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# Not in their name: re-interpreting discourses of STEM learning through the subjective experiences of minoritized girls

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## ABSTRACT

This paper problematizes the enduring conscription of STEM learning in discourses of U.S. global ascendancy, neoliberalism and militarism. Drawing on ethnographic data, we explore how girls of color make meaning of their everyday experiences in two settings: a racially tracked mathematics class in a suburban high school and a STEAM based after-school program in a working class urban community. The stories of these girls – separated by time, place, age, and social histories but bound by sensibilities grown in their Immigrant families and learning contexts – contest U.S. hegemony as the primary rationale for STEM learning; challenge individual gain at the expense of another; problematize what counts as science while insisting on its creative convergence with joy; and honor their ingenuity and humanity. Challenging representational and respectability politics, we consider how *dignity* may better account for the complexity of their experiences and serve as a resource for research, pedagogy and design.

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## KEYWORDS

STEM; politics; immigrant; girls of color; dignity; learning

## Introduction

This paper explores how two girls of color – one Palestinian, one Mexican, both growing up in the U.S. – experience two STEM (science, technology, engineering and mathematics) learning environments: a low-track Algebra class and an afterschool STEAM program (an arts-based interdisciplinary approach to STEM learning). We offer micro-ethnographic analyses of their subjective experiences in relation to larger normative discourses of STEM learning that otherwise neglect the intellectual and social possibilities of becoming that these experiences name. Specifically, we identify the inadequacy of representational and respectability politics in ascribing meaning to their experiences of STEM. In contesting and widening these readily available discourses, we ask:

- (1) How are Amina<sup>1</sup> and Stefanie experiencing discourses of STEM learning and equity in their respective learning environments?

- (2) How might their experiences and perspectives reflect, refract, or rewrite such discourses?

Studying students' subjective experiences makes visible their sensemaking in context, who they are and how they develop, and how they are (or can be) actively involved in improving educational settings (Erickson et al. 2008, 2). Erickson and colleagues particularly highlight experiences that signal 'surveillance from beneath,' (22), moments when students demonstrate they are not fully deceived by practices designed to conceal from them their domination or false ascension. Theorizing from the experiences the girls narrate and embody, we consider how the concept of *dignity* may better account for the complexity of their experiences and serve as a resource for widening discourses of STEM learning and equity.

### Normative discourses of STEM learning and equity

Education policy in the U.S. reflects the inextricable link between STEM learning, national economic gain, and global ascendancy. (e.g. NRC 2001; PCAST 2010). This conscription of STEM learning in neoliberalism and militarism (Vossoughi and Vakil 2018) largely shapes the normative discourses of learning and equity, where U.S. hegemony – and by extension, individual gain over others – occludes understandings of who children are becoming and how their experiences could be instructive for imagining other purposes for STEM learning. As Melamed (2011) argues, neoliberal multiculturalism has, under the banner of 'official antiracisms,' disguised the reality that neoliberalism remains a form of racial capitalism. Further: 'the demand that racialized subjects and social phenomenon adhere to official antiracist narratives [e.g. *diversity*] about their incorporability has produced resistances, noncorrespondences, recalcitrances, and other general mis-fits because that demand is often intrinsically and structurally impossible' (47). These 'mis-fits,' counter-moves and discourses, excavated from girls' subjective experiences, are a central concern of our analysis. First, however, we consider how neoliberalism as a racial, economic, and political project has led to a cottage industry of discourses for learning and equity, of which we foreground two: representational politics and respectability politics.

What was once a call for more math and science *learning*, has shifted to a call for more of a particular kind of math and science *learner* – women, African American, Latinx, Native Alaskan, and Native American learners (Honey, Pearson, and Schweingruber 2014; NSB 2012). Representational politics often undergird such calls because equity is achieved when, for example in a sex binary world, we reach 50% women and 50% men (or when racial demographics mirror population distributions) in the figurative STEM pipeline connecting schools and industry. Representational politics have given rise to a range of programs to redress the 'racial achievement gap' or 'gender participation gap' in STEM including, for example, *Girls Who Code*, *Black Girls Code* and *Million Women Mentors*. The benefits of such discourses include their emphasis on engaging girls in conversation with women scientists and mentors; providing low-cost access to technical skills and knowledge for future STEM careers; and in some cases, raising the feminist consciousness of young girls through design.

