

Teacher care and students' sense of connectedness in the urban mathematics classroom

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## ABSTRACT

This multi-method study draws on theories of teacher care, dispositions, and culturally relevant pedagogy to examine how 12 urban mathematics teachers' perceptions of their own care practices align with their Black and Latinx students' (n=321) sense of connectedness in the mathematics classroom. A qualitative analysis of in-depth interviews with the teachers established three typologies of care: *empathetic*, *transactional*, and *blended*. A questionnaire measure of mathematics classroom connectedness revealed that students in classrooms led by teachers who enacted an empathetic caring pedagogy were more likely to agree that their teachers provided emotional support, their classroom felt like a family, and their contributions were valued in class. Further, students' sense of classroom connectedness mediated the link between teacher care and students' perceived value and relevance of mathematics.

Keywords: care theory, mathematics education, school connectedness, urban education, culturally relevant pedagogy, belonging

### **Introduction**

Mathematics education has long adopted a colorblind perspective, where issues of race, racism, or culture have not been perceived to shape an individual's educational access or ability to learn or perform well (Martin, 2009). This perspective ignores how racial achievement gaps have been socially and politically constructed (Gutiérrez, 2008). Black American and Latinx students, especially those in economically oppressed communities, continue to experience limited opportunities to attend schools with rich curricular options, up-to-date materials and technology, or highly effective and experienced teachers (Hill & Lubienski, 2007; Oakes, 2005). These students also often have limited access to higher-level mathematics courses, notwithstanding prior achievement (Stiff, Johnson & Akos, 2011), ultimately perpetuating underrepresentation in mathematics-related majors and careers compared to their White and Asian peers (National Science Board, 2016). Further, earning differentials by race align with mathematics educational attainment, suggesting mathematics curricula are complicit in broader systems of structural racism that can limit Black and Latinx students' economic outcomes (Battey, 2013a).

Educational researchers have begun to shift blaming perceived cultural deficits in Black and Latinx communities to examining how racial inequity in mathematics instruction, curriculum, and assessment explains Black and Latinx students' persistent underachievement (Gutiérrez, 2008). For example, research has revealed low teacher expectations and deficit beliefs regarding Black and Latinx students' abilities (Spencer, 2009), infrequent instruction reflecting these students' culture and learning styles (Battey, 2013b; Lubienski, 2006; Schenke, Nguyen, Watts, Sarama, & Clements, 2017), and tracking Black and Latinx students into lower mathematics coursework (Oakes, 2005) where they frequently receive uninspiring, rote and

procedural instruction (Walker, 2003). Such evidence explains why these students may feel disconnected in mathematics classrooms and perceive low value and relevance of mathematics. In the current study, we argue that feelings of connectedness in mathematics classrooms may be a key lever in developing resilient mathematical identities and a strong value of mathematics for Black and Latinx students (Goodenow, 1992).

The desire to belong is a basic human need (Baumeister & Leary, 1995) and central to forming and maintaining interpersonal, caring relationships. Connectedness, or acceptance into a group, can generate internal feelings of belonging, emotional bonding, and personal identification with a group or its values. A sense of connectedness predicts student motivation (Goodenow, 1993) and performance across learning contexts (Connell & Wellborn, 1991; Deci & Ryan, 1991; Finn, 1989; Osterman, 2000). In the classroom, teachers have a great responsibility to build a sense of connectedness and belonging, particularly for historically disenfranchised students. Teacher care, through quality teacher-student relationships and a supportive classroom climate, is a linchpin in aiding students' feelings of connectedness and belonging (Vithal, 2003) and may associate with students' perceived value and relevance of the course content (e.g., value of mathematics). Teacher care is generally described as the way teachers relate to their students as a moral or ethical obligation to their welfare (Noddings, 1984). Growing evidence on teacher care suggests caring is a vital aspect of classroom instruction, student engagement, and achievement (Klem & Connell, 2004; Wilkins, 2008).

Research investigating the impact of teacher care in mathematics classrooms remains underdeveloped (Vithal, 2003). Hackenberg (2010) defines *mathematical caring relations* as teacher-student interactions involving teachers tuning into both a child's cognitive processes and their emotional reactions to mathematical tasks and activities as they move within and beyond

the students zone of potential construction (Steffe & D'Ambrosio, 1995). The qualitative study of her own one-on-one interactions with students in a rural middle school revealed how decentering her own mathematical thinking allowed her to better address students' cognitive constraints, revealed through students' energetic responses. Hackenberg's findings (2010) provide important evidence connecting teachers' care practices to students' mathematical outcomes; however, few empirical studies exist using both teacher and student data to consider the role of race or culture in rigorous mathematical activity (Jackson & Wilson, 2012).

Teacher care through a culturally relevant lens considers the ways race, ethnicity, and culture inform how teachers care for their students (Roberts, 2010; Rolón-Dow, 2005). Further, scholars argue effective mathematics teachers of Black and Latinx students are those that see the moral and political imperatives of their work (i.e. Bonner, 2014; Clark, Johnson, & Chazan, 2009; Gutiérrez, 2018; Tate, 1995). Drawing on Durie's (1998) indigenous model for effective teachers of Māori students, Averill (2012) described various culturally relevant mathematics teacher care practices and found that lessons in which teachers demonstrated the most care resulted in the highest student engagement and the most student-initiated interactions. Another international study found teacher care supported students' math self-efficacy, which subsequently predicted math test score performance, particularly among Hispanic English speakers (Lewis, Ream, Bocian, Cadullo, Hammond & Fast, 2012). Bonner (2014), although not explicitly focusing on care, found effective mathematics teachers of traditionally underserved students built trusting relationships with their students and demonstrated rigorous content-related expectations (Ware, 2006).

In the present study, we provide evidence of varied types of care among mathematics teachers and explore how that care shapes Black and Latinx students' sense of connectedness in

the mathematics classroom and ultimately their perceived value and relevance of mathematics.

We incorporate care theories in the analysis of teachers' reflections on their practices and examine how their care affects Black and Latinx students' experiences and perceptions in their mathematics classrooms. Through semi-structured, in-depth teacher interviews and student surveys, we addressed the following research questions:

1. In what ways do teachers say they exhibit care for Black and Latinx students in mathematics classrooms within urban schools serving low-income communities?
2. Do teachers' care practices predict students' sense of connectedness in urban mathematics classrooms?
3. Does student sense of classroom connectedness mediate the relation between teacher care and students' value and perceived relevance of mathematics instruction?

We examined 12 mathematics teachers' care practices within a large, low-income, urban community. We then related the teachers' care pedagogies to their own students' feelings of connectedness within their mathematics classroom. Finally, we assessed whether feelings of classroom connectedness then predicted students' value of mathematics and their perceived relevance of math instruction. In the current climate where educators are working to improve access and equity in mathematics, this study offers insight into the culturally relevant mathematics practices teachers utilize to better connect with students and the language needed to better understand these practices.

To explore the interactions between care and mathematics pedagogies, we first summarize theories of care, culturally relevant pedagogy, and mathematics teacher beliefs and dispositions. Our subsequent methodology section describes our two overlapping sets of data: 1)

subjective teacher practices and beliefs, and 2) student perceptions of classroom climate and personal beliefs about mathematics.

### **Analytical Framework**

#### **Care Theory**

Drawing on Carol Gilligan's (1982) notion of an 'ethic of care' and Nel Noddings' scholarship (1984, 1991, 1992, 2002, 2006), teacher care stresses the importance of teachers developing caring relationships with students. Noddings' work highlights the importance of considering care as embedded in a reciprocal relationship between the teacher (the one caring) and the students (the cared-for). Students are active participants in the relationship, as feelings of care are mutual. This shared aspect of care can develop a sense of connectedness for students.

Noddings differentiates two types of care: *caring-for* and *caring-about*. Caring-for is an ethical caring that entails a moral obligation involving "engrossment" in the cared-for or "apprehending the other's reality, feeling what he feels as nearly as possible" (Noddings, 2013, p. 16). Caring-for involves a "displacement of motivation" or interest from the self to the reality of the other: "We act not to achieve for ourselves a commendation, but to protect or enhance the welfare of the cared-for" (p. 24). In this way, caring-for is selfless and often requires teachers actively putting students' needs before their own.

Conversely, caring-about "involves a certain benign neglect. One is attentive just so far." (Noddings, 1984, p. 112). An individual can care-about a person without explicitly responding to that person. Caring-about is often evident when one's focus shifts from the cared-for to immediate problems and the act of problem solving. For example, teachers may focus on improving classroom management by using an impersonal system of punishments and rewards (e.g., token economies) while ignoring student needs or the true antecedents of problem

behavior. Here, the teacher still exhibits care for their students by attempting to create a safe, orderly classroom; however, the distinction lies in the focus of the caring: where caring-for focuses on the person, caring-about focuses on the problem.

### **Culturally Relevant Pedagogy and Critical Care**

The research on teacher care has been criticized for neglecting race, ethnicity, and culture. Beauboeuf-Lafontant's (2002) and Thompson's (1998) critiques of Noddings' colorblind construction of teacher care complicate using the theory for studying classrooms serving historically marginalized populations. A sociopolitical history of racism, marginalization, and segregation in U.S. schools has left an indelible mark on Black and Latinx people. This history communicates a lack of care that has perpetuated frustrations in belongingness among Black and Latinx youth (Gray, Hope, & Matthews, 2018). Schools today still communicate these messages, although more subtly than in previous decades. Therefore, acknowledging racial and sociopolitical histories of U.S. schooling and locating race in care theory are paramount (Valenzuela, 1999).

