Constructing a Mathematical Identity as an Adolescent Black Girl

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Abstract: Recent literature within mathematics education has begun to focus on identity and its effect on students’ self-perception as mathematical learners and doers, as it shapes every part of a students’ life, including their relation to mathematics. This study investigates the construction of mathematical identity for a middle school Black female mathematics student, Crystal, over the course of her sixth grade year. The student was observed in her online and in-person classroom and interviewed after school to gain insight into her mathematical identity. Selected interview data centered on discussions of identity were analyzed to generate an understanding of how her mathematical identity was crafted, and how this influenced her as a mathematician. This study emphasizes the importance of voice scholarship (Ladson-Billings, 1995) in spotlighting an oft-forgotten group to broaden research about their mathematics education experiences.

This case study considers the following research question: What are the factors associated with Black girls’ mathematical experiences, and how do they inform the construction of their mathematical identities? I ground my research on McGee’s (2015) construct of fragile and robust identities, a framework the author used to survey the intersection of mathematical and racial identities relative to the mathematical experiences of Black undergraduates. Mathematical identity construction involves the intersection of a plethora of factors including students’ personal experiences, and McGee (2015) argued that for Black students in particular, mathematics education researchers should also consider race as a dominant factor. Black students arrive at school with their own knowledge (Freire, 1968), and for them, this includes knowledge of racialized experiences and events they encounter, all of which contribute to their mathematical identity.

For Black girls like Crystal, mathematical identity research is critical because their self-perceptions about their mathematical competence are highly related to their social identity as members of two minoritized identity groups. Evans et al. (2011) emphasized the importance of examining multiple identities jointly, as one’s identity is a conglomeration. They claimed that even if identities may be hierarchically ordered, intersectionality, rather than additivity, must be the focus. In comprehending how Black girls craft their mathematical identities, it is crucial to understand what it means to learn mathematics while being both Black (Martin 2012) and a girl (Kurtz et al., 2008).

Methods

I engaged in a year-long study of Crystal in her mathematics classroom at a public suburban middle school in the Northeastern United States. This school was composed of approximately 71% White, 13% Black, 6% Asian, 5% Hispanic, 4% multiracial and non-Hispanic, 0.2% Native American, and 0.1% Native Hawaiian and Pacific Islander students. Nearly 11% of students are economically disadvantaged. Potential participation was limited to all Black girls who volunteered and whose parents consented across three sixth grade mathematics classes. Due to difficulties in recruiting during the first full academic year during the COVID-19 pandemic, as well as having to withdraw a student for inconsistent participation, Crystal was the single study participant. She identified as a Black girl with parents who immigrated from Nigeria, and she attended sixth grade through the full remote model up until mid April 2021, when she switched to being fully in person, per State and District orders for all students to return to K-12 schools.

There were three rounds of observations and interviews from February to June 2021, and following each one of these rounds of observations were interviews after school that lasted up to 30 minutes. In total, there were 10 interviews conducted. In these interviews, Crystal was asked follow-up questions related to classroom lessons, as well as questions about her identity more broadly. Due to limitations of online class observations (e.g., Crystal's choice regarding camera and microphone usage) to examine Crystal’s interactions with her peers or teachers, there was nominal data relevant to her identity in the classroom data. Conversely, much of the interview data related specifically to identity, the focal point of this study. As a result, only the interview data were selected for analysis. For one of the 10 interviews, I used a guided protocol, the Multidimensional Model of Black Identity (MMBI; Sellers, 2013) which included statements related to identity. This interview was not selected for analysis as the questions’ central focus on identity influenced Crystal’s answers, providing less spontaneous responses on her part.
I then transcribed each of the nine remaining interviews. In order to further pare down my dataset, I used a grounded approach (Glaser & Strauss, 1967) using ideas in formation (Charmaz, 2006) to identify emerging themes in the transcripts, highlighting those themes which repeated throughout all transcripts (see Data Analysis section). Identity was an obvious theme, but others emerged throughout my analysis. Thus, I decided to select only the interviews in which Crystal conveyed or explicitly suggested identity in our conversations at least once. In total, there were nine interviews selected.

