematical competence in relation to other students in the classroom as well as negotiating the teacher's attempts to position them as mathematically competent.

From the video analysis, what was typically accomplished in whole class discussions was establishing correct answers for the task being worked on and/or talking through conceptual or procedural sticking points for students. The two teachers had some similarities in how they lead whole-class discussions. They would call the class together after circulating during small group time, and begin by eliciting student solutions to particular problems. Large portions of their discussions followed IRE (initiation, response, evaluation) patterns, with teachers making a representation of a student strategy or drawing a table, graph, or other figure appropriate for the discussion. Student work was selected as the focus of discussion once in Ms. Williams' class but on at least three separate days in Mr. Anderson's class. There were also similarities in how the students as a class engaged in whole class discussion, most noticeably that there were few voluntary contributions in each classroom, and these were confined to a handful of frequent contributors in each classroom. In addition to similarities, there were important distinctions in how the teachers' orchestrated discussions that lead to different opportunities for engagement.

*Mr. Anderson's Classroom.* The data from whole class discussions in Mr. Anderson's classroom provide examples of how a teacher may attempt to position Latino/a youth as competent, while also meeting with resistance from the Latino/a student and other students. In Mr. Anderson's class, particular talk moves helped present the domain of formal mathematics as open for discussion rather than as an established set of rules and procedures, which supported Mr. Anderson's ability to attempt to reposition students as having integral roles in the co-construction of mathematics. Though an IRE pattern was still the frequent pattern of discussion, Mr. Anderson would also focus on incorporating multiple students into discussion and position a student's contribution as important mathematical thinking. In the coded

classroom whole-group discussion episodes, Mr. Anderson was most frequently coded for eliciting student ideas (15%<sup>20</sup>), giving directions (11%), positioning students as competent (10%), revoicing student ideas (8%), and disciplining students by refocusing students on mathematics (8%). In particular, the frequency with which Mr. Anderson both elicited student ideas, and validated students comments, questions, and ideas as important, even if they were not relevant or only partially relevant, supported a view of the domain of mathematics as open for student input and negotiation. Disciplining by refocusing students on mathematics may have also contributed to a view of mathematics as requiring every member of the classroom to participate, which may have supported a view that everyone had something valuable to contribute. He would often name contributions by students in his summarizing comments at the end of a whole class discussion, which added a level of ownership of the mathematics as generated by members of the class. For example, he ended a discussion on how to tell what direction a walker is moving given a graph with:

So, whether you prefer Emmanuel's way of writing your name on the graph of the walk to tell whether the walker is moving towards the motion sensor or Hillary's way of finding whether the slope is positive or negative, they are both good ways, and they will both work. The important thing is to find the way that works for you. (Mr. Anderson, Video 1, November 9, 2010)

Some students in Mr. Anderson's class vocally contested how Mr. Anderson lead discussions on a few occasions, pressing him to just give them the answer or move the discussion along instead of waiting for a particular student to answer. From classroom observations, these students were frequent contributors, and tended to engage with mathematics during small group work time. These students did not include the focal students. In one discussion, the teacher was pressing an infrequent contributor to answer a question about how he can tell the speed of a walker from a graph, and the student was insisting he didn't know. Mr. Anderson waited. One of the frequent contributors, in this case a high academic

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<sup>20</sup> Percentages were calculated from ratio of codes applied to all codes applied. Because every episode was coded for all codes that apply, reporting most frequent codes by percent is more reliable here than frequency counts.

status female student said to Mr. Anderson, “He doesn’t know. Ask someone else.” Mr. Anderson then stayed with this student for three minutes, despite his request that Mr. Anderson “pick on somebody else” (Mr. Anderson, Video 1, November 16, 2010).

These kinds of tensions between students who just wanted to know and move on, who exhibited traits of high academic status that some other students, and Mr. Anderson’s desire to position all students as competent may have contributed to some students’ perception that the classroom was not a safe place to talk, especially if other students might make comments about your intelligence. Rubén and Luis shared ideas in their interviews about not feeling like they felt safe enough to talk in front of the class. Push back from some students may have reinforced specific ways that people could be good at mathematics in this setting, namely fast thinkers and people who spoke clearly, even while the teacher attempted to reframe what competence looked like during whole-group discussions. However, Mr. Anderson persevered in using techniques to draw students into the discussions, but his efforts were only one piece of the experience. Students needed to be willing to respond to his efforts to position them as competent. Social breaches and prejudice comments by students may have contributed to the Latino/a EB students’ feeling that it was not safe to talk during whole class discussions, an idea I explore in the next section. Students like Rubén and Luis may have felt they had very good reasons to not participate, especially if the classroom was not a safe place to speak. The final layer of classroom practice to consider is how the classroom felt as a community of learners, and where were breaches in social contracts and points of reconciliation that may have influenced how Latino/a focal students perceived their classrooms as places where they could be competent mathematicians.

In Mr. Anderson’s class, the data suggest that none of the Latino/a focal students made vocal contributions in whole class discussions voluntarily, though students were frequently giving visual signs that they were tracking the discussion and on two occasions focal students’ work was the subject of whole class discussion. Instead, a particular set of six or seven students tended to drive the whole-class discussions either by making voluntary contributions or speaking for their table group if their group was randomly selected to talk. The focal students were not among these students. However in interviews,

when asked to name who was good at mathematics in their class, the focal students each named the students who talked the most as the people who were good at math. This recognition of others and not themselves as the people who are good at mathematics in the setting is an important reminder of the power of speaking rights to influence students' ideas about competence. A lack of recognition of themselves as the good mathematicians in this context may have gone hand in hand with their abilities to participate competently, and their own sense of mathematical competence.

Whereas in Mr. Anderson's classroom the teacher took an active role to position all contributions as competent, whole class discussions in Ms. Williams' classroom had important differences. Only one Latino focal student vocally participated in these discussions. His case is considered in her classroom because of the important counter story it provides to passive Latino youth in classrooms, and also to illustrate how though her style may have created less room for students to lead the direction or pace of the discussion, discussions in her classroom were still productive space for one Latino EB student to negotiate his mathematics identity.