Critical care is a critical race theoretical (CRT) perspective applied to teacher care. In the 1970s, critical legal scholars developed CRT to more adequately conceptualize the evolving yet enduring role of race and racism in the United States. Education scholars have applied the tenets of CRT to understand how common school policies and practices throughout U.S. history have maintained structural inequity in education (Ladson-Billings & Tate, 1995). Since then, CRT has been used to analyze curricula and standards (Ladson-Billings, 2003; Vasquez, Heilig, Brown, & Brown, 2012), teaching and pedagogical practices (Chapman, 2007; Roberts, 2010; Rolón-Dow, 2005), preservice teacher learning (Larkin, Maloney, & Perry-Ryder, 2016), and educational research (Ladson-Billings, 2005). Critical care acknowledges that caring for Black and Latinx



students in America involves teachers understanding how race and racism shape the sociopolitical conditions of their communities (Rolón-Dow, 2005; Roberts, 2010). Critical care requires teachers' engrossment to include sociopolitical and racial analyses of how curricula, school norms, and behavioral expectations fail to meet the needs of Black and Latinx students as the cared-for. Similar to critical care, Watson, Sealey-Ruiz, and Jackson (2016) describe *culturally relevant care* as a humanizing pedagogy that is warm demanding (Ware 2006) and builds a mutual trust that allows for open expression and a sense of bonding between teachers and students. This study examines how aspects of critical care and culturally relevant care show up in mathematics teaching and learning in ways that affects students' feelings of connectedness.

### **Teacher Care, Dispositions, and Beliefs in Mathematics Education**

Mathematics teachers' critical care for Black and Latinx students hinges on their beliefs and dispositions regarding both culturally relevant pedagogy and mathematics teaching and learning. Drawing on Garmon's (2004) work on teachers' dispositional factors that facilitated multicultural awareness, White, Murray, & Brunaud-Vega (2012) developed the multicultural mathematics dispositional factors of openness, self-awareness/self-reflectiveness, and a commitment to culturally responsive mathematics teaching. Collectively, these dispositions include how receptive teachers are to integrating culture in the teaching and learning of mathematics, holding high expectations for all children, and exposing children to rigorous mathematics.

Teacher dispositions can provide insight into teachers' identities, as dispositions are the "habits of mind including both cognitive and affective attributes that filter one's knowledge, skills, and beliefs, and impact the action one takes in classroom" (Thornton, 2006, p. 62). Many scholars agree that mathematics content knowledge and pedagogical content knowledge are

necessary for a fully-developed mathematics teacher identity (i.e. Ball & Bass, 2002; Van Zoest & Bohl, 2005). We assert critical care is also a crucial component to mathematics teachers' identities, particularly for those working with Black and Latinx students; however, little empirical work examines critical care and its effects for Black and Latinx students, particularly within the domain of mathematics.

Theories of culturally relevant pedagogy underscore how the nature of teacher-student relationships can support students' mathematics learning in ways that expand teacher care theories. How teachers interact with students influences their identity development as well as beliefs about their own mathematical ability and value of mathematics (Andersson & Wagner, 2017; Bonner, 2014). Bartell's (2011) framework for culturally relevant teacher care in mathematics classrooms emphasizes the teacher's role in developing trusting relationships. She concludes that culturally relevant caring relationships embrace color talk by explicitly attending to issues of race and ethnicity (Rolón-Dow, 2005; Siddle Walker, 1993; Thompson, 2004) and decentering Whiteness by working to understand how African American students come to understand and value mathematics (Martin, 2007). The current study provides empirical evidence to support these theoretical discussions by illustrating how teachers' critical care ultimately relates to students' sense of classroom connectedness and in turn their value of mathematics and perceived relevance of mathematics instruction.

## **Methods**

### **Study Context & Sample**

This study represents data from the first year of a five-year longitudinal project examining motivation in mathematics among middle and high school adolescents in an urban district (Matthews, 2018). The district is situated in a large city in the northeast United States

where over 50% of residents identified as Black/African American and approximately one-third as Hispanic/Latinx. One quarter of the population was living at or below the poverty line (U.S. Census, 2010).

Five schools and their administrators agreed to participate in the study after being recruited: two K-8 schools, two high schools, and one secondary school with grades seven through twelve. In all five schools, over 85% of students were eligible for free-reduced lunch. The student sample was recruited through in-person announcements in all of the participating schools' mathematics classrooms. Students were asked to return parental consent forms and sign assent forms. The response rate was approximately 64%.

The student participants were attending secondary and upper elementary mathematics classes taught by a total of 15 different teachers. Each of those 15 teachers was asked to participate in the study via semi-structured interviews conducted during the middle of the school year. Three teachers declined interviews, resulting in a final sample of 12 teachers and 321 students across those teachers. Therefore, the teacher sample was a convenience sample and not purposive for highlighting particular teacher characteristics. Rather, these teachers were selected simply due to their role as mathematics teachers for the students participating in the study. Table 1 summarizes the teachers' demographic data as well as their patterns of care, which are described in the results section. Of the 321 participating students, 56.4% self-identified as Black or African American, 30.2% as Latinx, and 13.4% as other, predominantly multiracial. Forty-eight percent were 9th graders, 10% in the 8th grade, 10.6% in the 7th grade, 19.6% in the 6th grade, and 11.8% in the 5th grade.

Table 1.

*Summary of teacher data.*

Teacher	Race/Ethnicity & Gender Identification	Relationship to city	Grade Levels Taught	Teaching Experience (in years)	Care Typology
Ms. Ellena	Italian American, White woman	Entered city as teacher	High	2	Empathetic
Ms. Emmett	Jamaican immigrant, Black woman	Entered city as teacher	High	9	Empathetic
Mr. Espada	Latino man	Entered city as teacher	Middle	5	Empathetic
Ms. Evans	Black woman	Raised in city, attended in-city schools	Middle	16	Empathetic
Ms. Talbot	White woman	Entered city as teacher	Middle	3	Transactional
Mr. Talleda	Ecuadorian immigrant, Latino man	Entered city as adolescent, attended in-city schools	High	12	Transactional
Mr. Tobe	Japanese American man	Entered city as teacher	Middle	2	Transactional
Mr. Todd	White man	Entered city as teacher	High	8	Transactional
Ms. Badowski	Polish immigrant, White woman	Entered city as adolescent, attended out-of-city schools	High	3	Blended
Ms. Bairos	Portuguese American, White woman	Raised in city, attended in-city schools	High	15	Blended
Mr. Bell	Black man	Raised in city, attended in-city schools	High	13	Blended
Ms. Brenda	Black woman	Raised in city, attended in-city and out-of-city schools	Middle	16	Blended

### **Data Collection & Analysis**

Teacher semi-structured interviews were the primary unit and measure of analysis. Three prominent care profiles surfaced from our analysis of this interview data. All students in the current sample attended mathematics classrooms led by a teacher representing one of the three care profiles. Through an online survey given at the beginning and end of the school year, the students self-reported their sense of connectedness to these mathematics classrooms, their attainment value of mathematics, and their perceptions of instructional relevance. These reports were used to corroborate the teacher interview data. Student scores on these scales were then collapsed into one of the three teacher care profiles, based on the profile their respective mathematics teachers most closely matched to. Thus, a quantitative categorical variable was computed representing the three care profiles: empathetic, transactional, and blended. Using this variable, a multivariate analysis of variance (MANOVA) was used to observe differences in students' perceptions and beliefs based on their mathematics teacher's care profile. Finally, structural equation modeling (SEM) assessed whether students' sense of connectedness mediated the relation between the teacher care profiles and the students' value of mathematics and perceived relevance of mathematics instruction.

**Teacher interviews.** The authors and a trained research assistant conducted 90- to 180-minute semi-structured interviews with all 12 mathematics teachers. The interview protocol was designed to capture the intricacy of how these teachers perceived: 1) their formative experiences as math students during their secondary and post-secondary years, 2) the nature of their students' critical thinking and mathematical reasoning, 3) their multicultural awareness, sensitivity, and beliefs, and 4) the coping/emotional support they provided their students. The interviewers implemented the protocol in a flexible manner, changing the sequence and presentation of

questions to allow the teachers to tell their stories and allow the interviewer to follow up on themes and responses of particular interest to the study (Kvale, 1996).

A constant comparative process was used to analyze the teacher interviews. The constant comparative method incorporates consideration of pre-existing theory (i.e., care theory & culturally relevant pedagogy) to generate the categories, conditions, consequences, or processes of a new theory (Glaser, 1965). This method involves comparing one piece of data (e.g., one incident, one statement, one theme) with all others that may be similar or different to understand the relations between them. This process considers the ideas and practices of the participants simultaneously with focal concepts of the researcher to develop both descriptive and explanatory categories (Lincoln & Guba, 1985).

The teacher interviews were audiotaped and transcribed verbatim. Once transcribed, the interview texts were read multiple times to generally understand the teacher's experiences and perspectives. Maxqda—qualitative coding software (MAXQDA, 2016)—was used to code the data. First, open coding was employed to organize the data from each interview into categories, which transformed it into manageable units. A summary was created for each interview regarding the corroboration and integration of codes. Second, using axial coding, codes were grouped to reflect larger thematic and interpretive codes, which allowed comparison of codes and themes across the interviewees (Strauss & Corbin, 1998). Third, in selective coding, teacher care codes were prioritized as the core categories and were compared across all their appearances within the interview texts, which revealed numerous similarities, differences, and extensions. The interviewees were then grouped based on similarities of the summaries. The various instances of teacher care – and other prominent codes – were compared, first with the summaries similar to one another and then across summaries that were dissimilar (Boeije, 2002). Theoretical

sampling is an important part of the constant comparison process to validate the groups derived from the initial analysis. Sampled students were surveyed from each of the interviewed teachers' classes to validate the care typologies derived from the teacher interview data (surveys described directly below).

