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Cover Page Footnote

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Abstract

Identity formation is complex, ongoing, and context specific. To be successful in mathematics classes, students must negotiate and navigate the normative identity of the class–what counts as being "good at math" [4]. Within the constraints of normative identity, students must also negotiate a personal doer-of-math identity: who they are within the context of this particular mathematics class. When students are compelled to suppress key aspects of their identity in order to accommodate the normative identity of the class cognitive bandwidth for learning may be impeded [24]. Conversely, when students are guided in braiding individual identity traits with the normative identity, they may improve their personal opportunities for learning and benefit the class. This article describes how one student learned to use her powers for good as a comedian-mathematician. It also offers an analysis of how a teacher helped her student become good-at-math while keeping true-to-self.

Key words: identity; equity.

For many students, school is where you learn what is wrong with you. You are too loud, too quiet, speak the wrong language, or wear the wrong clothes. You have the wrong address or even family. Similarly, many students experience the learning of mathematics as raced and classed (c.f. [12]). Marginalization impedes success in mathematics classes. It is harder to focus on learning when important pieces of personal identity must be metaphorically checked at the door.

Against this bleak backdrop, this article offers a portrait of hope, pride, and success. It describes how Lauren[1] successfully braided her personal and mathematical identities in Ms. Mayen's sixth-grade mathematics class. This work offers answers to these questions: What happens when students are not asked to check important parts of their identity at the door? What happens when students are guided in re-framing pieces of identity in service of learning mathematics?

1. Theoretical Framework for the Research

The theoretical framing for this study interweaves identity and pedagogical theories. Identity is considered from both individual and collective perspectives. The pedagogical theory of Complex Instruction [6] considers how individual and collective identities are mediated within classroom settings.

1.1. Identity

Identity in mathematics education has been considered from multiple theoretical perspectives [8, 16]. Grainsize matters when we talk about identity in mathematics classrooms. As classmates, students are both members of learning collectives [20, 4, 24] and individual learners. For this study, I consider identity from a variety of perspectives.

Broadly, identity is an ever-evolving "nexus of multi-membership" [29, page 145]. We are what we do, what we know, who we know. Identity is thus both a social and personal construct and who we are is a product of how we internalize (or reject) social interactions. Because identity is always under construction and thus fluid, I wish to be clear that any identity description is a snapshot—a captured moment, subject to change.

Identities evolve based on feedback from multiple social interactions. Feedback includes narratives and social *positioning*. Sfard and Prusak [23] frame identity as composed from *narrative*—the stories others tell about us. These stories are told to us and to others, and include those we construct about ourselves. The person we know ourselves to be, in any given setting, is knit together from the ways we envision ourselves and perceive others as seeing us.

[1] All names are pseudonyms chosen by the participants in the study.

In mathematics classes, multiple strands of identity are braided to form a student's identity as a *doer-of-math*. These strands need not be specific to learning mathematics. For example, a student might identify (or be identified) as sibling, athlete, gamer, nerd, by race, ethnicity, gender, or sexual orientation, or any other marker of identity.

Students in mathematics classes are positioned through implicit and explicit stories about who they are in a particular place and time [13, 15]. For example, an explicit story might include verbal feedback that your answer has merit and is worth sharing with the class [22]. An implicit story might arise from noticing when your ideas are taken up in mathematical discussions. The rejection of an idea implies it was unwelcome; the acceptance of an idea implies it was valued [21]. Humans take in sensory data and make sense of it, metacognitively building representations of who-I-am in a particular space-and-time ([7], [19, page 160]). This process is iterative as a person incorporates (or rejects) new and evolving evidence about how they are perceived in particular contexts. This process frames the metacognitive narratives of who-we-are in social contexts such as mathematics classes. The process can be self-positioning: if I anticipate success I am more likely to perceive myself as successful. The converse is also true.

While students are constructing their individual doer-of-math identities, they are also collectively defining what it means to be *good-at-math*. This *normative identity* is, colloquially, how a member of a learning community would recognize someone who is good-at-math. Students and teacher negotiate the specific mathematical and general obligations students must fulfill to be considered successful [4, 20]. Historically, being good-at-math meant completing calculations quickly and correctly [14]. Note that this historical normative identity does not necessarily imply conceptual understanding, risk-taking, or collaboration.