Representational politics, however, implicitly assume that racially minoritized students and girls *should* pursue a STEM career, which hints of paternalism in negating the

possibility that *not* choosing STEM careers reflects sound reasoning. As Gholson (2016) explains, most studies or national reports do not ‘center or frame the experiences of Black girls and women as a phenomena of interest’ (293), which leaves unexamined the reasonableness of rejecting a STEM career or what the nature and purpose of STEM learning could mean *to* women and/or racially minoritized learners (e.g. McGee 2013). Further, representational politics relegate equity to a kind of ‘heroes and holidays’ multiculturalism (Nieto 2009), or what Melamed (2011) frames as liberal multiculturalism, which, he argues, moves to contain more radical notions of culture emerging out of Black Power and women of color feminisms (work that ‘recognized race as a material structure of capitalism and democracy’). Such containment works by turning the radical into aesthetics, identity, recognition and representation, where the diversification of who wields power displaces the questioning of power structures themselves. Thus we argue that understanding students’ relationships to STEM learning on their own terms carries great potential to widen or contest representational politics and identify counter-moves to the normative racial and cultural politics of STEM.

Related to representational politics but somewhat distinct are the respectability politics embedded in the argument that persons devalued in society will be valued when they reflect what the market values – in this case, STEM learning. Respectability politics as a grappling of minoritized communities with cultural hegemony has a long and storied history in the U.S. In describing the work of the Women’s Convention of the Black Baptist Church during the Progressive Era (1880–1920), for example, Higginbotham (1993) describes the politics of respectability as a strategy to reform ‘the entire structural system of American race relations’ (187). On one hand, emphasizing conformity to white society’s norms of morals and manners represented an ‘uplift’ of (poor, working class) brethren and on the other, a demonstration to white people that African Americans can be respected (and respectable). Higginbotham describes the women leaders’ reliance on a politics of respectability alongside traditional forms of protest and petitions, as combining ‘both a conservative and a radical impulse’ in search of common ground between white and Black. In the context of STEM education, the logic of respectability politics follows its early roots – women and racially minoritized people prove their value to society by demonstrating their value to the labor market (in this case, by acquiring the norms, morals and manners of a corporate STEM career).

In education, the idea of strategic acquiescence to cultural hegemony, as respectability politics argues for, is perhaps best known in the early writings of Lisa Delpit. Delpit (1988) describes education as a process of acquiring rights to a *culture of power*. As theorized, Black and poor white youth should be explicitly taught the rules of the culture of power (e.g. language, comportment) in order to gain power. Here respectability politics, as a discourse of STEM *learning* becomes a discourse of *equity* – if more minoritized students have access to STEM (learning) it follows that they will then have more power (equity). This discourse permeates beyond individuals when STEM education gets cast as restoring respect for urban school districts and cities (Bullock 2017; Nasir and Vakil 2017). Respectability politics, as a mechanism of neoliberalism, has merit insofar as STEM workers can expect to earn at least 29% more than their non-STEM counterparts; and, even when *not working in a STEM occupation*, STEM degree holders can anticipate making 12% more than their counterparts (Noonan 2017). If respectability is equated to income and status, it follows that a STEM degree carriers power.

The shortcomings of respectability politics in education are related to its racist and assimilationist underpinnings, which necessarily stop short of structural change (see Calabrese-Barton and Yang 2000; Philip and Azevedo 2017). As Martin (2003) reminds, decades after mathematics was cast as a civil rights imperative for Black families akin to voting rights (Moses and Cobb 2002), and even after ‘Algebra for All’ became the curricular face of this promise, the respectability politics of STEM learning has not delivered collective social, economic or political uplift for Black families writ large. Thus the simplicity of this discourse – she who has more STEM has more power – overlooks the structural realities that, for example, in the aggregate, women in STEM can expect to earn between 80 and 87% of what their male counterparts earn (less for women of color: Corbett and Hill 2015). Moreover, seldom addressed is the way respectability politics entangle individual desire and neoliberal gain in the lives of minoritized youth. That is, when Brown immigrant girls (like Amina and Stefanie) express a desire to pursue STEM, we cannot easily disentangle ‘pure desire’ from their sense of vulnerability, or their perception that STEM (and STEM of a particular kind, as we discuss below) is the only path to respectability within a terrain of disrespect and domination. Although centering subjective experience cannot undo this entanglement, it can generatively widen and complicate the simplicity of respectability politics as a normative discourse for STEM learning and equity.