### **Quantitative Measures of Classroom Connectedness and Mathematical Beliefs**

**Mathematics classroom connectedness scale (MCCS).** The MCCS questionnaire items were developed as a part of the ongoing longitudinal study that examines the development of motivation in mathematics among urban adolescents. The MCCS assesses the degree to which students feel supported by and integrated into their math classroom community. Students evaluated nine items for themselves on a six-point Likert scale (1= *Completely Disagree*, 2= *Mostly Disagree*, 3= *Disagree a Little*, 4= *Agree a Little*, 5 = *Mostly Agree*, 6 = *Completely Agree*). Students completed these questions early in the fall of the school year and again in late spring. The MCCS had three subscales: 1) *emotional support from teacher* (e.g., “My math teacher is someone I can count on to help me”), 2) *my math class is like a family* (e.g., “Students in math class help each other, even if they are not close friends”), and 3) *my contributions are valued* (e.g., “My math teacher knows that I can do good work”; See the full items in the appendix). In the fall, internal consistency for each subscale was acceptable ( $\alpha=.82$ ,  $\alpha=.70$ ,  $\alpha=.66$ , respectively) and the items demonstrated acceptable fit in a second-order confirmatory factor analysis:  $\chi^2= .45.66$   $df=24$ ,  $p=.005$ , CFI = .98, TLI = .97, SRMR = .031; RMSEA = .047 [90% CI .026, .068] (Hooper, Coughlan, & Mullen, 2008; Hu & Bentler, 1999). Similar internal consistency and confirmatory fit were found in the spring as well. The MCCS also showed concurrent validity with the *Sense of Social and Academic Fit* scale ( $r=.56$ ; Walton, Logel,

Peach, Spencer, & Zanna, 2015), a measure of perceived belongingness, measured concurrently in the same sample.

**Value of mathematics.** *Attainment* value of mathematics (i.e., a proxy for *mathematics identity*) was also measured, which indicates the degree to which an individual sees math as important for their identity (e.g., “being a good math student is an important reflection of who I am”). Four items were rated on a six-point Likert scale in the fall and again in the spring. In previous research, this scale has shown adequate internal consistency ( $\alpha=.73$ ), and strong fit in a confirmatory factor analysis:  $\chi^2=.234$   $df = 2$ ,  $p=.89$ , CFI = .99, TLI = .99, SRMR = .006; RMSEA = .000 [90% CI .000, .046] (Matthews, 2018). The scale has also established concurrent validity with intrinsic motivation for mathematics ( $r=.49$ ; SRQ-A; Ryan & Connell, 1989).

**Perceptions of instructional relevance.** An additional, well-validated measure of secondary classroom climate was used in this study: the *Inventory of School Climate-student form*, which measures students’ reports of instructional innovation and relevance (Brand, Felner, Shim, Seitsinger, & Dumas, 2003). This measure assesses students’ perceptions of their teachers’ willingness to implement innovative teaching approaches and the relevance of the content taught. The scale was evaluated on a five-point Likert scale (1= *Never*, 5= *Always*), and items were adapted to be mathematics specific (e.g., “new and different ways of teaching are tried in this math class”). This scale was also administered in the fall ( $\alpha=.67$ ) and again in the spring ( $\alpha=.70$ ).

## Results

In the first part of this section, we present two types of care – *empathetic* and *transactional* – and draw from the data to describe how teachers exemplified elements of each (Figure 1). Here, we note that while our results dichotomize teacher care, this presentation of



oppositional profiles is arguably disingenuous. Further, we do not suggest that some teachers cared for their students while others did not. Each of the teachers in this study demonstrated care for their students at some level; however, that care materialized differently in each teacher. Despite the potential complications arising from reductionism, creating care typologies allowed us to a) recognize nuances in teacher care that are not well understood in previous research and b) provide empirical support for how some teacher actions may predict Black and Latinx students' sense of connectedness in mathematics. Finally, we present a third typology demonstrating elements of both empathetic and transactional care – a *blended* care. After detailing the diverse care profiles, we make connections between teachers' care pedagogies and their students' sense of connectedness.

### **Empathetic Care**

Empathetic care is a teacher's authentic expression of identifying with the challenges of their students and prioritizing students' wellbeing above their own. In the present data, empathetic care was often discussed in an active sense through consistent verbal and physical actions extending beyond inert philosophy or rhetoric. More than possessing mere concern for students or having high expectations for their success, empathetic caring teachers truly saw the multiple facets of their students' selves and attended to students' challenges within and sometimes outside the classroom. In the data, empathetic care appeared through three integrated yet distinct patterns: 1) emotional consciousness to understand and manage student frustration, 2) affirming student self-identity while engaging mathematics, and 3) partnering with student struggles in mathematics and life. Four teachers consistently aligned with these empathetic care patterns, and thus were given pseudonyms that begin with the letter "E" (Ms. Emmett, Mr. Espada, Ms. Evans, & Ms. Ellena).

<b>Care Profiles</b> (12 Urban Mathematics Teachers)		
	Empathetic Care	Transactional Care
<b>Conceptualization</b>	A teacher’s authentic expression of identifying with the challenges of their students and prioritizing students’ well-being as equal to or above their own.	A teacher’s perfunctory expression of concern, affection, or expectations enacted as part of an informal negotiation of teacher and student roles.
<b>Data Patterns</b>	<ol style="list-style-type: none"> <li>1) Emotional consciousness to understand &amp; manage student frustration</li> <li>2) Affirms student self-identity while engaging mathematics</li> <li>3) Partners w/ student struggles in mathematics and life</li> </ol>	<ol style="list-style-type: none"> <li>4) Sees students primarily as mathematical beings</li> <li>5) Believes students must conquer math struggles and life challenges independently</li> <li>6) Contingency for caring</li> </ol>
<b>Distinctions</b>	<ul style="list-style-type: none"> <li>• Care that is <i>active</i></li> <li>• Students are cared-for</li> <li>• Sociopolitical awareness of care</li> </ul>	<ul style="list-style-type: none"> <li>• Care that is inert, philosophic</li> <li>• Students are cared-about</li> </ul>
<b>Behavioral Associates</b>	<ul style="list-style-type: none"> <li>○ Rigorous mathematical press</li> <li>○ Celebrates mathematical strengths while scaffolding weaknesses</li> <li>○ Sees complexity within students</li> </ul>	<ul style="list-style-type: none"> <li>○ Generic encouragement “cheerleader”</li> <li>○ Waits for student initiative</li> <li>○ Sees students as either motivated or not</li> <li>○ Superficial &amp; deficit-based discussion of students</li> </ul>

Figure 1: Teacher Care Profiles

This group of teachers tuned into their students’ behaviors, emotions, and frustrations, and then separated negative emotions from their students’ mathematical thinking and identity (pattern one & two). Each of these teachers discussed their desire to identify and address students’ emotions and behaviors before addressing content knowledge and mathematical thinking. Ms. Evans stated, “Students in this particular environment come with a lot of baggage and a lot of emotions that they might not tell you about... It’s not just teaching. Teaching probably is number three or number four. Emotional behavior is...one or two.” Ms. Evans prioritized understanding her students’ emotional behavior in her teaching and care practice. Although she does not mention race explicitly, her comment reflects a sociopolitical awareness that undergirds her empathetic care. Referencing “this particular environment” subtly suggests she is mindful of the ways social and economic oppression have affected the surrounding community and how those issues may have impacted her students’ sense of worthiness and belonging expressed through negative emotions when struggling with mathematical content.

Empathetic caring teachers also discussed their beliefs that students' frustration and unproductive behaviors did not necessarily reflect mathematical ability or identity. Ms. Ellena said, "I think the biggest thing for the content-struggling students is that it's not them that's wrong. It's...how we're talking about math that's wrong. Because I think sometimes it becomes like personal, and I don't want it to become personal. It's about the math that we need to fix, and not that we're trying to fix them as people." Mrs. Ellena and the other empathetic caring teachers relied on their emotional consciousness to realize their students' mathematical identity, paying particular attention to how students' negative internalization caused persistent mathematical struggles (pattern two). Empathetic caring teachers also tended to focus their correction on the mathematical thinking of students while protecting the students' sense of self and competency. Notice Ms. Ellena's use of 'we' throughout the previous text, which suggested collaboration in this process (pattern three), versus something the students needed to figure out and struggle with individually.

In another example, Ms. Emmett protected and affirmed the identity of one female student who showed improvement in her algebra class after initial underperformance:

I saw her mom at report card night, and her mom had the scent of marijuana all over her... And you could tell that [student name] was cringing to have to introduce her to me. But I pulled her to the side and I was like, "Don't be embarrassed. My brother was a pothead, I get it. It's not a reflection of who you are, this new grade that you have is showing me that you care enough, don't worry about it... So I told her mom, "I'm super proud, I have high expectations for her..."