*Ms. Williams' Classroom.* A major contrast to the way the rest of the Latino/a focal students negotiated whole class discussions in this study is the way one of Mr. Williams' students, Marco, participated in whole class discussion in her classroom. Marco was a frequent participant who took on an integral role during whole group discussion in Ms. Williams' classrooms. Ms. Williams was most frequently coded for giving directions (20%), eliciting student ideas (18%), making expectations explicit (14%), and disciplining students by calling them out for off task behavior (10%). Ms. Williams' held particular authority during whole class discussion that included the way she gave directions and made expectations explicit. She explicitly named what good students do to participate in discussions, and in doing so retained authority as the person who had power to set expectations. For example, a few days into the unit she began the warm up discussion by emphasizing the way students need to take care of their own issues. It was both a disciplinary move and in some ways pressing students to take ownership of their own educations. She says to them towards the end of her commentary, "So from now on, when you have your own little personal problems, do not put them on me. I will put them back on you, politely... you will ask

someone else for a pencil, but I'm done. Too many of you think that I should give you things you should come to school with." (Video 1, Ms. Williams, November 9, 2010.) Most of her discipline was directed towards a particular set of loud, generally off-task students, mostly freshmen, and not towards the Latino/a focal students.

As she elicited student ideas, rather than follow with a move like Mr. Anderson to position the student ideas as competent, she was more likely to evaluate student ideas, and occasionally telling a student "no, try again" when they gave a wrong answer. In his second interview, Samuel commented on his teachers' instructional style, saying that "asking how was (an) important" thing that Ms. Williams did to make sure everyone knew how to do problems like that for next time (Samuel, Interview 2, February 2011).

Overall, the way Ms. Williams' facilitated whole class discussions supported a view of mathematics as a domain in which problems need to be figured out, and mathematics problems had one answer (whether that answer was a particular point on a line, a table, a graph a measure of slope, etc.). This was reinforced by the way she retained authority over the norms of the class and what counted as participating in mathematics during whole-class discussions. Though she named students' ideas as she revoiced them (ex. "So Alejandro is saying we should look at the x axis to find the change in time"), she was still the person who needed to be convinced of a method or methods, and then she underscored what she thought the important parts were that students needed to know and do to be good students. The urgency with which Ms. Williams taught is also captured from some of the frequency counts, in particular the prevalence of calling students out for off task behavior. She moved through discussions quickly, cold-calling<sup>21</sup> on students most of the time, which also reinforced a sense that there was no time to waste in the classroom. There was little room in the way she facilitated discussions for students to dictate the pace or direction of the discussion.

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<sup>21</sup> Calling on students by name, not by who has a hand raised or necessarily seems ready with an answer.

Ms. William's whole-class discussions were spaces for active participation for a handful of students in her class, and in particular for Marco. To understand why this participation structure within the context of these particular classroom norms and expectations worked for Marco, it's important to understand layers of Marco's mathematics identity. On the personal level, Marco loved mathematics and liked school a lot. He connected his mathematics identity to an over-all sense of satisfaction with himself, describing in interviews how knowing he could persevere and solve a difficult math problem gave him a sense of pride. He had a history of success with schooling in Mexico, and had already graduated from high school in Mexico. He had a particular goal while in school, which was to learn English. At the identity in context (second) level, he described his role in the classroom as to be a role model for other students. And yet the video data show that Marco did not tend to engage in mathematics in the small group setting, preferring instead to work on his own or, when he had questions, to work with a language IA. Whole group discussion may have been an ideal platform for Marco to act on his role-model concept because his successful engagement with mathematics during the small group time set him up to be a knowledgeable participant. A CRT lens may also illuminate how Marco, as an EB Latino student, is a counterstory to the dominant discourse of Latino disengagement and resistance to schooling. At the same time, contextualizing Marco's experience in broader discourses of Latino/a schooling raises the question of why Marco was in an Algebra 1 class to begin with, when he had already graduated from high school in Mexico. In addition, Marco had techniques to participate in whole-class discussion in English while still explaining that he preferred to speak Spanish, suggesting he had resources to participate in English even as he negotiated his linguistic identity within the classroom.

The multiple identities Marco brought to the classroom may have helped him be well suited to contribute to the joint enterprise of the classroom. Even though he didn't engage with table partners as frequently in small group work, he was frequently engaged as an active participant in whole group discussions. The kinds of contributions Marco made to whole class discussions varied across the unit: volunteering his graph to be the focus of the class discussion early in the unit, frequently answering teacher's solicitations to model a calculation or share an answer to a calculation, volunteering to "walk a

line” during the motion sensor demonstration. What is important to notice about Marco’s case is that the aspects of practice in Mr. Williams’ classroom may have supported the mathematics identity that Marco brought to the classroom, and helped him maintain or ‘thicken’ his identity over time. His experience contrasts with Latino/a students for whom mathematics classrooms need to be transformative spaces to support their development of positive mathematics identities because they are not positively identified with mathematics. After the next section, I revisit the case of Rubén who may be the kind of student who needed positive, transformative experiences as part of the socialization process in his mathematics identity.

### **Breaches in Social Contracts and Reconciliation: A Critical String of Incidents**

As argued in the literature review section, breaches in social contracts and moments of reconciliation provide insight into the kinds of classroom communities in which students navigate their mathematics identities. Here I describe one salient trajectory of breaches in social contracts that developed over time in Mr. Anderson’s classroom, and discuss how two Latino/a focal students, Luis and Rubén, articulate the impact of the particular kinds of bullying they witnessed or experienced in their classroom.

In Mr. Anderson’s class, a particular string of bullying episodes in which a particular student participated came to a head when Mr. Anderson explicitly addressed the issue with the class, allowing for redress and reconciliation of a series of social breaches. The first was on day one of data collection, when during a whole class discussion the teacher paused to interrupt a side conversation between Rubén and Luis, and told them that the class was having one conversation, and so they needed to stop talking to each other. Jim, another white male student in the class, took the opportunity to loudly say, “Speak English.” Ignacio immediately responded from across the room with, “Don’t be so racist. It’s sad.” Other students in the class physically reacted by straightening up in their seats and turning towards Jim. The teacher walks towards Jim, and says, “That’s not the point. The point is we are having one conversation here. Everyone needs to be in this conversation.” The teacher is trying to say that what matters most right now is common purpose and staying focus, but does not address the interaction that just transpired and through

which racism was made explicit in the classroom. Students said a couple of other things, and teacher brought the class back to the toothpick pattern discussion. The episode was over. The classroom continued with the mathematics discussion, and Luis and Rubén did not continue their side conversation.

Towards the middle of the unit, some students in his class had started reacting poorly to when a particular white male student spoke. This student, Matt, had many interesting things going for him that made him kind of an outsider and which the teachers described in his interviews as important to notice in how Matt works with his small group, and how Matt's ideas were received by the class. Matt was home schooled for middle school, this was his first year back in high school, a freshman who wore button down shirts and ties to school, mostly all black, and carried a briefcase. He was a self-proclaimed cynic, and could be obtuse at times, especially evident in how he had a hard time working with his Mexican and Filipino table mates and, as the teacher noted, didn't seem to think they knew any math.