1.2. Complex Instruction

Current research and resulting theory in mathematics pedagogy reflect a newer, very different normative identity—one that is grounded in productive struggle, risk-taking, and collaborative sense-making [1, 18]. The teacher participating in this study enacted the co-construction of this particular good-at-math identity in part through *Complex Instruction* (CI), a specific pedagogical theory based on social psychology [5, 6].

Complex Instruction encompasses the co-construction of normative identity and positioning of students. CI frames productive groupwork as the social engine for learning. Groups are, by design, heterogeneous with regard to race, class, gender, language proficiency, and *abilities*. In CI, abilities are anything about which a student can claim "I am able to do this." Thus, abilities are markers of legitimated competencies related to the tasks at hand. Wide definitions of competency create more opportunities for students to succeed.

In contrast to the framing offered by CI, the word *ability* commonly refers to measures, such as test scores or grades, by which students are often tracked in mathematics classes. This definition of ability marks particular elements of mathematical proficiency such as procedural competence and conceptual understanding. CI works from assumptions that mathematical proficiency is fluid and changeable. Proficiency is mediated by prior knowledge, familiarity with tasks at hand, and interpersonal dynamics. These factors all interplay with students' development of mathematical understandings. CI embodies the ethos that: *no one is an expert at everything, everyone is an expert at something*. In this way, ability and expertise are seen as fluid constructs that are context- and person-dependent. Teachers can expect to be surprised by brilliance at any moment from any student, and primed to watch for it. Teachers can leverage such observations in *status interventions*: redirecting classmates to notice and act upon important mathematical contributions of lower-status students that might otherwise be missed or ignored by their colleagues.

2. Methods, Data Sources, and Analysis

This article describes and analyzes the results of a part of a larger study, which followed a cohort of 62 sixth-grade mathematics students across the 2015-2016 academic year to determine how the students and their teacher co-constructed what it meant to be good-at-math. The whole study is presented in detail in [20].

2.1. Participants

The students were divided into three classes, all taught by mathematics specialist Isabella Mayen. In the context of the United States, specialized teaching is common beginning in grade six or seven. The students presented as:

76% Latinx, 15% African American, 8% Asian, and 1% Filipinx. The students attended City School, a San Francisco Bay Area middle school that serves a diverse student body drawn from across a large urban setting. According to the school's website, more than 91% of students qualified for free lunch, a proxy for low socioeconomic status.

Isabella Mayen identifies as Latina, earned her teaching degree at a prestigious teacher preparation program, and was in her second year of teaching at the time of the study. I chose this context because the larger study was designed to discover how students' identities as doers-of-math shifted. For that purpose, I sought a teacher who was well educated and relatively stable in her practice of facilitating mathematical sense-making, and students who were likely to be transitioning from traditional mathematical instruction to sense-making. All names in this study are pseudonyms chosen by the participants. While in mathematics class, students sat at tables in randomly assigned groups of three or four. Ms. Mayen and her students referred to these groups as "teams."

2.2. Data Collection and Analysis

The data sources for this multiple-methods study are described in Table 1.

The pre- and post-surveys were designed to capture what the students thought it meant to be good-at-math. The Statistical Package for the Social Science (SPSS) V.21 was used to analyze ANOVA testing for differences in means on each Likert-scale item. Dedoose was used to develop and refine qualitative coding to analyze patterns in the open response items. All video footage was first documented with timestamps and content in a log [11]. Because it was created in harmony with daily observations and field notes, the video log informed the analytic memoing process. These memos included initial jottings of ideas, reflective memos written after each observation, and informed emerging analytic themes [9].

The ongoing analysis informed the creation of *snapshots*, collective (normative good-at-math) or individual (doer-of-math) identities. I use the term snapshot specifically because identities are always under construction. They may be volatile or stable, fluid or frozen. Borrowing from this water analogy, what appears stable is still changeable, much as a glacier seems frozen, but still flows. For more detailed descriptions of the broader study and its methods please see [20].