Ms. Emmett revealed her own personal experiences with family drug use to connect and empathize with her student (patterns one & three), conveying that she not only identified with the student but was also willing to support her in sharing her burden. Ms. Emmett communicated her high expectations for her student and redirected her attention toward her renewed commitment in the classroom, reflected in her improved Algebra grade,

despite the clear challenges possibly happening outside of the classroom. Thus, she engaged and affirmed the student's identity by saying, "This new grade that you have is showing me that you care enough" (pattern two). Instead of taking a deficit view of this student's family circumstances, Ms. Emmett focused on school and – more specifically – mathematical progress as important for her student's actualization of her personal goals and enhancement of her sense of self.

There were also instances when the teachers' empathetic care revealed urgency in Black and Latinx students attaining mathematics knowledge to resist stigma and stereotypes of cultural and intellectual inferiority. Ms. Emmett recounted her own students' stereotypes about math: "Even just our African American culture in general, they don't equate mathematicians with being black." She combated this through a personal story of someone doubting her mathematical abilities when she decided to major in applied mathematics in college:

Even my advisor said, "That's a hard major. Are you sure you want to do that? It's mainly towards men..." That's what my advisor said in college and I tell my kids that...The best thing you can do is prove them wrong. So whoever said it in 8th grade, 7th grade, 6th grade, that you don't get math, you were never good at math, let's prove them wrong. Give me a try. You've never had me, give me a shot. And they're like, "alright, I'll give you a shot."

Ms. Emmett used this powerful story not only to challenge disparaging stereotypes about race and gender in mathematics, but also to communicate care and win the trust of her students through saying, "Let's prove them wrong. Give me a try" (patterns two & three). Ultimately, she said, "I like the fact that they get to see a young Black immigrant doing it [reference to herself], and I always share my story with every class... so when they tell me their stories of hardships, they know I have empathy cause I share mine too." Altogether, this underscores how possessing racialized and sociopolitical understandings

of care may provide unique entry into developing supportive relationships with historically disenfranchised youth.

All four teachers worked relentlessly to connect with their students, each adopting different strategies. They sought to understand their students' personal challenges inside and outside of the classroom, and then partnered with their students to work through those struggles, recognizing them to be a shared – not an individual – burden. Similar to Ms. Emmett, Mr. Espada discussed the similarities between his background and that of many of his students: "I've lived and I've learned a lot because growing up in an urban district is not great. Having a mother that had three jobs just in order to support me and my other three siblings was something that's challenging. I mean it's something my students are challenged with now." Mr. Espada saw himself in his students, and that connection informed how he encouraged student persistence:

My philosophy is honestly you gotta teach students with love, but you gotta be strict with them as well...you can't be like, "Oh, it's okay. I understand, you don't have your homework." No, you don't. You have to be strict like, "You know at the end of the day you need to bring it. I understand we all have our different crises or what not. Like you can talk to me about it, but I expect it from you." But it means getting to know the students, getting to know the family, doing whatever I can in order to support them. In any way possible.

Mr. Espada's experiences growing up in an urban environment established his acuity to simultaneously acknowledge his students' personal challenges (pattern three) while actively maintaining high expectations for them.

Mr. Espada, Ms. Evans, and Ms. Emmett all discussed building relationships with students and their families by drawing on shared lived experiences. For example, when discussing why he decided to teach math in an urban district, Mr. Espada said, "It's a struggle. That's how I was raised, you know? I see all my kids as roses coming up from a stone." Mr. Espada's personal experiences informed his belief in his students' abilities to succeed despite

their sometimes challenging circumstances. Ms. Evans reflected on how critical the support she received from her own 6<sup>th</sup> grade mathematics teacher was in inspiring her to encourage her own students to “break the cycle” and neutralize the effects of social inequity in their community: “And so I just try to focus on the issue that they can change the world by breaking the cycle... and so I want to be like what [former math teacher’s name] was to me, even though, at the time, I didn’t know I would love math.” And, as mentioned above, Ms. Emmett said, “let’s prove them wrong.” Beyond building relationships with their students, these teachers also possessed a collective struggle orientation (O’Connor, 1997), recognizing inequity in their students’ experienced social conditions and the critical nature of their care as an expression of solidarity (Freire, 2005) that empowered their students to resist this inequity through their own personal growth.

Not all empathetic teachers showed evidence of critical care, but all were at least emerging in this regard. Ms. Ellena, a White woman from a suburb outside the district where she was teaching, was in her second year of teaching during this study. She admitted that she was still developing sociopolitical awareness and that doing so was important to her: “Right now I’m actually doing a fellowship on culturally responsive pedagogy, which is actually helping me to be more conscious of what I’m saying to the students, what math problems that they’re being exposed to...” She also acknowledged that integrating that knowledge into her instruction was challenging: “I think something that I really look at is empowering students, like really thinking about race to empower Black and Latino students to become mathematicians. It’s something that I’m struggling with but working toward doing more often.” Overall, while the data suggests elements of critical care were most evident among empathetic caring teachers, those attributes were still limited and the teachers represented a range of critical care enactment.

The three patterns of empathetic caring were ultimately related to teachers' press for rigorous mathematical thinking and metacognition from their students. These teachers believed building strong relationships with students directly affected student learning. Mr. Espada explained, "It's when you build that trust and respect with the students that you are able to get everything out of them." Mr. Espada found that students who trusted him were more willing to take risks in the classroom. As he consistently affirmed his students' identities (pattern two), he could better press students' mathematical thinking. He started his class by informally assessing his students and identifying those already frustrated by learning mathematics; he then set goals for their learning:

In September I try to identify them as much as possible and try to work with them throughout the year doing interventions...to ensure I'm challenging them to their ability... My goal is that they are able to persevere through their work at a rate of 80% or higher by themselves. By March or April that is usually the case that I want to see.

Mr. Espada utilized a gradual release process that began with highly structured support and then reduced the amount of support over time until students were more self-reliant.

Pressing students for rigorous mathematical thinking required the empathetic caring teachers to focus on what students knew while scaffolding what they still needed to know. These teachers encouraged mistakes and framed them as opportunities to learn by valuing the process toward conceptual mathematical understanding. When students struggled, the teachers offered encouragement targeted at the students' specific challenges and then praised the subsequent growth. The teachers described motivational speeches they would give in whole-class settings, one on one, and even as quick notes on exams. Ms. Emmett described her feedback to one student: "Remember you told me you didn't know how to do this? You did! It's your arithmetic you messed up! Two times six isn't fourteen, but you knew how to do the property which is what I was teaching, so you do get it!" Ms. Emmett praised the student's

growth by valuing what the student knew about the mathematical concept and devaluing the student's error in arithmetic (pattern one & two).

As they scaffold their students' mathematics learning, these teachers also maintained high expectations for precision and understanding. Ms. Emmett explained:

I want to see them be able to justify an answer by explaining it to me, and convincing me and each other at the end of what they've done... that's one of our math practices that we're focusing on this year, is being able to critique the reasoning of others and attending to precision. So if they say the answer was the ordered pair,...  $(-3,4)$  and they have  $(3,4)$  and they're like "Same thing, you know what I meant!" Nope. And then they have to...prove to me why  $(3,4)$  and  $(-3,4)$  are two completely different things. If they can't prove to me why it's different, we're not moving on...I let nothing slip.

Although Ms. Emmett facilitated the discussion, pointing students to how she wished them to proceed, she required students to validate their reasoning both to her and their peers. By encouraging peer-to-peer support, she empowered students by encouraging mathematics discourse with limited supervision. Ms. Emmett pushed her students' ability to attend to precision in their answers, and she "let nothing slip." This and previous examples demonstrate how each of the three empathetic care patterns work collectively to cultivate classroom contexts in which teachers can consistently press for rigorous mathematical thinking and deep learning.

### **Transactional Care**

As a noteworthy reminder, both empathetic and transactional caring teachers showed evidence of wanting students to be successful and maintaining high expectations and caring concerns for students. However, transactional care manifested as perfunctory expressions of concern, affection, or expectations, enacted as part of informal negotiations between teachers and students. Thus, transactional care was often superficial, inactive, narrowly focused, or conditional. Transactional caring teachers discussed their care as inert and infrequently leading



to action on behalf of their students. Transactional care seemed to be linked to how teachers saw their students, understood teacher and student roles, and perceived how mathematics learning happens. The teachers in this study exemplifying transactional care 4) saw students as primarily mathematical beings; 5) saw students' math and life struggles as intrinsic challenges that they must learn to conquer independently; and 6) consistently expressed a contingency to their caring [patterns #1-3 are empathetic caring patterns]. Transactional caring teachers rarely saw or understood the multiple facets of complex individuals. Instead, their care primarily related to students becoming better math people and often depended upon student effort or performance. While Noddings (2013) would describe empathetic care as "caring-for" students, she might describe transactional care as "caring-about" students. "Caring-for" implies action by the caregiver, while "caring-about" implies hope or concern for students characterized by detachment and inactivity. Four teachers exemplified transactional care (Mr. Talleda, Mr. Tobe, Ms. Talbot, & Mr. Todd).

Regarding pattern four, transactional caring teachers often focused more on students' math learning and less on students as people with meaningful lives outside the classroom that could inform in-class math learning. In fact, outside life, values, and beliefs were sometimes seen as limitations if they interfered with activities in the math classroom. Mr. Tobe said,

A lot of the students are coming in with really high standards themselves. I think a lot of them are just lazy or, again, that's not their priority, or that's not in their value system. They don't hold education as the highest thing, which is a shame, you know? And I guess it's also reflected in occupations. Why do basketball players get paid more than doctors?