As an alternative to the assimilationist currents of respectability, recent work asserts that equity in STEM must include a critical widening of the disciplines and professions themselves, whether in science (Medin and Bang 2014; Barton and Tan 2009; Roseberry, Ognowski, DiSchino, and Warren 2010); making and technology (Blikstein 2013; Booker 2010; Garcia 2017; Vossoughi, Hooper, and Escudé 2016; Pinkard et al. 2017; Vakil 2018); engineering (Philip et al. 2018) or mathematics (Gutiérrez 2017; Gutstein 2012; Nasir 2002). Rather than treating STEM knowledge and practices as settled (Bang et al. 2012), this work crucially asks: Which histories and ways of knowing are valued or erased? And, STEM for what purposes? Centering such questions productively troubles the meanings and purposes of knowledge production within an unequal and hierarchical society. As Gutiérrez (2017) writes: ‘an Indigenous production of knowledge to benefit others is in opposition to knowledge production as performance that benefits mainly oneself and that is seen in most white institutions or places that value Western thought’ (10).

In line with this decolonial and democratized view of knowledge production, we consider how the concept of *dignity* offers a critical lens for interpreting subjective experiences of STEM learning, particularly for young people confronted by the demands of assimilation and respectability. Espinoza, Vossoughi, and Rose (*under review*) define educational dignity as ‘the multifaceted sense of a person’s value generated via substantive intra- and inter-personal educational experiences that recognize and cultivate one’s mind, humanity, and creative potential.’ Espinoza and Vossoughi (2014) have emphasized the historical and collective dimensions of this concept by 1) arguing that dignity can be derived from productive participation in learning as well as resistance to the inaccessibility of opportunities to learn, 2) conceptualizing learning as ‘rights-generative activity,’ and 3) asserting that dignity requires a fundamental respect for the intellectual and political self-determination of all peoples and a commitment to fostering the conditions that support this potential to bloom. Here, we are interested in the ways dignity can push past discourses of individual gain that either ignore or emerge at the expense of collective forms of survivance, self-determination and well-being.

## Methods

### Setting and participants

#### Amina

Amina attended Redbird High School (RHS) in a western U.S. suburb. RHS was the most socioeconomically, ethnically and racially diverse school, and the lowest performing school in the district. Amina was in a new district program targeting struggling mathematics students called Yearlong Algebra 1. While all other math subjects were taught in one semester, this lowest track was two semesters. A Pearson's chi square ( $\chi^2$ ) analysis of track placement showed statistically significant racial disparities ( $p = 0.000$ ): Latinx students were disproportionately assigned to the lower tracks for *all math subjects* except Algebra 2 (Sengupta-Irving 2009).

Eleven students in the class identified as female, five as male ( $n = 16$ ), and all as racially minoritized students, the majority of who were Latinx ( $n = 11$ ) and first-generation college students. By several measures, the class was a success: 15 of 16 students passed, including students who had failed Algebra twice and thrice before; students also forged generative relationships through shared mathematical activity over time (Sengupta-Irving 2014); and for Amina, she said the class 'changed [my opinion]; I hated math, it felt like enemys (sic) but I'm actually understanding and I'm finally passing' (Survey\_6/6/07). Amina, the youngest student, was a 13 year-old freshman. She identified as Muslim Palestinian from Jordan, reiterating her Palestinian identity by clarifying, '*not* Jordanian, *Palestinian* from Jordan'. She was one of three *hijab* wearing students at RHS, and the eldest of five children. Amina was born in the U.S. and had been designated an English Learner at RHS.

Amina's teacher, Ms. Pankhurst, was a white woman who had taught math for eight years, but was in her first year at RHS. She was recommended by the director of a university teacher education program known for its social justice mission. Pankhurst completed her student teaching at a high school nationally known for its use of Complex Instruction (CI). CI is a theory of pedagogy designed for heterogeneous classroom environments. CI views status inequality among learners as a barrier to achievement, where status refers to the way children can be differentially positioned in a classroom based on popularity (locally derived) and racial, class or gender inequality (sociohistorically derived). The central tenet of CI is the disruption and mitigation of status inequality, which includes the use of group roles (e.g. Facilitator, Team Captain) to distribute authority; norms of collaboration that value a diversity of perspectives from a diversity of people (Boaler 2008); the use of open tasks that allow for interdependence in problem solving; and pedagogical moves known as 'status treatments' by which a teacher intervenes to assign higher status to a low status student (e.g. "Jacqueline, did you hear what Amina is suggesting? (see Cohen and Lotan 2004; Cohen et al. 1999).