Along with two other coders, we developed a coding scheme through a line-by-line review of the interview transcripts. We noted themes that were referenced in the transcript lines, which were the following: (1) affect, (2) expectations, and (3) identity. Using Merriam-Webster Dictionary’s definitions, affect is defined as: “the conscious emotion that occurs in reaction to a thought or experience.” Expectations are social norms around what others consider “reasonable, due, necessary” or expected of someone. I define identity by extending McCartney and Moje’s (2002) definition: it is comprised of social and/or personal constructions about self that can vary over time and contexts that shape or are aspects of how humans understand the world around them and how they too are understood.

I coded every line of the transcripts to identify these themes, and used an utterance as my unit of analysis, focusing only on Crystal’s utterances. I define an utterance to be a single line of verbal discourse by a speaker, bound on each side (i.e., beginning and end of an utterance) by utterances from another speaker. Utterances could be coded for multiple themes and sub-themes (see below). To ensure the reliability of my coding, a second training coder with a PhD in mathematics education and I each independently coded 20% of the transcript data (i.e., two interview transcripts) for the three themes; this also accounted for 20% of the total interview time (1). The second coder and I had an 84.71% agreement.

I then returned to the nine interview transcripts to identify sub-themes (Saldaña, 2013) to gain a deeper understanding of how all of the themes materialized and shifted over time. The respective sub-themes, which all fall under the expectations theme, shown in Table 1, are: (a) personal expectations, (b) parental expectations, and (c) societal expectations.

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<tr>
<th>Sub-themes</th>
<th>Definition</th>
<th>Example</th>
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<tbody>
<tr>
<td>Personal expectations</td>
<td>Personal beliefs about what is considered “reasonable, due, necessary” or expected (using Merriam-Webster Dictionary definition of “expect”).</td>
<td>“Math is one of those things that you just have to do.” February 4, 2021, Line 71</td>
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<td>Parental expectations</td>
<td>Messages parents/guardians convey to children relative to their beliefs regarding what is considered proper and necessary (Parsons et al., 1982).</td>
<td>“And my parents kept-, kept on telling me, ‘make math your friend.’” April 30, 2021, line 179</td>
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<td>Societal expectations</td>
<td>Normative beliefs fostered by others in the social environment (Joseph et al., 2020).</td>
<td>“They just portray [school] as a horrible place that you should never wanna go to.” February 4, 2021, line 139</td>
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After refining the sub-themes, I shifted my attention towards identifying what may have prompted Crystal to answer my questions in particular ways, to learn more about Crystal’s relationship to mathematics. For example, were there types of questions associated with specific sub-themes, and could any shifts identified be explained? I considered each coded utterance in context to explore this, looking at how these themes shifted across the three rounds of data collection. I did this by first identifying the topics covered during our discussion, and calculating the percentages of each sub-theme in her discourse about the topics. These shifts were used to then construct my study’s claims.

**Findings**

Figure 1 displays a heat map of all nine interviews in which Crystal participated over the course of her 6th grade year that had utterances coded for expectations. On the top of the heat maps are the different topics discussed across all interviews, which were identified from examining the questions from the interview protocol. These
topics are alphabetically ordered. Gaps in the heat maps are a result of the lack of topic and sub-theme overlap. Cell shading corresponds to the intersection of sub-themes and topics. The lightest shade denotes lower percentages of these occurrences, while the darkest shade denotes higher percentages. For example, 62.5% in the personal expectations row means that 62.5% of the utterances across the nine interviews had an overlap between personal expectations mentioned by Crystal and a question from her about her beliefs about being a student. The column width of the topics do not denote the length of interview time spent on them.

Figure 1 Heat map comparing Crystal’s utterances coded for expectations for all the three rounds of data collection.