Mr. Tobe believed what the students bring to the classroom, in this case value systems or priorities, complicated gaining an education. Little evidence existed to suggest Mr. Tobe investigated students' values to understand them beyond superficial stereotypes. Mr. Tobe's narrow vision led him to over-simplified, one-dimensional diagnoses of students' problems. All

four teachers often made similarly broad, superficial, and sometimes deficit-based statements about students, or they disclosed they knew very little about the students' community beyond common stereotypes. The intimate knowledge these teachers actually gathered about students was usually unsolicited and through interactions initiated by parents, colleagues, or students.

Transactional caring teachers instead focused on students as mathematical learners (pattern four) while engaging little with the experiences students might have had beyond the classroom.

Teachers who showed transactional care for students often acted as cheerleaders, versus partners, by offering general statements of praise and admonishing students to overcome the intrinsic challenges preventing them from being good at math or good students (pattern five). This often led to generic motivational messages and encouragement, but not necessarily action by the teacher to truly support students through their challenges. For example, Mr. Talleda discussed one student:

She's a smart girl, but there's something in her motivation that she gets the right answer of the problem, and she is, "Oh, I have the wrong answer. I don't know how to do this. I don't know how to do this," you know? So even though she got the right answer, but there's something going on that her motivation, she doesn't seem to have self-confidence, you know?...I told her, "Listen, you're a smart girl, you know, but there's just something going on, that I don't know what is it, but uh you just need self-esteem, you know? Like you need to be confident in yourself, you know? But you got it. You got the stuff. You got it."

This quote is exceptional for underscoring the nature of transactional care. While it illustrates that this teacher authentically cared about the student, his superficial understanding of her "confidence problem" and his subsequent generic motivational message were perfunctory (e.g., "You got the stuff") and likely ineffective in bonding with the student or motivating new behavior. He admitted unfamiliarity with the student's challenges but offered advice anyway by suggesting she "just need[s] self-esteem."

Mr. Talleda did not focus on the student's mathematical knowledge, nor did he investigate or probe for the source of the "confidence problem." He later explained how he offered another student similar praise: "I will push him. I'll be like, 'You got this,' you know? 'You, you need to do this. It's, it's hard, but you can do it,' you know? 'This is for you,' you know? 'You can do it. Just the fact that you need to pay attention, you know? Write down the steps that I do.'" Mr. Talleda again offered students general statements of encouragement or correction. Students' confusion, frustration, or misunderstanding were all located in their inability to "pay attention," and math learning required mimicking the teacher's steps to find the answer. The transactional caring teacher concentrates on the content being taught and not the learner trying to understand complex concepts (pattern four). In response, they often promote more rote and less rigorous learning to increase students' confidence in the classroom. Transactional teachers also may not acknowledge that frustration is often a natural consequence of a learner entering their zone of potential construction, and thus more teacher support is needed (Hackenberg, 2010).

A sixth pattern of 'care as conditional' also emerged amongst the transactional caring teachers. This pattern incorporated contingencies for expressions of care, where a teacher's caring response was offered only when students fulfilled the teacher's expectations. Within the interview text, this was often identifiable by some sort of "if-then" contingency (e.g., "If the student would just..., then I could..."). Mr. Todd clearly illustrated this contingency:

I think there's two types of students. There's the students who truly want to learn, and then there's the students who are just here for other reasons... For the students who are here to learn, I'll try to do everything possible to make sure they're learning, to give them what they need, and to give them more than what they need.

This notion fundamentally implies that not all students are deserving of care and that students' complexity (i.e., both their weaknesses and strengths) is not acknowledged. Instead,

students are seen only through the lens of the teacher's expectations and measured by the degree to which they meet these expectations. If students can self-regulate and perform up to the teacher's expectations, then they become deserving of teacher care and support. Later in the interview, Mr. Todd reinforced this perspective when responding to a question about how he understands critical thinking in the classroom.

For me, I think it [critical thinking] is something that comes from the students. When the students are- so for example, my last year at [school name], I had a troubled 12th grader for whatever reason enjoyed math. His other classes he was fighting all the time. But every time I taught him a new concept, he would stop, look at it, and then he would say "Well Mr. Todd, can't we do this with the problem" or "doesn't this apply to something else?" So the student was engaging me in such a way where I actually had to think about what he was saying.

In this quote, Mr. Todd almost dives into his contingency statement ("When students are-...") before he cuts himself off to give an example. Here, Mr. Todd expects students to initiate the critical thinking; the student has to make the first move to show that they care. He underscores how the student engaged him when the inverse should probably be true, at least initially.

Teachers who demonstrated transactional care often dissected problems in the classroom as either the teacher's or the students' responsibility and rarely acknowledged partnering to share the burden of the classroom, to learn, or to address teaching difficulties. At minimum, teachers are responsible for disseminating content; in ideal cases, teachers enact the best version of their caring selves, but only if the student shows the requisite motivation.

Underlying many of these cases were the challenges the teachers had with balancing content coverage, pacing, and promoting students' rigorous mathematical thinking. Ms. Talbot shared, "I still prefer to teach everybody at the same time..., cover more ground." She saw whole-class instruction as efficient and valuable for avoiding issues with student behavior. This was particularly evident in her description of her most memorable lesson: "Just the fact that it

was like everyone sitting doing what I was asking and like you know what I mean, I was able to teach. I was able to teach and not be like correcting behaviors so yeah...I don't know how to put it but like it's yeah like I can teach. I don't want to doubt my ability to teach you know what I mean?" Her "ability to teach" was measured by her ability to keep students seated and attentive. Once at the board, she expected students to watch her perform a single problem-solving method and then practice that one method: "I kind of just want to be told like, 'Do it this way only and just do it.' You know what I mean? I just want to be consistent, and I don't want to have all of these other options and then do this and oh never do that and you hear just more versions." Her anxiety about delivering math content made her acutely concerned about her students' behavior, limiting the flexibility in her instruction and thus her ability to push students' critical thinking. Ms. Talbot was a third-year teacher who still struggled to develop a strong classroom culture and implement effective instructional strategies – two issues that likely constricted her ability to see students deeply and care for them empathetically.

### **Blended Care**

As mentioned earlier, empathetic and transactional care may appear dichotomous; however, they are two types of care with their own important nuances. While these two profiles were most robust within the data, there were four teachers (Ms. Bairos, Mr. Bell, Ms. Brenda, & Ms. Badowski) who did not easily fit into either of these care typologies. Each teacher in this category demonstrated varied combinations of characteristics from the two typologies (i.e., some patterns from empathetic care and some patterns from transactional care). These teachers sometimes showed patterns of caring-for students, but at times talked of caring-about students (Noddings, 2013).

Ms. Bairos is one example case that possessed certain patterns grounded in empathetic care (i.e., patterns one & two) and other patterns of transactional care (patterns five & six; other teachers showed different intersections of empathetic and transactional patterns). Regarding empathetic care, her strongest pattern was her 1) emotional consciousness in seeing and managing student frustrations. She also occasionally showed evidence of 2) addressing issues of self and identity while engaging mathematics (descriptions of these empathetic patterns are discussed above). She shared, “I think I’m pretty nonjudgmental of what the students bring in that day, and I think I’m really good at gauging them as people. Like I don’t just see them as math students. It’s easy to do that, I think.” She also mentioned multiple examples of deep and persistent conversations with students to mindfully address social, emotional, and mathematical needs. Interestingly, Ms. Bairos once underwent extensive meditation training in order to handle a past personal medical issue. She referenced this training as helpful in allowing her to see subtle emotional cues in her students. She even brought this emotional sensitivity into her algebra classroom. When she noticed students were stressed or unfocused, she briefly stopped math work and asked students to participate in mindfulness activities (e.g. stretching and breathing exercises) to help center their concentration.

Conversely, Ms. Bairos also enacted some patterns of transactional care, specifically contingency of care (i.e., patterns five & six under transactional care). For students she identified as “low-level,” Ms. Bairos was superficial in her support. She sometimes distinguished between “smart” versus “regular” students without referencing her students’ individual complexities. This might have been reinforced by the magnet school where she was teaching, which had a palpable culture of talent-sorting students. She also occasionally employed rhetoric distinguishing between student versus teacher responsibilities, as opposed to talking about partnering with

students (pattern five). She recounted a confrontation in the hallway with one female student she identified as having motivational issues.

And she'll often say things to me like, 'Well, I'll come see you after school with this,' kind of thing. And I don't have after-school hours. "[student name]! I'm not here for you after school! I'm sorry!" Like I think she needed to realize that um... I don't know. She needs to grow up a little bit. Like she expected me to just be here for her all the time, regardless of what the situation might be.

In another example of contingency care (pattern six), Ms. Bairos only facilitated the aforementioned meditation activities with her honors algebra class and not with her non-honors class, despite admitting some students in the non-honors class needed it more. She reasoned that only her honors students were mature enough to engage in stretching and breathing exercises during class. Below, she reflected on her concerns with implementing these exercises with her non-honors class.

We stand in a circle sometimes, and we're moving, and we're stretching. And I think literally just seeing your classmate across from you moving is going to cause, it's going to trigger somebody who has less of impulse control to say something about the person doing that. Either they're going to make fun of them, or they're going to just notice, "Oh, look, her shirt is stretched, and she looks funny," or whatever. Like they don't... a lot of the students there, and I (sigh), I try to get them to stop, but they just can't...

Thus, Ms. Bairos only offered empathetic care to her "high-level" students.