Data Source	**Collection Frequency**	**Analytical Methods**
Initial and Final Survey: 26 Likert-scale, 3 open response items	August 2015, March 2016	Quantitative regression and qualitative coding
Interview: individual students	September, 2015	Qualitative coding
Classroom observations: Video recording from two perspectives	September 2015-March 2016 (18 visits)	Analytic Memoing
Classroom observations: Field notes	September 2015-March 2016 (18 visits)	Analytic Memoing
Ad Hoc: Interviews with teacher and students	As needed, across all field site visits	Analytic Memoing
Ad Hoc: Exit tickets (short answer open item question)	As needed, across all field site visits	Qualitative coding

Table 1: Data sources, collection frequency, and analytic methods.

2.3. Individual Identity Sketch

In this article I follow the construction of one student's doer-of-math identity, in concert with both the normative identity of her class and aspects of her personal identity. I selected Lauren as a focal student for her success in braiding of identities in the service of learning mathematics.

For this study, I analyzed field notes, memos, and interview transcripts to craft an identity portrait for Lauren—who and how she appeared to be in her math class across time. The field notes and memos provided guidance for revisiting video footage of Lauren interacting with her classmates and Ms. Mayen. The video footage both informed and checked the refinement of the initial findings.

3. Results

To better understand Lauren's opportunities to develop a doer-of-math identity it is important to first understand what it meant to be good-at-math in Ms. Mayen's classroom. The results are organized in two sections: the normative identity in Ms. Mayen's classroom, and Lauren's personal doer-of-math identity.

3.1. Good-at-Math in Ms. Mayen's Classes

Ms. Mayen had a particular vision of what it meant to be good-at-math. She wanted her students to be independent and creative problem solvers who worked collaboratively to make sure they understood how others "saw" mathematics. Ms. Mayen and her students grew their mathematical understanding by connecting multiple representations. This vision of good-at-math was at odds with how many of her students understood success based on their previous experiences in mathematics classrooms. They arrived in her classroom believing that good-at-math meant answering questions quickly, not making mistakes, and replicating mathematical procedures presented by their teacher. The students and Ms. Mayen negotiated a new normative identity [21]. This normative identity formed within three weeks of the beginning of the academic year and continued to stabilize across the remainder of the year.

In Ms. Mayen's mathematics classes, a person was considered good-at-math if they were brave, willing to share their thinking, able to help others when they understood, able to ask questions when they did not understand, and committed to the collective goal of everyone's understanding. Notably absent from these markers are requirements to organize one's body or thinking in rigid ways.

This normative identity evolved from a series of bids, both explicit and implicit, through which any member of the classroom was able to propose ways of doing mathematics [21]. For example, Ms. Mayen explicitly asked students to be "brave" in sharing their thinking, even when they were uncertain, and praised them for doing so. Students who were reluctant to share their thinking publicly implicitly signaled the need for support in being brave. Ms. Mayen responded by scaffolding her instruction explicitly to support students in working through their own reasoning, sharing in teams, then presenting to the whole class [22].

3.2. Lauren's Personal Doer-of-Math Identity

Like many of Ms. Mayen's students, Lauren was Latina. She was unique in her vision of then- and future-self as comedian. Based on her early social interactions in the class, I could easily imagine how she might have been positioned as a troublemaker. But in Ms. Mayen's class, she was positioned as a leader. This identity portrait shares how Lauren braided pieces of her personal identity into her evolving doer-of-math identity.

Social Power. In many ways, Lauren was a pivotal player in her mathematics class. She was the clear social leader in her group and was comfortable commanding attention in the classroom. At first, this attention was socially oriented. Within the first days of the year she struck an implicit deal with Ms. Mayen: Lauren would use her powers for the general good—she would direct her social power toward doing and learning mathematics. This was contingent on Ms. Mayen letting her know, implicitly and explicitly, how to do so. Lauren learned to be successful by observing Ms. Mayen's reactions during their interactions in and outside of class. Examples of these interactions follow.