Matt was a frequent contributor to whole class discussions, both answering mathematics questions as well as critiquing other students' work, cynically suggesting there was an easier way to do a problem. The teacher, as he did for almost all contributions, would respond positively to Matt's questions or critiques. The bullying seemed to be around how Matt would launch into "long confusing" explanations (according to Daisy, a high status white female student in this class) instead of getting to his point. He might use phrases that were superfluous, such as "vis-à-vis" or "essentially moot"<sup>22</sup> and speak quickly, making him hard to understand. Jim, again, was the first antagonist in the series of incidents directed at Matt.<sup>23</sup> Jim was a student frequently removed from Mr. Anderson's class, and when Matt talked shouted out "shut up" during one discussion, and later that day during another said "You're not that smart, you know" (Video 1, Mr. Anderson, November 5). At first the teacher treated comments as they came up, for example, saying to Jim, "What's that comment? Can you say something politely?" and then refocused all students on mathematics, such as probing Daisy's request that Matt just say things simply

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<sup>22</sup> As in "when we examine the graph vis-à-vis the slope we see that the increase is virtually moot." (Mr. Anderson's classroom, Video 1, November 22, 2010).

<sup>23</sup> Jim also decided not to participate in interview portions of the study, though the teacher told me that he had particular reasons for wanting to make the class a positive place for Jim.

with, “what do you mean by just say it simple, ask about what?” By the middle of the unit, a series of things happened in whole class discussions whenever Matt would be called on: some students would groan or roll their eyes, make sounds of exasperation, or sit up and look tense. The bullying came to head on November 22, when Matt began talking for his table group, sharing whether a table represented a linear relationship or not. He began by saying it’s not necessarily a simple question. On the video, the high status student Daisy crosses her arms, sighs, and says, “Just say it, Matt.” At which point Matt says, “No, I certainly don’t think it’s a simple answer.” This prompts loud noises from other students, and one student begins to plead with the teacher to intervene. The teacher immediately addresses the class that something he does not like is happening. It takes a few moments to get all the class listening, and to get Matt to stop protesting the issue the teacher is trying to address. Matt is clearly engaged in face saving, saying he’s not feeling bullied or uncomfortable, and the teacher is trying to get him to listen to his perspective. There is an exchange between Kato, a Filipino male student in Matt’s group, and Matt in which Kato clams Matt down and gently requests he lets the teacher speak. The teacher addresses the class, naming the bullying, and saying that:

To me, people groaning when Matt talks is bullying, and I do not accept that in my classroom.

We've created a pervasive environment where people don't feel comfortable, not just for him but for others. It makes it so that this room is not a space where everyone's ideas are welcome, and I want this to be a space where *everyone's* ideas are welcome. Now, Matt has a habit of speaking very quickly, and sometimes when people speak quickly it's hard to break down what they are saying. Now, I'm going to ask him to say what he was thinking again, more slowly.

Then he takes the class back to the math, focusing on Matt’s idea and saying, “Tell me and I’ll write it up.” The conversation is a very good and necessary conversation to have with the class, and as the teacher emphasizes any kind of bullying makes the class unwelcoming for everybody. But it is hard to separate the lesson from how it is constructed in defense of a student who is already high academic status, and may not be addressing Jim’s previous display of racial prejudice. In Matt’s case, on the video the students who are doing the eye rolling were other students who were higher in academic status and typically

highly involved in whole class discussions. It is interesting to notice that the issue, though seeming to pertain to a subsection of the class, was addressed with the whole class precisely because of the implications for bullying anyone on the whole class as a community, and Jim was not independently disciplined.

At the same time that this was an important issue in his classroom to address explicitly, questions remain as to whether he went far enough. In interviews, Luis and Rubén both reported that Mr. Anderson's classroom was not a safe space to talk in front of the class. After watching a video in his second interview well after this unit of instruction was over, I asked Luis why he did not share his answer with the whole class when the teacher, hearing Luis say it to himself, asked him to repeat it. Luis' response was, "Because I'm shy. I don't want to be — let's say I say a word, let's say I'm wrong everybody's gonna laugh at me. Especially Jim. That's what Jim does." (Interview 2, February 2011). Luis expressed a fear that Jim, perhaps based on the previous episode, would laugh at him too if he was wrong. But I probed further, because in this case Luis had the right answer. He insisted that he just didn't want to say it, and preferred to let other people do it, even though he knew the teacher knew he had the right answer. Similarly, Rubén described particular reasons why he did not want to speak in this classroom. It's important to note that while the social breaches around bullying were addressed in the classroom, in January (Rubén) and February (Luis) the students were still characterizing the classroom as not a safe space, and did not suggest that the climate had changed in a way that allowed them to speak in front of the class.

#### **Coordinating Multiple Aspects of Mathematics Identity: Rubén's Refusal to Talk**

To further illustrate intersections in classroom practice and mathematics identity negotiation for Latino/a youth, I'm going to focus on what we might learn from coordinating layers of Rubén's experience. Recall from the vignette at the beginning of the article that Rubén does not take up the opportunity to share an idea that the teacher found important with the whole class. This analysis suggests that there are many aspects of identity and practice that help us understand why Rubén did not take up the teacher's attempt to position him as a valuable contributor to the whole class discussion. As the findings

suggest, coordinating the multiple opportunities for engagement across aspects of classroom practice in conjunction with Rubén's beliefs and attitudes, all within a broader context of racial discourses and stereotypes of achievement, provides insight into his identity negotiation in the particular moment in which the teacher asks him to share his idea, and his subsequent refusal to talk.

Foregrounding the classroom context, all the aspects of practice together help us understand what is going on for Rubén that support his participation in this moment, and explain why he may not take up the opportunity to be positioned as an important contributor to the classroom (see Figure 7). This particular whole group discussion followed an activity to which Rubén had some access, and though he did not complete it as directed (write a story to match the line graph) he did raise an idea the teacher noted was important. In that regard Rubén had successful access to the domain during small group time, and the space of small group work time also allowed for interaction that let the teacher see something important was going on that he could take back to the rest of the class. Therefore, the disciplinary context and small group work time supported Rubén to figure out something important that the teacher wanted him to share with the group. Recall that Mr. Anderson was always looking for ways to draw students in and position them as competent. In the whole class discussion, Rubén does not take up teacher's attempt to position him as competent, not because he doesn't have an idea but because, as Rubén explained in his interview, "No es que me da vergüenza, pero no quiero/ *It's not that I'm embarrassed, I just don't want to.*" (Rubén, Interview 2, January 2011). The social breaches, in this case previous incidents of bullying and language prejudice, might also explain why Rubén does not take the position that the teacher opens up for him, and why he reports it as something he just doesn't want to do. So it would seem that while the disciplinary context and preceding social arrangement (small group work time) support Rubén to be positioned to make an important contribution, one of many with the potential to impact his mathematics identity over time, attending to the social breaches, which happen during whole class discussions, provides some possible explanatory power of why Rubén chooses not to share.