Ms. Bairos provided additional examples of transactional care with her non-honors class. While explaining pacing and content-coverage demands, Ms. Bairos said this of her non-honors class: "I'm kind of saying, 'Thumbs up? Does everybody understand? Can I move on?' Or I'm saying, 'Any questions? Any questions?' And nobody's responding. And even though [I know] there might be questions, and I suspect some people might be struggling, I move on." Ms. Bairos' decision to "move on" with her lesson while students still struggled exemplifies pattern five of transactional care in that she expected students to work independently to conquer challenges they may have with the material. Similar to other transactional care teachers, Ms.

Bairos' concerns regarding pacing suggested school politics and administrative stressors might also place additional pressure on teachers that can inhibit opportunities for enacting empathetic care. In fact, the teachers enacting transactional or blended care also more frequently discussed school administrative stressors in their interviews and did so in greater detail, especially compared to teachers that demonstrated empathetic caring.

### **Students' Sense of Connectedness in their Mathematics Classrooms.**

We hoped to learn more about how the typologies of teacher care related to students' feelings of connectedness in their mathematics classrooms. A quantitative analysis using the MCCS questionnaire revealed that students feeling most connected to their math classroom were often in classrooms taught by one of the four mathematics teachers consistently demonstrating empathetic care, compared to classrooms of teachers consistently demonstrating transactional or blended care.

Correlations (Table 2) revealed that the three subscales of the MCCS (i.e., emotional support from teacher, my math class is like a family, my contributions are valued) were moderately-to-highly correlated amongst each other at both time points, and correlations of these subscales between the two time points (i.e., fall to spring) showed small-to-moderate associations. There was 7.9% attrition (26 cases) by the springtime assessment. An analysis of the missing data revealed that the 'missing completely at random' assumption (MCAR) was retained ( $\chi^2 = 20.87$ ,  $df = 18$ ,  $p = .286$ ) and reflected a lack of consistent patterns in how data was missing. Given the MCAR assumption was not violated and the relatively small amount of missing data across few variables, all subsequent analyses used the complete case dataset (Nakai & Ke, 2011).



Table 2.

*Bivariate Correlations and Descriptive Statistic.*

	1	2	3	4	5	6	7	8	9	10	M	SD	<i>n</i>
1. Care Type	-	.02	.14*	-.22**	.16**	-.05	.10	-.09	-.03	-.13*	-	-	-
2. Age in Months		-	-.16**	.03	-.09	.04	-.17**	.10	-.10	-.08**	159.90	19.03	319
3. Emotional Support from Tchr (fall)			-	.35**	.50**	.27**	.55**	.35**	.26**	.21**	4.28	1.38	314
4. Emotional Support from Tchr (spr.)				-	.14*	.49**	.16**	.65**	.29**	.39**	3.88	1.59	295
5. My Math Class is Family (fall)					-	.44**	.42**	.22**	.20**	.18**	3.53	1.31	314
6. My Math Class is Family (spr.)						-	.16**	.43**	.18**	.27**	3.48	1.48	295
7. My Contributions are Valued (fall)							-	.29**	.27**	.09	5.04	1.01	314
8. My Contributions are Valued (spr.)								-	.36**	.36**	4.78	1.25	295
9. Attainment Value of Math (spr.)									-	.31**	4.15	1.30	294
10. Instructional Relevance (spr.)										-	2.84	.87	263

\*  $p < .05$ . \*\*  $p < .01$ .

A multivariate analysis of variance (MANOVA) was used to observe differences between empathetic caring versus transactional caring teachers regarding students' perceptions of connectedness to their mathematics classroom. Therefore, teacher caring type was modeled as the independent variable and the three subscales of the MCCS (i.e., emotional support from teacher, my math class is like a family, and my contributions are valued), measured in the spring, were modeled as the dependent variables. The fall measurements of the three MCCS subscales were used as covariates in the model, along with student age as an additional covariate. Levene's test of homogeneity of variance was violated for the subscale "emotional support from teacher" ( $F(2, 297) = 5.07, p = .007$ ), but not for the other two subscales, "my math class is like a family" ( $F(2, 297) = 0.52, p = .59$ ) and "my contributions are valued" ( $F(2, 297) = 0.73, p = .48$ ). Given the violation for the first subscale ("emotional support from teacher"), univariate analyses involving this variable as an outcome were assessed at a more stringent level for significance ( $p < .01$ ).

The multivariate result was significant for teacher care type ( $F(6, 582) = 5.98, p < .001$ ; Wilk's  $\Lambda = 0.89$ , partial  $\eta^2 = .06$ ), indicating overall differences in students' sense of connectedness to their mathematics classrooms (see Table 3). Pillai's Trace, Hotelling's Trace, and Roy's Largest Root all showed identical  $F$ -values and statistical probabilities with Wilk's  $\Lambda$ . The univariate  $F$  tests showed significantly higher perceptions of emotional support from the teacher ( $F(2, 293) = 15.82; p < .001$ ; partial  $\eta^2 = .09$ ), of feeling their math class is like a family ( $F(2, 293) = 5.92; p < .01$ ; partial  $\eta^2 = .04$ ), and of their contributions being valued ( $F(2, 293) = 4.98; p < .01$ ; partial  $\eta^2 = .03$ ) for students under empathetic caring teachers compared to the other two typologies (Table 4). These findings all controlled for the same constructs measured in the fall as well as student age measured in months.

Table 3.

*Multivariate ANOVA of dimensions of Mathematics Classroom Connectedness by Care Type and Baseline Covariates.*

	Wilk's $\Lambda$	F	<i>df</i>	<i>p</i> -value	Partial Eta-Squared
Age in Months	.96	4.16	3	.007	.04
Emotional Support Teacher (fall)	.88	12.49	3	.000	.12
My Math Class is Family (fall)	.82	21.18	3	.000	.18
My Contributions are Valued (fall)	.97	3.44	3	.017	.04
Care Type	.89	5.87	6	.000	.06

Table 4.

*Univariate Effects on Student Spring Perceptions of Connectedness to their Math Classroom.*

Source	Dependent Variable	<i>df</i>	Mean Square	F	<i>p</i> -value	Partial Eta-Squared
Age in Months	Emotional	1	5.59	2.75	.099	.010
	Family	1	3.84	2.24	.135	.008
	Recognition	1	15.16	12.13	.001	.041
Emotional Support from Tchr (fall)	Emotional	1	71.37	35.08	.000	.110
	Family	1	4.63	2.70	.102	.009
	Recognition	1	22.71	18.17	.000	.060
My Math Class is Family (fall)	Emotional	1	.03	.01	.905	.000
	Family	1	88.37	51.51	.000	.153
	Recognition	1	1.69	1.36	.245	.005
My Contributions are Valued (fall)	Emotional	1	.08	.04	.847	.000
	Family	1	.94	.55	.460	.002
	Recognition	1	6.74	5.40	.021	.019
Care Type	Emotional	2	31.54	15.46	.000	.098
	Family	2	10.06	5.89	.003	.040
	Recognition	2	6.16	4.93	.008	.033

Pairwise comparisons (see Figure 2 with 95% confidence intervals) showed specific differences across student connectedness (i.e., MCCS subscales) between the teacher care profiles (empathetic, transactional, and blended). Students in mathematics classrooms led by empathetic caring teachers reported significantly higher perceptions of emotional support from the teacher compared to students in classrooms led by either transactional ( $p < .001$ ) or blended caring teachers ( $p < .001$ ). However, there were no differences on student perceptions of emotional support from the teacher between students in classrooms led by transactional versus blended teachers ( $p = .798$ ). Students in mathematics classrooms led by empathetic caring teachers were also more likely to report their mathematics classroom felt like a family compared to students led by either transactional ( $p < .004$ ) or blended caring teachers ( $p < .017$ ).

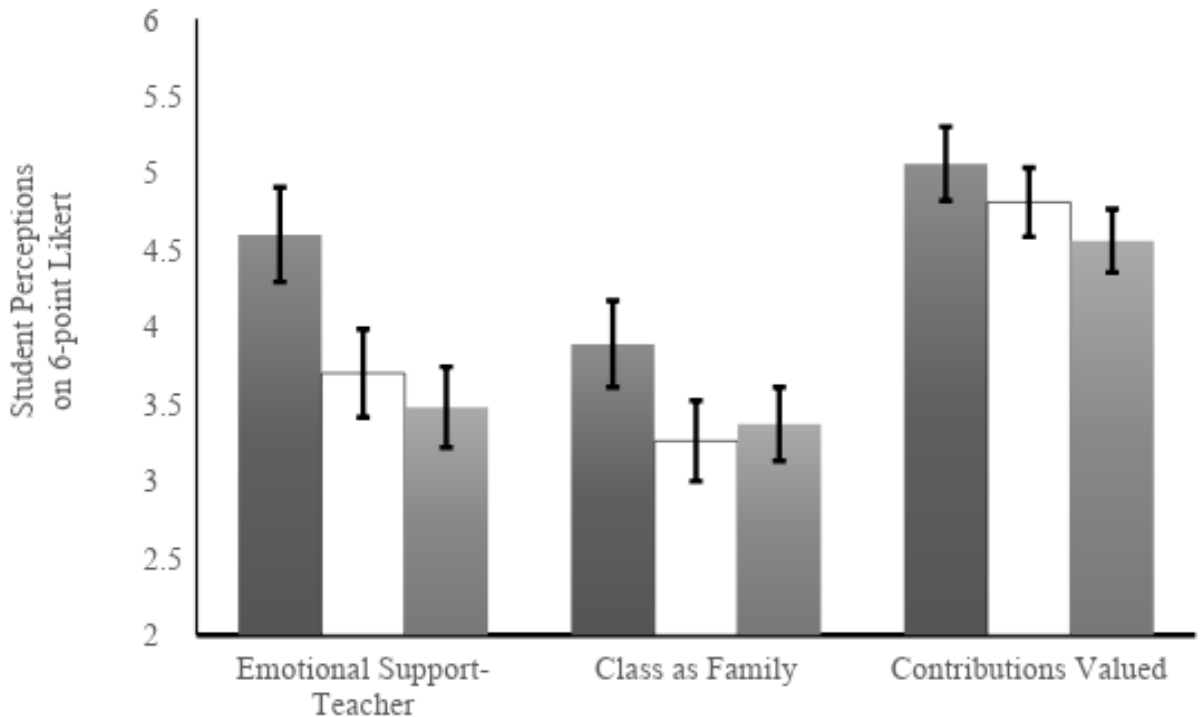


Figure 2: Pairwise Comparisons of Students’ Perceptions of Mathematics Classroom Connectedness by Teacher Type

Note: Error bars represent 95% Confidence Intervals

Again, however, there were no differences between transactional and blended teachers ( $p = .999$ ). Finally, students led by empathetic caring teachers were more likely to feel that their contributions in the classroom were recognized compared to students led by blended caring teachers ( $p < .006$ ), but no differences compared to students led by transactional caring teachers.