Fear of Failure. When Lauren arrived fall of 2015, she was afraid of mathematics class. She reported she was "not very good" at math on the survey she filled out the first day of class. Despite this fear, Lauren connected socially with her first teammates, Jazmin, Elizabeth, and Yoshi. Lauren dominated the team's social interactions. Their collective attention to mathematics diffused and focused depending on her whims. The three girls quickly ceded academic authority to Yoshi, whom they regarded as "smart" at math. Lauren remained socially dominant, nicknaming Yoshi as "Jeff," which Ms. Mayen discouraged because she saw names as important markers of identity. It is possible Lauren chose the name Jeff as short-hand for "jefe," or "boss" in Spanish.

Beginning the Year. In those first foundational weeks, Lauren's team frequently focused on social interactions at the expense of mathematical discussion. These social interactions may have been important early practice for later mathematical discussion; the team learned to function as a social group first to accomplish team-based mathematical goals later [10, 17]. That said, based on her regular redirection of the group, Ms. Mayen was clearly displeased that the team was frequently off-task. Jazmin requested and was granted relocation to another group, perhaps to signal her seriousness about learning. This move disrupted the team's socializing.

Bonding with Ms. Mayen. The first few weeks of relationship building in the school year were critical for all students and Ms. Mayen, but perhaps more so for the girls in this team. Though Jazmin left the team, she and Lauren bonded quickly and became regular members of a group of students who frequented Ms. Mayen's room during lunchtime.

Ms. Mayen referred to these students as "my lovelies." Early in the year, Ms. Mayen asked her students to write her a letter about themselves. To introduce the assignment, Ms. Mayen presented a powerpoint slide show of her own life history that included how she came to teach mathematics. Through this presentation, Lauren learned her teacher's middle name. After that revelation, Lauren frequently referred to Ms. Mayen by her middle name, "Anita." Ms. Mayen tacitly allowed this, as she did Lauren calling her "mija," or "my daughter" despite the inversion of their ages. This term of endearment was used by some of the female students to refer to close female friends. Initially used solely by Latina students, the term was taken up by Jessica, an African American student. Based on objections by another student about the appropriation of Spanish by non-native speakers, this was a potentially risky act. It was not only tolerated, it was actively accepted. Jessica was a powerful student in the class both mathematically and socially. Her adoption of particular Spanish words seemed to position her as both accepted and accepting of Latina identity. This was evidence that strong Latinas, such as Lauren, were valued in the class.

Learning Limits. Lauren frequently pushed boundaries with Ms. Mayen. For example, during a lunchtime visit, she snatched a tortilla from Ms. Mayen's plate and accidentally dropped it on the floor. Based on this interaction, a teacher might have positioned Lauren as a troublemaker. Lunch, and lunchtime, are precious commodities for teachers, and even the very patient Ms. Mayen was visibly and audibly irritated at Lauren's act. This was unusual as Ms. Mayen rarely raised her voice or showed frustration with her students. Lauren left the classroom and returned with a can of fizzy juice from the cafeteria. Lauren was making amends, which Ms. Mayen accepted both explicitly (the can of juice) and implicitly (the apology), marked by Ms. Mayen's return to her usual welcoming demeanor.

On another occasion, Lauren took Ms. Mayen's phone and erased photos of classwork done on the whiteboard. Lauren did not want those photos shared at an informational back-to-school night for the students' families. To be clear, the photos recorded work in which Lauren had collaborated. It could be argued the records of the work were intellectual property, in which she shared ownership, whereas the phone itself and photos clearly belonged to Ms. Mayen. Ms. Mayen expressed dismay and sadness because all physical records of the erased work were gone.

She did not remark on the personal invasion of her phone. In these ways, Lauren took, and Ms. Mayen allowed, an astonishing degree of liberty in the relationship. For her part, Ms. Mayen was clear and consistent in marking and keeping boundaries with Lauren—Lauren knew when she had pushed too far. Ms. Mayen was remarkably patient, allowing time and space for Lauren to learn the boundaries for acceptably exercising power in this mathematics classroom.