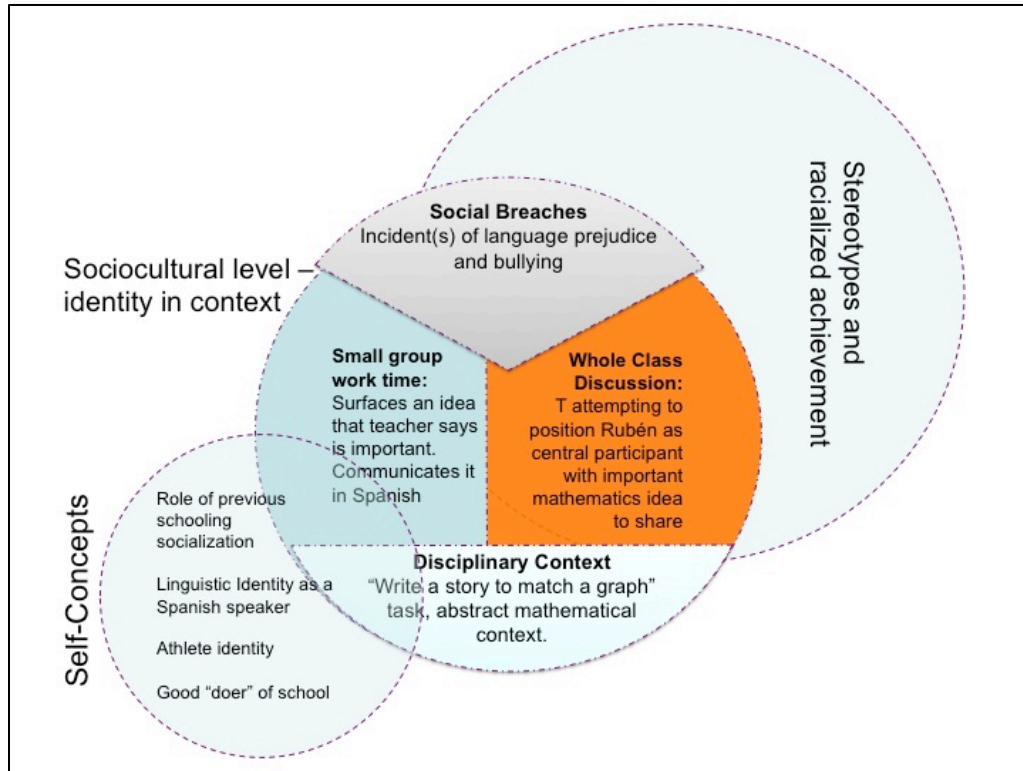


Figure 7: Rubén's Mathematics Identity Negotiation in One Moment of Whole-Class Discussion

When we coordinate the other dimensions of mathematics identity with what Rubén is navigating in the classroom context, multiple identities are brought into view that are at work for Rubén in his negotiation of this moment: his linguistic identity as Spanish speaker, the star soccer player identity, and also how Rubén managed being good at doing school while not doing a lot of the work in class. Rubén must negotiate what these other identities mean in the context of this classroom, and what his subsequent actions are. Recall from the previous dissertation section that he was not someone with deep connections between doing mathematics and his sense of self. In addition, Rubén's positive agency in learning mathematics was hard to see within the context of Mr. Anderson's classroom. The data in this study do not speak to where Rubén chose to exercise his mathematical agency, though he did put considerable time into making sure his grades were always up in part because he needed good grades to stay on the soccer team. Finally we don't know the impact of the stereotypes and racialized achievement that may influence his decision that he's not a talker in the class, or that impact his beliefs of who the "smart kids" are.

The framework in this way helps us see the aspects of practice that support Rubén towards more central participation in his classroom, more sustained engagement that could impact his mathematics identity in positive ways, while also helping us see the potential points of resistance as Rubén's sense of self and perceptions of the classroom environment come into conflict with who the teacher would like him to be.

The ruptures in social contracts around bullying may have influenced Rubén's perception that this classroom was not a safe place to speak. The impact of an overt racist statement may last in ways that are hard to track, but at least for the moment we know that racist statements had been made towards using a language other than English in the classroom, and that may have had a lasting impact on Rubén. Precisely because of his linguistic identity he could have taken those attacks very personally, and found it hard to then navigate this moment when his linguistic identity was so entwined with his mathematics identity.

As capturing the depths of this moment for Rubén illustrates, mathematics identity is complex. This is just a glimpse of what may be going on for Rubén, but is more than we might expect had we elected to just try to understand one aspect of his experience in this classroom. Because of the power of speaking in whole group discussion to potentially shift students' relationships to mathematics, at least to each other in the mathematics classroom, Rubén's active nonparticipation must be seen as consequential to his opportunities to both be recognized as someone with good ideas, and recognize himself as someone with good ideas. It is important to notice that Rubén was in a classroom with a teacher who would continue to open up space for Rubén to contribute to the whole group, and eventually he did contribute during a whole group discussion.

### **Discussion**

As we learn from the short example of Rubén's participation in a single whole group discussion, and the evidence of how other focal students navigated their opportunities to learn in the classroom, coordination of students' perceptions and opportunities for engaging in mathematics helps us make sense of how students negotiate who they are in their mathematics classrooms. Classrooms are contexts that are made up of multiple layers of practice that support engagement. This analysis contributes to our

understanding of what aspects of classroom practice contribute to qualitatively different forms of engagement and subsequent mathematics socialization of Latino/a youth. The analysis of three distinct aspects of classroom practice (the disciplinary context, social arrangements, and social breaches/reconciliation) illuminated pockets for potential engagement and barriers to engagement that could be useful to examine the experiences of Latino/a and other students from diverse backgrounds experiences in other mathematics classrooms.