### **Sense of Connectedness as a Mediator**

The final set of analyses consisted of a mediation model using Mplus 7.1 software (Muthén & Muthén, 1998-2012) for structural equation modeling. Teacher care profiles were modeled as the independent variable, while attainment value of mathematics and perceptions of instructional relevance, both measured in the spring, were modeled as the two dependent outcomes. Student sense of connectedness, measured by the MCCS, was modeled as the mediator between the independent and dependent variables. The final model controlled for baseline attainment value of mathematics, perceptions of instructional relevance, and MCCS, all measured in the fall (i.e., baseline). To address our third research question, we hoped to find that the direct pathways between the independent and dependent variables would be non-significant, as this would indicate full mediation through the proposed mediator (i.e., sense of connectedness) assuming the indirect effects were statistically significant. Ninety percent confidence intervals were reported to determine the significance of the indirect effects.

In the final structural equation model, teacher care did not predict attainment value of mathematics nor perceptions of instructional relevance; however, teacher care was a significant predictor of students' sense of connectedness in their mathematics classrooms ( $\beta = -.27$ ). Empathetic caring teachers was set as the reference group for this analysis; thus, the negative coefficient illustrates a weaker association between teacher care and students' sense of connectedness for transactional and blended caring teachers compared to empathetic caring

teachers. This result is consistent with the MANOVA results described above. Further, students' sense of connectedness was a moderately strong predictor of both attainment value of mathematics ( $\beta = .34$ ) and perceptions of instructional relevance ( $\beta = .43$ ), indicating that as students' sense of connectedness in the mathematics classroom increases, so does their value of mathematics (i.e., math identity) and their reporting of the teacher's effort to make instruction personally relevant. The non-significant direct effects together with significant indirect effects for sense of connectedness on attainment value of mathematics ( $\beta = -.09, p = .001$  [90% CI  $-.13, -.05$ ]) and perceptions of instructional relevance ( $\beta = -.12, p = .001$  [90% CI  $-.17, -.07$ ]) suggests full mediation (see Figure 3). The model fit the data well:  $\chi^2 = 41.70$   $df = 18, p = .001$ ; CFI = .96, RMSEA = .06 [90% CI: .04, .09], SRMR = .04 (Hooper et al., 2008; Hu & Bentler, 1999). Ultimately, through this model we find teacher care does predict students' value of mathematics and their perception of the instructional climate, mediated through their sense of connection to the mathematics classroom.

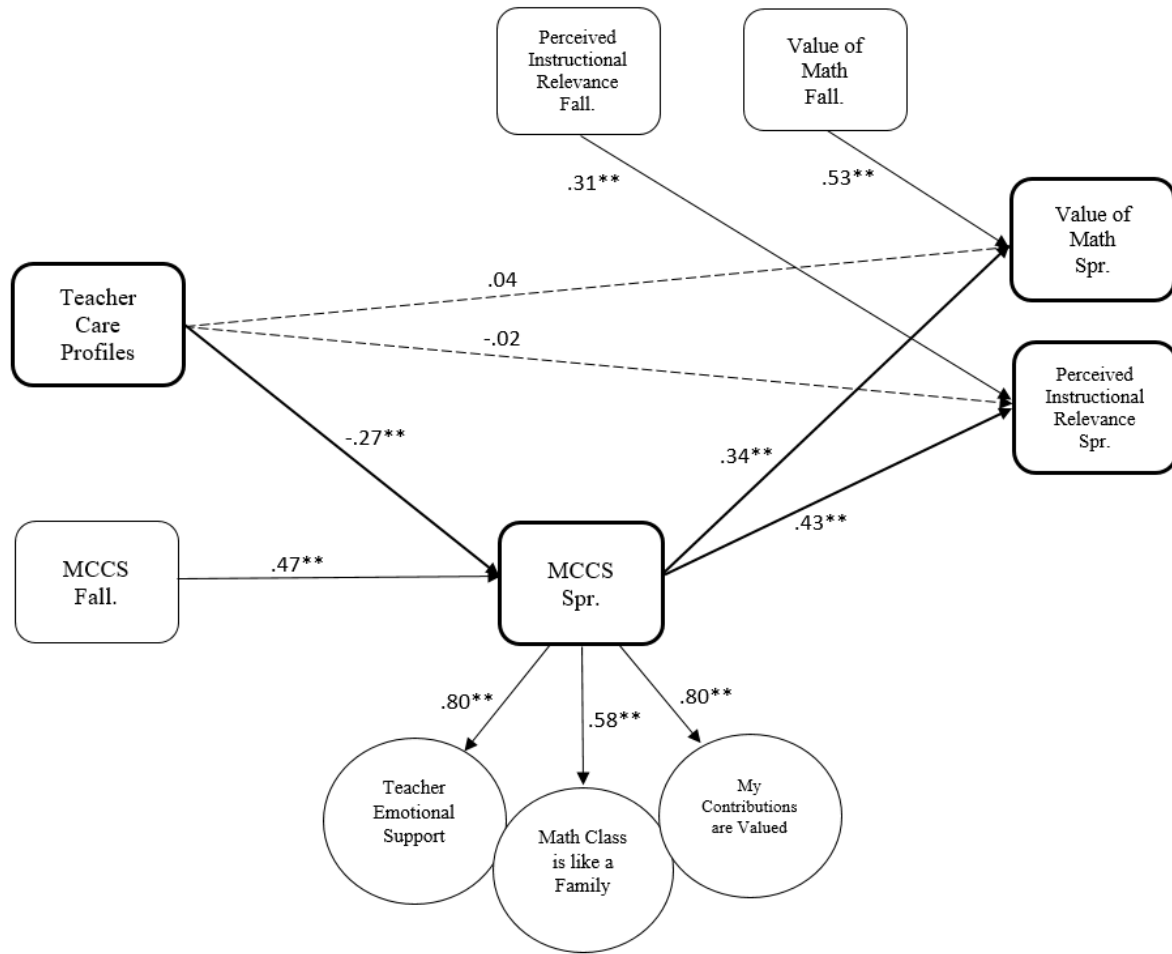


Figure 3:

Mediation Model. \*  $p < .05$ . \*\*  $p < .01$ . Standardized coefficients

( $\chi^2 = 41.70$   $df = 18$ ,  $p = .001$ ; CFI = .96, RMSEA = .06 [90% CI: .04, .09], SRMR = .04).

Indirect Effect: Teacher Care → MCCS → Value of Math  $\beta = -.09$ ,  $p = .001$  [90% CI -.13, -.05]

Indirect Effect: Teacher Care → MCCS → Perceived Instructional Relevance  $\beta = -.12$ ,  $p = .001$  [90% CI -.17, -.07]

Note: MCCS = Mathematics Classroom Connectedness Scale; “Empathetic Caring Teachers” was set as the reference group for the teacher care profiles.



## **Discussion**

Using both qualitative data from teachers and quantitative data from students, this study examined how urban mathematics teachers discussed their care practices and their students' feelings of connectedness in response. The qualitative analysis established three care profiles: empathetic, transactional, and blended. Quantitative analysis of questionnaire measures revealed relationships between teacher care practices and students' sense of connectedness as it related to students' value of mathematics and perceptions of instructional relevance. Our discussion will interpret the findings regarding the three care profiles and the identified relationships between teacher characteristics and students' experiences in mathematics classrooms.

### **Interpretations of Relationships between Teacher Care and Student Connectedness**

While teacher care and culturally relevant mathematics pedagogy have been well-studied and theorized in previous research, the quantitative portion of this study extends this literature by underscoring how these teacher qualities related to student outcomes. We found that students were more likely to perceive teacher emotional support, a familial rapport with classroom peers, and recognition for their work when empathetic caring teachers – compared to teachers of other profiles – led their mathematics classes. Further, this sense of connectedness mediated students' value of mathematics for their own identity as well as their perceptions of the mathematics instruction's relevance, which illustrates the process through which teacher care becomes meaningful for students' perceptions about mathematics. We found that teacher care did not predict students' mathematics perceptions directly; rather, sense of connectedness was the key lever through which teacher care patterns played a role on students' growth in mathematical identity and their perceived relevance of mathematics. Altogether, the mediation results suggest that feeling supported, connected, and recognized is key for historically disenfranchised

students' mathematical identity development, which challenges the belief that mathematics identity is purely intrinsically negotiated— popular among transactional teachers in this study— suggesting it also requires teacher support.