Family. Lauren also held an identity as the only daughter in a family of seven children. Her relationship with her brothers and male cousins was rough-and-tumble. It seems plausible that she was learning to navigate expectations and normative identities that differed between home and school, such as those in Ms. Mayen's mathematics class. The class was, as might be expected, centered on posing and refining mathematical arguments far more than physical acts of strength or dominance. But it was not surprising, given the powerful social agency of students such as Lauren, Jazmin, and Jessica, that public mathematical arguments had a robust and, at times, verbally combative nature [20].

3.3. Braiding Social and Mathematical Power

As stated earlier, Lauren was learning to use her powers for good. For example, she was careful in her arguments with Christopher, a student who could easily have been positioned with low social and mathematical status [20]. Christopher could have been crushed by Lauren's social dominance in the classroom. But when Lauren debated with him, based on the prosody and volume of her voice, she appeared to intentionally frame her arguments in terms of the points she was making and how they did or did not agree with Christopher's. Lauren directed criticism at arguments rather than people. For example, Christopher presented two competing strategies with two different answers to compute 9×15, one of adding nine fifteen times, the other multiplying nine fifteen times. Lauren was visibly frustrated—she appeared to be physically and vocally restraining herself. During the class discussion she kept her language neutral and her tone of voice even, though emphatic, as she pressed Christopher to explain how he could reconcile two methods that produced two different answers for a problem with a unique answer. The question resolved with Christopher abandoning the repeated multiplication strategy for the mathematically correct repeated addition strategy.

Through this interaction, Christopher reinforced his growing academic status, which included asking good questions, in part due to the ways Lauren was socially and mathematically respectful of his thinking.

3.4. Braiding Individual and Normative Identities

One of the most striking aspects of Lauren's identity as a mathematical sense-maker was her insistence on the role of humor in the classroom. Lauren described her future-self as a comedian. As I have written elsewhere, many of Ms. Mayen's students were initially deeply concerned that if they presented a wrong answer in class students might laugh at them [20, 22]. In fact, both Lauren and Jazmin declared in an informal interview early in the year that they would "never go to the board" for fear of humiliation. Yet fifteen weeks into the school year, when asked on an exit ticket what she needed to feel comfortable presenting at the board, Lauren responded "Laughter. I need to be in a good mood. I need to have people laughing at me."

This need was apparent in Lauren's presentation to the class during the fourth week of the school year. Ms. Mayen staged a status intervention [6] by asking Lauren to present her work to the class, letting her know it was valued and worthy of sharing. A visibly uncomfortable Lauren went to the overhead and asked a number of questions of Ms. Mayen, some in Spanish (which Ms. Mayen translated to the class). Lauren fumbled with the pen, then turned the fumbling into a joke. Her body relaxed when the class reacted with laughter. Ms. Mayen appeared to appreciate Lauren's incorporation of clowning with her mathematical presentation.

When I interviewed her later, Lauren talked about the importance of laughter to re-set the mind and reclaim *cognitive bandwidth*, the breadth of a person's attention span. Specifically, she said that as discussions grow longer it gets harder to keep paying attention. A well-timed joke is important because "you can chill, and get all that seriousness out of you." Laughter allowed the class a brief mental break before re-engaging with the work of sense-making, or as Lauren put it, "it releases all of the negative energy." Thus, Lauren used humor to improve public learning opportunities.

The stories Lauren told about herself include her former identification as not being good-at-math, the importance of humor to herself and the class, and that she valued female friendship (perhaps in contrast to or complementing

the strong male relationships in her family.) The stories that her classmates and teacher told Lauren about herself include that she was, indeed, funny and powerful, that her mathematical arguments were worthy and helpful, and that she was better appreciated when she used her powers for good. Lauren presented herself as an independent, powerful, compassionate, and funny doer-of-math.

4. Discussion

This article presents the ways one sixth-grade student learned to succeed in her mathematics class. Her success was contingent on successfully incorporating her personal identity and social power with the class's emerging normative identity of good-at-math. This process was facilitated by Ms. Mayen's recognition and reinforcement of what did, and what did not, matter in terms of learning mathematics. Upon reflection, it was clear that this identity work, done in concert by Ms. Mayen and her students, protected cognitive bandwidth–ability to focus on learning.