### **The Impact of Aspects of Classroom Practice on Latino/a Mathematics Identity**

Findings suggest that the focal students in Ms. Williams' class found that they could enact positive mathematics identities and sustain engagement in mathematics (through accessing the domain, taking on integral roles, and participating in forms of self-expression), whereas in Mr. Anderson's class the focal students' engagement tended to be less consistent. We might conclude from the analysis of opportunities for engagement that the contextual factors examined here did not seem to transform any students' relationships with mathematics, rather the features of practice supported a kind of 'thickening' (Wortham, 2004) of who they already were as people when they came to the class. This could explain why the focal students in Ms. Williams' classroom were able to be highly engaged. This especially seems to be the case for Marco, the oldest student in the study who brought extensive experience, previous success, and enjoyment of mathematics with him to the classroom. But of course all Latino/a students are not like Marco, especially those who may be at the beginning of their high school trajectories and for whom the next few years will be consequential to how they are positioned for life after high school graduation. It is still important to examine the opportunities for engagement that each dimension of practice presented in this study to consider what lessons we learn from this set of focal students classrooms with similar disciplinary contexts and different teaching styles influencing the social arrangements and negotiation of social contracts.

The disciplinary context in many ways opened up opportunities for out of school knowledge to be used as a resource in reasoning about algebra. However, the contexts were not necessarily relevant to students' lives, which constrained possibilities in each classroom for meaningful participation. The

mathematical contexts may have been more of the kind that adults assume will have meaning for children, and questions remain as to whether learning mathematics through the “real-world” contexts in and of themselves supported unique opportunities for engagement (Boaler, 1993). Tate (1994) argued that mathematical contexts are not neutral, and that instead we are always doing mathematics in some context that privileges someone’s lived experiences or knowledge bases. Though a deep analysis of contexts for whose experience is privileged is beyond the current study, this analysis raises the questions of the limits of presenting mathematics in seemingly accessible contexts without accounting for the students who are going to engage with those contexts. Radically rethinking the disciplinary contexts that underlies the way mathematics is done in a classroom could open up more connections to students’ lives, and through this more intersections of their mathematics identities and their racial, ethnic, or home community identities.

This research also suggests that the disciplinary context that underlies the social arrangements and norms of the classroom may also contribute to the constrained definitions of competence in the classroom. Examples from the literature include generating authentic problem contexts in which to explore issues that matter to students (Turner, Gutiérrez, Simic-Muller, & Díez-Palomar, 2009), to introduce social justice topics that are disciplinary contexts for rigorous mathematics (Gutstein, 2003, 2007). As disciplinary contexts, mathematics for social justice or funds of knowledge approaches open up spaces for students to connect to mathematics and give it meaning. Hand calls this, “blurring the lines between what constitutes cultural versus domain activity” (Hand, 2009, p. 127). Gutstein (2006) documented how in a pedagogy for social justice, in which the disciplinary context involved using mathematics tools to understand, critique, and act on a social justice issue, students’ opportunities to engage in self-expression through mathematics (critiquing inequity with mathematical tools) contributed to overall deeper connections of their cultural identities with mathematics identities. The power of the disciplinary context to support or constrain students’ productive engagement in mathematics is an area for continued study, especially to answer the question of how particular curricula support disciplinary contexts that may be more desirable for classrooms with students from multiple different linguistic and racial communities, or how to prepare teachers to work with particular curricula that may lend themselves

to constrained disciplinary contexts for students. This research surfaced linguistic challenges that students face in engaging in mathematics as a potential barrier to mathematics identity negotiation as students may be barred from engagement. This is another area where future research should take up the thread.

Evidence from examination of how highly engaged EB students participated in mathematics through task cards suggests a need to study how linguistically demanding task cards may support or bar students from playing integral roles in the collective learning of the classroom. Though researchers have contributed to our understanding of how linguistic challenge bars access to mathematics content or distorts assessment results (Abedi, Hofstetter, & Lord, 2004; Garrison & Kerper Mora, 1999), taking the next step in how the linguistic challenge of task cards impacts Latino/a EB students' identity negotiation requires more research. This would help the field draw tighter connections between curricular contexts and identity negotiation.

With regards to the social arrangements, it is important to notice how students seemed to find one or another social arrangement that worked for them, but no focal students really flourished across both. As the literature suggests, the particular social arrangements of small group settings and whole class discussions are distinct setting for students to engage in mathematics. This finding may speak to the importance of making sure students have access to multiple social arrangements in their classrooms, so that they can navigate the classroom in ways that work best for them. For example, the social arrangement that supported Julieta's agency in the classroom was small group work time, while for Marco the whole-class discussions afforded him the most opportunities to access mathematics and take on an integral role for the class. Further research should continue to document the features of each of these social arrangements that support or constrain engagement, while attending to how social arrangements can be spaces to analyze the kind of agency Latino/a youth exhibit in their mathematics educations.

Findings show that small group settings created opportunities for students to play integral roles for each other's learning. This is an important difference in how Nasir & Hand (2008) described taking on integral roles in relation to the classroom's practice of mathematics and rather places the relationship between particular students. This is a new avenue to explore for the impact taking on integral roles for

each has for students' mathematics identities. The small group setting in particular afforded Julieta and Samuel space to productively engage in mathematics, with Samuel taking on an integral role for Julieta at her request. It is also important to notice that the setting allowed Julieta to engage in mathematics in the language of her preference, which was not the language of whole class discussions. This was an important avenue for self-expression in Julieta's identity negotiation because of how her linguistic and mathematics identities intersected.

Perceived difference in status may have accounted for why Anita and Rubén's partnership was not as productive during the small group work time (Boaler & Staples, 2008). Anita's perception that Rubén was not an independent worker and was always in need of help may have manifested as a status difference between them. Rubén was not someone Anita asked to help her, instead she normally could work ahead on her own. Though status may have been an issue, they were also good friends. They had an important connection through their shared heritage and linguistic identities. Anita exhibited agency in taking a protective approach to working with Rubén. Both status issues and the salience of social roles may have impacted how Anita and Rubén engaged in more socializing than mathematics (Boaler & Staples, 2008; Esmonde et al., 2009).

From Rubén's perspective, the teacher's role may have been the most important authoritative role in the classroom. With a perspective that the teacher is the primary way to access the domain, Rubén may have had a hard time seeing classmates as mathematical authorities in the classroom. One issue here is that research rarely accounts adequately for the previous school experiences that students with histories of socialization in other classrooms in other countries bring to the United States (Suárez-Orozco, Suárez-Orozco, & Todorova, 2008). In order to understand his perspective, we may need more research in both the differences in socialization into mathematics, and how immigrants students make sense of the roles of teachers and students, and consequentially themselves, in classrooms. However in Rubén's case, the multiple layers of the mathematics identity framework do suggest that he is grappling somehow with his previous experiences and competing identities, which is an important contribution to the documentation of experiences necessary to push back against monolithic categorization of "a" Latino/a experience.