### **Empathetic Teachers and Critical Care**

Empathetic caring teachers in this study were more likely to demonstrate elements of critical care through their stated sociopolitical awareness, high expectations, and perceived moral obligations as teachers of Black and Latinx students. These teachers expressed awareness of how systemic inequity impacts the communities within which they teach as well as their students' personal and academic experiences. Empathetic caring teachers revealed a strong fictive kinship with their students and operated from a collective struggle orientation (O'Connor, 1997), attempting to fortify their students' resistance motivation to prove wrong a world that has negatively stereotyped them (Carter, 2008; Matthews, 2018).

While some empathetic teachers mentioned racial stereotypes, they did not actively center race or racism in their mathematics instruction nor did they feel compelled to address policies or practices impacting the learning experiences of their Black and Latinx students, such as challenging standardized testing or implementing a more race-conscious mathematics curriculum (Battey, 2013; Gutstein, 2006). This suggests all of the sampled teachers – even the empathetic teachers – focused on the immediate consequences of their care practices and may not have focused on addressing the broader, long-term changes for equity in mathematics instruction. While many were knowledgeable about hegemonic forces impacting various systems and structures, they rarely reflected on how hegemony may materialize through their own instructional choices. These findings are consistent with Averill's (2012) study in which culturally relevant teachers developed a sense of community with their students, but there were

very few examples of “culturally linked mathematics learning experiences” in the 100 lesson observations of 10 different multiethnic classrooms (p. 121). Further investigation may elucidate why some teachers who discuss race, racism, and culture informally may not attempt to disrupt racism through their instruction or agency.

### **Relationships between Care Profile and Teacher Racial/Ethnic Background**

The findings in this study revealed some connections between a teacher’s race or gender and their care profile. Three of the four empathetic caring teachers were Black or Latinx and attended K-12 schools in the same community they now teach or similar urban communities. Thus, race and sociocultural background were likely meaningful for building kinship and a collective struggle orientation with students. These findings reinforce research that suggests teachers of color often improve the academic outcomes and school experiences of students of color in part by maintaining high expectations and favorable views of them (Hanushek, Kain, & Rivkin, 2004; Ingersoll & May, 2011; Ingersoll et al., 2014; Villegas & Irvine, 2010).

However, racial and cultural match did not fully determine teacher care practices. Several other transactional and blended caring teachers shared similar background characteristics with their students which substantiates research that highlights important limitations of cultural match (Clark & Flores, 2001; Kohli, 2014; Philip, Rocha, & Olivares-Pasillas, 2017). Also, Ms. Ellena, a White teacher who attended a nearby suburban school, consistently showed patterns of empathetic care. Though her critical care was notably underdeveloped compared to the other empathetic teachers -- creating a source of tension in our analyses and interpretation of the findings -- Ms. Ellena developed connections with her students through strategic and deliberate efforts that may not have been as culturally savvy as those of other empathetic teachers, but were still meaningful to her students nonetheless. Building on the work of Ware (2006) and Irvine

(2003), Ford and Sassi (2014) suggest effective White teachers of Black children cultivate alliances with their students and learn to balance authority and care. Ford and Sassi (2014) also suggest teachers might share authority with their students by discussing race and positioning students as co-producers of knowledge. In our analyses, Ms. Ellena did position her students as co-producers of both mathematical knowledge and classroom culture; however, she continues to consider how to discuss race and racism in her classroom.

### **Implications for Teachers, Teacher Educators, and Future Research**

The care profiles, and nuanced patterns within, can help teacher educators identify areas of strength and weakness for targeted support and development. It would be ineffective and narrow-sighted to propose that teachers need to simply care *more* for students. Care patterns and interpersonal interactions, particularly with students from historically stigmatized groups, are deeply ensconced in personal schemas and dispositions often resistant to change. Therefore, we propose leveraging teacher strengths within each of the profiles to aid self-awareness and self-reflection, which can lead to authentic upgrades in personal care pedagogies. Further, we believe all teachers, including empathetic teachers, can engage in self-reflection and improve.

For example, given their sociopolitical awareness, empathetic caring teachers are primed for learning to teach mathematics for social justice. To inform their curriculum and lesson planning, Bartell (2013) suggests learning from community members and parents about social ills within the community and using mathematical modeling to examine those issues from a social justice perspective. Some empathetic teachers in this sample have already demonstrated their acuity to connect with their students' families. Transitioning to discussing salient issues with community members may be an incremental but powerful next step in partnering with students and their families, but also using mathematics to learn about and resist oppression.

Throughout this paper, we sought to convey transactional caring teachers authentically care about their students, which is certainly a strength. They show concern, expect their students to do well, and offer general encouragement to motivate students. However, the perfunctory ways in which these teachers enact care may impede students from feeling the sense of connectedness that mediates their mathematical identity development. How these teachers see students (i.e., primarily as mathematical beings) and understand student versus teacher responsibilities may shape how they perceive and manage (i.e., care-for) student frustration in mathematics. Hackenberg (2010) frames student frustration as the result of engaging in mathematical tasks situated outside the student's zone of potential construction (Steffe & D'Ambrosio, 1995), where support from more knowledgeable others is imperative. For Black and Latinx students, frustration may be exacerbated by experiences of institutional marginalization. However, our data has shown that transactional teachers often believe student frustration indicates low effort, grit, or self-confidence. These teachers generally provide less empathetic support during moments of frustration and instead offer generic encouragement or admonishment, which may complicate connecting with students. This may be an important point of self-reflection that supports transactional caring teachers in seeing their students and managing their emotions and struggles with mathematics.

Teachers demonstrating blended care bring different strengths to their practice given the various combinations of empathetic and transactional patterns possible. Ms. Bairos, for example, had high expectations for her students, which is an important tenet of culturally relevant pedagogy (Ladson-Billings, 1995) and generally endorsed for all students. However, she often weaponized her expectations through contingencies. If students did not meet her high expectations regarding appropriate motivation, behavior, or performance, then they did not

receive care and additional support. Teacher care should instead be used to support students in reaching the teacher's high expectations. While high expectations for students is generally a strength for teachers, they can be precarious when teachers do not clearly see their students beyond being mathematical beings or when teachers lack critical consciousness to understand how race, power, and privilege play out in the mathematics classroom (Matthews & Lopez, 2018). Reflecting on weaponizing high expectations and learning the unique contributions each child brings to the classroom may help teachers like Ms. Bairos.

Finally, preliminary evidence existed suggesting school-based stressors, norms, and culture may play a role in the types of care practices teachers enact. For example, Mr. Tobe, a teacher demonstrating transactional care, worked in a competitive, college preparatory magnet school. He described his students as either the characteristic, high-performing student the school attracts or the non-conforming, low-performing student that may not belong at the school. This type of school culture can absolve teachers of their responsibility to holistically educate students by expecting students to take ownership for their own learning. In the qualitative interviews, we also found an association between transactional care practices and school-based stressors such as demands from administration to *cover* curriculum in limited time periods or persistent challenges with classroom management. For teachers like Ms. Talbot or Ms. Bairos, classroom management and time pressure seemingly undermined attempts to build students' sociopolitical awareness or partnerships with students regarding emotional struggles. Thus, school-based stressors may complicate transactional and blended caring teachers' mathematics teacher identity development process. Perceptions of school-based stressors and school culture were not central to this study, and future research is needed to understand how they relate to teacher care, teacher mathematics identity development, and students' sense of connectedness in mathematics classrooms.

The methods and sample used in this study offered a unique approach to investigating care in the mathematics classroom. The few studies investigating similar questions often utilized purposive sampling—specifically nominations of exceptional teachers (i.e. Bonner & Adams, 2012; Chazan, Brantlinger, Clark, & Edwards, 2013) or self-study (i.e. Hackenberg, 2010). Using a convenience sample in this study allowed investigating perceptions of care among ordinary urban mathematics teachers, permitting us to detect nuances between different care practices that are not as evident when solely studying exemplary teachers. Though subtle, the present study reveals that these nuances are important for understanding how Black and Latinx students experience their mathematics classrooms.

Overall, analyzing teachers' reflections of their care practices in conjunction with their students' sense of connectedness to their mathematics classrooms is a unique approach that future research should consider further. By intersecting theories on teacher care and culturally relevant mathematics pedagogy, we meaningfully contribute to the larger body of literature attempting to deconstruct the work of teaching in the support of student connectedness in urban mathematics classrooms. Although investigating classroom-level questions regarding student-teacher interactions is valuable and instructive, it does not negate the great need to further examine, name, and resist institutionalized inequalities.

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## Appendix A

## MATHEMATICS CLASSROOM CONNECTEDNESS SCALE (MCCS)

*Emotional Support from Teacher*

- 1) I feel that I can talk to my math teacher(s) about things that are bothering me
- 2) My math teacher is someone I can count on to help me
- 3) I believe that my math teacher(s) are interested in the things that I have to say

*My Math Class is like a Family*

- 4) Students in math class help each other, even if they are not close friends
- 5) When I do well in math, the other students in class are usually happy for me
- 6) My math class is like a family.

*My Contributions are Valued*

- 7) My math teacher(s) know that I can do good work
- 8) I want my math teacher(s) to be proud of my work
- 9) I have a lot of opportunities to get involved in my math class