Of her utterances about beliefs about being a student, 62.5% of them were coded as her personal expectations. For instance, Crystal leans into perfectionism, believing that mistakes are a negative mark on one’s competence. She reflected on her negative 5th grade mathematical experience:

98 Crystal: All I know that, is that in 5th grade, I kinda varied. But most of the time, what I [inaudible]. I didn’t really like 5th grade [inaudible] is that oftentimes I would, I would get in this habit of pouting during math class.

101 Crystal: Uh, most of it because of a bad score, or I felt as though I was, you know, low self-esteem. I thought I was dumb, I was getting things wrong. I thought everyone knows this but I don’t. So, what’s wrong with me? (April 30, 2021 Interview)

She continues this thinking in sixth grade:

134 Crystal: Like, some people accept their mistakes, except I’m just one of those people that don’t like them.

135 Sophia: Mhm. What-, what do you think-, what don’t you like about your mistakes?

136 Crystal: Well, I don’t know. I just-, I just hate, uh. [inaudible]. OK, so bottom line, I’m the kind of person that likes to be right.

Though initially this understanding may seem to be isolated as her own expectation, it was in fact connected to her familiarity and interpretation of societal and parental expectations. Joseph et al. (2019) claimed this is true for all students, as their academic identities are a mix of how they, their families, and others see them. Crystal’s parents wield momentous power in her understanding of what it means to be Black and learning mathematics. She acknowledged that despite her parents informing her that “Black people are really, really smart” (February 23, 2021 interview, line 204), “[Black people] have to work twice as hard as a White person might work” (June 8, 2021 interview, line 49). Crystal had a keen awareness of societal expectations about mathematics which implies that mathematics learners are not typically perceived to be Black or female. In speaking about the lack of Black women in the mathematics field, Crystal said this:

237 Crystal: Maybe they-, maybe th-, they want to get into the math field, except-, e-, e-, except all the-, all these White people th-, th-, that-, all these White people th-, th-, that are part of the math field are like, “you can’t do this. You can’t be in the math field. Get out of here!” (February 23, 2021 Interview)

Crystal’s parents’ expectations themselves are rooted in societal expectations for Black students and subsequently, a desire for Crystal to achieve well. This undoubtedly affected her own personal expectations. As evidenced by the heat map above, in addition to her beliefs about being a student, Crystal’s utterances related to her personal expectations were centered on topics related to ideas she had conceived about school (30%), academic expectations (27.3%), and discussion about others’ perceptions of her identity in mathematics (27.1%). And yet, 100% of her utterances across the interviews about her parents’ beliefs about being a mathematics learner were coded as her parents’ expectations. Contrastingly, 0% of her utterances about the same were coded as her own personal expectations. I contend that this is because Crystal’s own expectations were actually rooted in her interpretation of her parents’ expectations for her.
Conclusion
In McGee’s (2015) three-component framework, a fragile mathematical identity is based on the “delicate” (McGee, 2015, p. 604) relationship between a Black student’s mathematical achievement and their constant racialization sustained in doing mathematics. Contrastingly, a robust identity centers on the resilience and fortitude these students develop and exhibit in spite of racialized mathematics experiences to maintain the necessary motivation for mathematical achievement. Crystal was extrinsically motivated to achieve highly in mathematics due to her parents’ expectations, which were based on societal expectations for Black students. According to McGee (2015), this means her mathematics identity is fragile.

There are several limitations to this study, one of which is the fact that this is a single case study, which is not generalizable. Nonetheless, for students like Crystal, their attitudes about mathematics cannot be examined as existing in a silo, but in combination with external factors, especially race, which is often a dominant factor for identity. Next, Crystal’s identity as a child of immigrants adds a different dimension to identity construction that my study does not address. This would certainly be a unique experience that cannot necessarily be extended to other Black girls.

Endnotes
(1) The total interview time was 3 hours, 53 minutes, and 20 seconds, and 20% of this time was 37 minutes and 47 seconds.

References