### **Polarized and Flexible Participation Structures and Latino/a Mathematics Identity Negotiation**

As the literature suggests, whole group discussions are social arrangements in which the consequences for students impact their identities, such as their sense of self as a competent mathematician or how they decide other students are good mathematicians (Enyedy et al., 2008; Jansen, 2008; Turner et al., 2010). The urgency in Ms. Williams' disciplinary style may have alienated students who did not want to contribute to discussions in direct opposition to her requests that they participate. Her classroom may have seemed dominated by what Hand (2003,2009) called a "polarized participation structure," in which the teacher sets and enforces a narrow way of being a competent student in the class (pay attention, ask questions, raise your hand when I ask questions, be thinking about your answer), and just as the name suggests, polarizes the class into two types of students: good and bad. As Hand (2009) noted, an important consequence of a polarized structure is how it may constrain both students and teachers from breaking out of typical roles, which can lead to escalating displays of authority by the teacher and foster student resistance. And yet, the Latino/a focal students in Ms. Williams' classroom found resources to make learning mathematics in her classroom work for them, suggesting they were able to negotiate their mathematics identities with a measure of success in her classroom.

In contrast, Mr. Anderson's classroom had more of a flexible participation structure (Hand, 2003, 2009). Students were given multiple and varied ways to show they were competent. This was complemented by Mr. Anderson's varied moves to draw students into discussion, with a focus on competence and disciplining by re-orientating students to the mathematics task at hand. The purpose seemed to be an important one to attend to: reposition students vis-à-vis mathematics by getting them to contribute to the discussion, and then using one of a number of tools to position them as competent and important mathematical people (O'Connor & Michaels, 1993; Turner et al., 2010). But the flexible participation structure itself did not make the classroom a safe enough space for Luis and Rubén to feel that they could take up the space Mr. Anderson opened up for their contributions to whole class discussions. Was the overarching participation structure in Mr. Anderson's class so flexible that it

allowed some students to establish authority early on in unproductive ways, and foster a de facto polarized structure which alienated students like Luis and Rubén? It's important to note that they were not the only EB students in the class, and that Luis also voiced his fear about not just saying the wrong words, but being wrong mathematically. Luis may have anticipated double marginalization by particular peers who, in the name of a flexible participation structure, may have exercised too much agency, and in doing so made the classroom not a safe space.

In Mr. Andersons' classroom, a particular theme of conflict and resolution around the bullying helped establish (among other students' perceptions) for two focal students that the classroom was not a safe space to share your ideas. Rather than draw any causal conclusions, these kinds of breaches do call attention to the way power is negotiated in mathematics classrooms, and not always through the mathematics itself, but rather through contestation of social norms and expectations. Though in research on classrooms we may hear about off-task students or how teachers discipline students, conflict is often left out of the analysis. These particular breaches in social contracts between students and teachers raise questions to keep researchers thinking about how to best research classrooms as racialized spaces and methodologically account for the complexities of negotiating power in these spaces, which has consequences for the mathematics identity negotiation of Latino/a and other diverse student populations (Martin, 2009; McGee & Martin, 2011; Yosso et al., 2009). In addition, students may draw conclusions from how the teacher handles the situation that fostering a sense of belonging is not a top priority (Valenzuela, 1999). A sense of belonging, and ways to connect the multiple identities students bring to the classroom to important mathematical work through engagement are fundamental to support productive on-going socialization into being a mathematician for Latino/a youth.

### **Conclusion**

As we continue to think about the dimensions of practice in a mathematics classroom that impact the identities of Latino/a youth, the analytic framework posed here is a useful step to illuminate the pockets of productive engagement for students, and the pitfalls within participation structures. Each dimension of practice can structure opportunities to pull students towards central participation, or

marginalize them; to reaffirm their sense of self as a competent mathematician, or position them as having nothing to contribute. In examining the engagement afforded by multiple layers of practice proposed in this framework we increase our understanding of how classrooms are places that impact Latino/a students' mathematics identities, and how students' may impact the classroom. There is a continued need to explore how dimensions of racial and linguistic identities intersect with the structures of schooling to aid in positive mathematics identity negotiation. This research is one step in the direction.

## CONCLUSION

The goals of this study were to contribute to the understanding of the socialization processes of Latino/a youth into mathematics. In particular, this research was conducted to contribute to the literature on how Latino/a youth themselves articulate what has an impact on their mathematical agency, and how aspects of classroom practice have an impact their identity negotiation. In the year 2000, Danny Martin put forth a theory of mathematics identity and socialization for African American youth as a racialized process, and this study now builds on his work and the work of others to assert similar findings and framing for Latino/a youth. The findings from the students' perspectives and from those same students' participation in their classrooms during one unit of instruction illuminate important intersections of their experiences, both how they make sense of their experiences and how they take up and reject opportunities to engage with mathematics.

The framework for Latino/a mathematics identity has the potential to contribute to future research by providing an initial platform on which to build. The framework for mathematics identity helps us understand learning as more than academic outcomes, and contributes to larger equity projects in mathematics education to shift deficit discourses around Latino/a youth. By supplying the theoretical and methodological tools (such as *testimonio* and *counterstory* from CRT) to understand how Latino/a youth exhibit agency in their own mathematics education and in the mathematics educations of others, the framework contributes to understanding how mathematics socialization is a complex and non-deterministic process. In this way, this research also refutes views of Latino/a youth as deficient and in need of fixing. At the same time, the findings from students' perspectives push back against the monolithic categorization of "a" Latino/a experience. Rather, the variety of navigational techniques in classrooms and articulation of what matters in learning mathematics among these focal students provides evidence that the experiences of Latino/a youth are varied and complex, rather than identical and able to be summed up or reduced to a need to overcome a language barrier.

This study also provides existence proof of how, for some Latino/a students, racial identities may intersect with mathematics identities in complex ways. The intersection of mathematics identity and racial

identities may provide some explanatory power for how students resist dominant discourses of Latino/a underachievement by feeling motivated to succeed, as in the case of students like Anita. The intersections of mathematics and linguistic identity provide fruitful area to understand the agency students may exhibit in findings resources for their own educations, as in the case of Julieta's partnership with Samuel. The intersections of race, language, and mathematics identities are underresearched and undertheorized areas. This study contributes to this research by framing mathematics identity as requiring multiple theoretical lenses to understand its complexity.