Ms. Mayen had a firm and abiding belief that her students were intellectually capable and curious people. She saw them as fully realized human beings, with pasts, futures, communities, and family connections. Every aspect of who they were, and who they were coming to be, was important in how she came to know and engage with them as mathematical sensemakers. Ms. Mayen worked with many students from low-income families. Ms. Mayen believed pity was "dehumanizing." Consistently framing her students as capable and full of potential widened Ms. Mayen's vision of who they were, and who they were becoming. The students knew how she felt about them and thus their own visions of who they were, and who they could be, expanded. This was reflected in the normative identity of the class, which valued bravery, helpfulness, and sharing one's thinking [21]. The normative identity was broad enough that Lauren's ways-of-being were readily braided into meeting the obligations that marked being good-at-math.

The sketch of Lauren's personal identity reveals the importance of being one's authentic self in a classroom setting. Lauren was not required to check her socially powerful comedian self at the door, though she was expected to put those parts of identity into the service of learning mathematics, as per the normative identity. Claude Steele [24, 25] and colleagues studied

the impact of *stereotype threat* on task performance. They explain why invocation of a stereotype can diminish cognitive bandwidth—a stereotyped person can suffer a bifurcation of cognition into both proving a stereotype wrong *while* completing a task. This body of research includes the stereotypes that: women can't do math [28]; white men can't jump [27]; Black people can't succeed academically [26]. These compelling stories give pause: when students seeking success must suppress parts of their authentic selves to fit within narrowly structured normative identities, do they sacrifice cognitive bandwidth? How much learning is lost to such suppressions? What would have happened if Lauren was unable to be both a successful doer-of-math *and* a comedian?

When Lauren arrived in Ms. Mayen's class, she thought she was bad at math, she was afraid of presenting in front of the class, and she was convinced of the value of humor. Ms. Mayen's authority as teacher, a teacher who quickly won the loyalty and love of her students, made her judgements powerful. Her reaction to Lauren's humor was thus pivotal. Instead of obliging Lauren to check it at the door, Ms. Mayen welcomed Lauren's sense of humor. Like many other social traits, it was braided into Ms. Mayen's instruction and the class's normative identity: so long as no one's learning was impeded, individual personal identity traits were more than welcome. In this case, Lauren's humor was elevated in status when it was framed as helpful in explaining and understanding mathematical concepts. Ms. Mayen's implicit and explicit feedback about how Lauren interacted with her peers helped her simultaneously co-create and navigate the class's normative identity.

As Lauren explained, humor had a real and observable value in the classroom: it provided a cognitive break for students to relax briefly, then re-engage with their thinking. Lauren's humor not only provided respite, it may also have fostered anticipation for her engaging presentations. In bringing her authentic self into the mathematics classroom, Lauren may have had more cognitive bandwidth for learning mathematics. Instead of suppressing her humor she applied it strategically to improve learning for herself and her classmates. Further, finding herself-as-comedian embraced and valued by her teacher and peers, she was invited into new ways of growing and inhabiting a vision of herself as good-at-math. Lauren's identity story is thus a tale of transitivity:

$$\text{I value humor} \implies \text{Humor is welcome} \implies \text{I am welcome and valued.}$$

5. Conclusion

When students' personal identities are allowed, even encouraged, to braid with their emerging identities as doers-of-math, they find opportunities to flourish. Students whose whole selves are welcomed in class have more bandwidth to focus on learning. This is not always a simple proposition—Lauren could have been read and positioned as a disruptive student. Would Lauren have persevered in learning mathematics if she perceived herself and her ways-of-being as unwelcome? Through their shared efforts, Ms. Mayen and Lauren found ways to incorporate things Lauren loved–humor and social power–as central to her sense of self in the context of her mathematics class. In these ways, Lauren's individual doer-of-math identity fit within and supported the class's developing normative identity of good-at-math.

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