This study is one illustration of the potential of CRT to illuminate intersections of discourses and provide insight into the daily experiences of learning mathematics for Latino/a youth. For example, as this research shows, Latino/a students may find ways to exhibit agency through peer relationships to resist schooling practices in productive ways. As argued in Section 2, most empirical work utilizing CRT does not explicate the productive resistance of Latino/a youth within their classrooms. This study provides an example of how CRT and LatCrit may be useful for understanding the experiences of Latino/a youth not only in retrospect as they reflect on and process their *testimonios*, but also as we make sense of how they describe their own mathematics agency and couple that with interactions observed in their classrooms.

The analytic framework for mathematics classrooms parses out aspects of mathematical practice that have an impact on the identity negotiation of Latino/a youth. In particular, paying attention to students' opportunities for engagement across social arrangements is important to understand the way Latino/a youth find ways to express themselves and position themselves and others as important mathematical thinkers. The explanatory power of the framework may also help teachers and researchers understand that it is not just one part of classroom practice that is implicated in the identity negotiation of Latino/a youth—rather, there are many aspects of practice to coordinate for the successful uptake of opportunities to learn. Attending to the proposed aspects of the disciplinary context, the social arrangements, and the social breaches and reconciliation, may be a useful starting point for analyzing how Latino/a youth negotiate their mathematics identities in classrooms.

At the same time as this need to provide more research from the point of view of Latino/a youth, there are also new questions that emerge from this research, such as:

- What are the roles of other social identities (such as gender, political, etc.) in the mathematics identity negotiation of Latino/a youth?
- How would students who are multigenerational Latino/a-American articulate the role of race in their mathematics identity negotiation?
- How do the potentially conflicting goals students pursue as they learn mathematics have an impact on classrooms as learning settings, and subsequently how those goals have an impact on identity negotiation?
- How do the frameworks proposed in this study help make sense of the experience of Latino/a youth in settings that are more or less diverse than the classrooms in this study?
- What is the impact of the family and community in the mathematics identity negotiation of Latino/a youth?

Finally, there are important implications from this research for teachers and other classroom practitioners. One major implication is that coordinating various aspects of classroom practice has the power to help teachers understand the way Latino/a youth (and possibly youth from other backgrounds) engage with or reject opportunities to learn. In particular, the disciplinary context can constrain not just access to mathematics, but opportunities for students to be productive mathematical people. This may mean that teachers and school administrators need to think about what opportunities curricular choices afford for qualitatively different kinds of classroom engagement. Teachers also need to pay attention to how Latino/a youth navigate social arrangements especially for the way they exhibit agency. When it comes to the classroom being a welcoming space for EB Latino/a youth, teachers need to look critically at how they explicitly or implicitly value English over other languages. A focus on students being English speakers may work against students' best interests in learning mathematics. But teacher's tolerance of other languages may not be enough—teachers need to be aware of the ways in which they and the

students in their classes communicate; whether they really value students' linguistic identities in the classroom; or if they simply tolerate their students' linguistic identities. The connections between Latino/a youths' linguistic and mathematics identities illustrate the importance of this level of awareness. As this research shows, social breaches around language can have an impact on students' mathematics identities. Though it may seem more appropriate to teachers to move past social breaches, it is important for teachers to focus on how social breaches can rupture the classroom community and alienate students, and how some social breaches may require redress in more than one way.

There are multiple layers of experiences to understand about how Latino/a youth are socialized into being qualitatively different kinds of mathematical people. This research is my initial contribution to the ways Latino/a youth articulate their own experiences and navigate their classrooms. May it be a building block for others seeking to contribute to the conversation around Latino/a mathematical achievement and social justice for Latino/a youth.

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APPENDIX A: Latino/a Focal Students Characteristics and Pertinent Attitudes and Beliefs

Name	Teacher	Gr	Age	Years in US	Previous Schooling	Interview language	Math is useful for?	How would you describe yourself as a math learner?	Does race matter? How?	Does language matter? How?
Marco	Ms. W	12	19	2	México (graduated from Preparatoria)	Español	It is important in everyday life and for mental development. Mathematics is hard, but useful.	Capable, hard worker, and likes to solve problems	No- individual attitude matters most	Language matters: English language proficiency is the advantage other students have in class over non-English speakers.
Julieta	Ms. W	11	19	2	México (primaria/ secundaria on and off)	Español	It is useful for multiple things in life (provided many examples) Linked to her independence.	Enjoys doing math, recalls crucial positive experiences learning mathematics	n/a <i>Julietta left school before completing her final interview, about the role of race in learning mathematics</i>	Language matters: English is the only thing between her and the math. Jealous of English speaking students, who don't understand what privilege they have.
Samuel	Ms. W	9	15	15	US Pac Northwest	English	Knows it's important for some things (non-specific)	Capable, "normal" student, not excited about math. Math is easy.	No- individual attitude matters most. Everyone is equal.	Language matters: If you are proficient in both English and Spanish, then your job might be to help others who are not to access the math in English.

Appendix A: Continued

Name	Teacher	Gr	Age	Years in US	Previous Schooling	Interview language	Math is useful for?	How would you describe yourself as a math learner?	Does race matter? How?	Does language matter? How?
Ignacio	Mr. A	9	15	15	US Los Angeles	English	It is necessary for college, not a lot else.	Has changed from feeling good at math in elementary school, to not good anymore after sixth grade	No - individual attitude matters Yes - can knock you down because people may not expect much from you	Language matters: for people who don't speak English
Rubén	Mr. A	9	15	3	México (primaria)	Español	It is useful for everything you do and especially for securing your future career	Capable, "normal" student, but is not excited about mathematics	No- individual attitude is what matters most Could matter for why Asian students are successful	Language matters: explaining the vocabulary of mathematics clearly is what matters most, if it can be explained in Spanish is best. Non-English speakers are at a disadvantage.
Anita	Mr. A	9	15	9	US Pac Northwest	English	It is a part of everyday life. It is important for her plans to be a teacher that she learn math well	Capable and interested in learning – puts pressure on herself to work hard when not happy with her math grades	No - individual Yes – can remind you that you need to do better, to take advantage of your opportunities	Language matters: both to help people learn math who don't speak English, and because it's how she expresses her Mexican identity
Luis	Mr. A	11	17	3	México (on and off)	English/ Español	It is necessary for everything. (non-specific)	Does not think he's very good at it, and points out he likes to work with people "smarter" than him so he can learn	No- individual attitude is what matters most. Could matter for why Asian students are successful	Language matters: learning vocabulary matters most. People may tease you if you don't speak English well enough.

## APPENDIX B: Sample Codes

These represent some but not all of the codes applied to episodes in the video data.

Category	Code
<b>Teacher</b> <i>What were the range of ways that teachers engaged students in mathematical and related non-mathematical activity?</i>	Relationships w/ Ss
	Revoicing
	Repeat (S to S)
	Pos Ss as Competent
	Positive Reinforcement
	Making Expectations Explicit
	Explaining a Math Idea
	Eliciting S Ideas - what
	Eliciting S Ideas - how
	Eliciting S Ideas - why
	Turn and Talk
	Wait Time
	Modeling Thinking
	Solving a Simpler Related Problem
	Making a Representation
	Pressing Ss - to answer
	Pressing Ss- to go further
	Giving Directions
	Naming What Good Ss Do
	Discipline - refocus on math
	Discipline - calling out for off task behavior
	Sarcasm
	<b>Students</b> <i>What were the range of ways that students participated in mathematics, and the ways they engaged themselves in non-mathematical activity?</i>
Socializing	
Voluntary Contribution - WG	
Non voluntary Contribution - WG	
Give answer	
Explain an idea	
Asks a question	
Reasoning with a representation	
Shares an answer: called on by T	
Student work in discussion: selected by T	
Student work focus of discussion: by student	
Remains quiet when asked to talk	
Hedges	
Refuses to talk	
Tracking discussion : marginal participation	

## Appendix B: Continued

<b>Students (cont.)</b> <i>What were the range of ways that students participated in mathematics, and the ways they engaged themselves in non-mathematical activity?</i>	Disengaged
	Engaged in math : alone
	Engaged in math - T or other Adult
	Engaged in math : partner
	Engaged in math: small group
	Display of math knowledge
	Bullying or Prejudice
<b>Language</b> <i>How were languages other than English used by students in the classroom?</i>	Use of Spanish : Socialize
	Use of Spanish : Math
	Use of Other Language: Math
	Use of other Language : Socialize

## APPENDIX C: Task Cards and Use During the Unit

Day in the unit	Mathematical Context	Mr. Anderson	Mathematical Context	Ms. Williams
Day 1	Toothpick growing patterns	3.1A Create and investigate triangle and squares patterns with toothpicks	Toothpick growing patterns	3.1A Create and investigate triangle and squares patterns with toothpicks
Day 2 (block day)	Toothpick growing patterns  Crossing Paths	3.1A Continued from previous day  3.2A Launched Find when three different vehicles cross paths	Toothpick growing patterns  Crossing Paths	3.1A Continued from previous day  3.2A Launched Find when three different vehicles cross paths
Day 3	Crossing Paths	3.2 Follow up Find when two ants cross paths	Crossing Paths	3.2A Continued Find when three vehicles cross paths
Day 4	Crossing Paths  Launch Motion Sensor	3.2 A return to Crossing Paths  3.3 Investigation Walk the line	Crossing Paths	3.2 A Continued Find when three vehicles cross paths
Day 5	Motion Sensor	3.3 Investigation Walk the line	Crossing Paths	3.2 A Continued Find when three vehicles cross paths
Day 6	Crossing Paths	3.2 Finished Find when three vehicles cross paths	Crossing Paths  Launch Motion Sensor	3.2 A Finished Find when three vehicles cross paths <i>Motion Sensor introduced, no task card</i>
Day 7	Motion Sensor	3.3 Time Distance Relationships	Motion Sensor	3.3 Investigation Walk the Line
Day 8	Motion Sensor  Launch Calorie Burning	3.3 Time Distance Relationships  3.4 Linear equations and Intercept form	Motion Sensor	3.3 Time Distance Relationships
Day 9 (block day)	<i>Matching Tables, Equations, Graphs Stories</i> <sup>25</sup>	3.5 Matching Sheet	Launch Calorie Burning	3.4 Linear equations and Intercept form
Day 10	<i>Matching Tables, Equations, Graphs Stories</i>	<i>No task card</i>	<i>Matching Tables, Equations, Graphs Stories</i>	3.4 Writing Equations in slope intercept form
Day 11	Wind Chill	3.5 Linear or non-linear?	Wind Chill	3.5 Linear or non-linear?

<sup>25</sup> No real world context for this activity – rather, students were asked to match tables, equations, and graphs, and then write a story that could match this linear situation.

## Appendix C: Continued

<b>Day in the unit</b>	<b>Mathematical Context</b>	<b>Mr. Anderson</b>	<b>Mathematical Context</b>	<b>Ms. Williams</b>
<b>Day 12</b>	Wind Chill	3.5 Is this table linear or non-linear? (new table, data out of order)	Wind Chill	3.5 Is this table linear or non-linear? (new table, data out of order)
<b>Day 13</b>	Wind Chill	<i>No task card (tables on overhead)</i>	Wind Chill	<i>No task card (tables on overhead)</i>
<b>Day 14 (block day)</b>	<i>Teacher sick day</i>	3.5 Worksheet Linear or non-linear	Test Review Day	Unit 3 Review Packet
<b>Day 15</b>	Test Review Day	Unit 3 Review Packet	<i>Unit 3 Test Day</i>	
<b>Day 16</b>	Launch Unit 4: Slope			
<b>Day 17</b>	<i>Unit 3 Test Day</i>			

## VITA

Maria del Rosario Zavala was born in Miami, Florida to Peruvian immigrants Susana Arbe and Luis Manuel Zavala. Significant experiences growing up in Pennsylvania, Massachusetts, and finally California shaped her own love of mathematics and passion for social justice. She attended University of California Santa Cruz and received a BA in Mathematics in 2002. After many years of volunteering in schools and working part time as an elementary school language arts and mathematics teacher, Maria moved to Seattle for graduate school to learn more about how to address the inequities she witnessed, especially for Latino/a students learning mathematics. While pursuing her degree in Seattle, she volunteered in local classrooms, taught in a middle school summer program, and taught graduate courses in the University of Washington Seattle and Tacoma Teacher Education Programs focused on rigorous mathematics teaching and specific attention to emergent bilingual students. Maria received her PhD in Education with a focus on Mathematics through the Learning Sciences program at the University of Washington Seattle in June 2012. She will begin her new faculty appointment Summer 2012 in the Elementary Teacher Education program at San Francisco State University (CSU).