#### Stefanie

Stefanie attended Sunrise elementary school, located in a working-class community on the southern side of a large metropolitan U.S. city, and regularly attended the adjacent Boys and Girls club after school. The demographic makeup of the children at the Boys and Girls club was reflective of the neighborhood: 48.7% Chinese, 17.9% Latinx, 10.9%



Black, 10.3% Multiethnic, 8.3% Vietnamese, 1.9% Pilipinx, and .6% white. The number of Black participants grew to 38.7% for highschool, a reflection of demographic shifts tied to gentrification and the displacement of Black communities from the city.

Stefanie was a regular participant in the Tinkering Afterschool Program (TAP), a partnership with a science museum in the city. Participants included children (K-5), youth educators (ages 15–20) and adult educators. All educators were from Immigrant and Diasporic backgrounds, including a core group of teen educators (many of whom lived in the neighborhood and attended the Boys and Girls Club). A typical day was comprised of a whole group ‘circle time,’ followed by individual or group projects during ‘workshop time.’

I (Vossoughi) conducted research on TAP in collaboration with Meg Escudé, the director and lead teacher of the program. Tinkering activities – scribbling machines, sewn circuits, musical instruments – were designed to contextualize scientific concepts and practices in meaningful activity; emphasize play, iteration, and the arts; and support multiple ways of knowing. A central goal of the program was to develop and document pedagogies that were responsive to students’ needs, capabilities and cultural lives; question dominant definitions of learning, intelligence and science; and expand understandings of where and how learning takes place (Banks et al. 2007).

Stefanie was seven years old when she joined TAP, and continued participating through her elementary years. Her family was from Mexico, and she spoke Spanish with her parents. Stefanie’s siblings also featured prominently in the stories she shared. She was close friends with three of the girls (all girls of color) who regularly participated in the program and usually worked with or near them. Stefanie and I also often worked together. She was a wise kid with a skeptical sense of humor and a deep curiosity about the world.

## **Data collection**

### **Amina**

The analysis derives from a yearlong ethnographic case study of mathematical learning and peer collaboration (Sengupta-Irving 2009, 2014), and draws on fieldnotes, interviews, sociometric network and written surveys. I (Sengupta-Irving) observed 36 weeks of instruction, where an observation cycle focused on four collaborating peers over 20 days. This analysis draws on nine cycles of observing Amina. In handwritten fieldnotes, I attended to group interactions and talk, teacher talk, and whole-class discussions. Subsequently, electronic research protocols (Hatch 2002) were created to elaborate observations and differentiate the descriptive narrative from the inferential one (Emerson, Fretz, and Shaw 2011). Three semi-structured student interviews were conducted over the year. The first interview explored students’ familiarity with CI and perceptions of themselves as math learners. The second also included perceptions of peers as more or less desirable collaborators. The third interview elicited students’ summative reflections on the year. Sociometric network surveys were used to model relationships among peers over time (Wasserman and Faust 1994). The roster-format network surveys, in which students circled names of peers from a roster in response to a given prompt, allowed me to create a network model of social relationships (i.e. *sociometric*) over time. The surveys coincided with the first two interviews and asked students questions like, ‘If given the chance to choose your own group for the class,



whom would you choose and why?' Finally, students were periodically surveyed as part of class instruction to elicit perspectives on the pedagogy and use of groupwork.

### **Stefanie**

The analysis of Stefanie's subjective experiences drew on fieldnotes, audio-video recordings and interviews. Data collection was focused on capturing joint activity across children, youth and adults, with emphasis on talk and interaction as windows into processes of learning (McDermott and Raley 2011). Though the corpus includes information about Stefanie's experiences from age seven to 10 years, this analysis focuses on the first year, when many key ideas about the meanings of STEM learning were expressed. An in-depth interview with Stefanie in May of her first year included questions about her experiences with science teaching and learning across various settings. Stefanie was also invited to view video-recorded interactions and asked to comment on her prior remarks, particularly around the meanings and purposes of science learning. Drawing on participatory design research (Bang and Vossoughi 2016) and social design experiments (Gutiérrez and Vossoughi 2010), I also engaged in ongoing co-analysis of emergent data with adult and youth educators, which significantly shaped data collection, construction and analysis.

The heterogeneity of method and data source invoked across these analyses speak to the authors' respective desires and contextually developed approaches to capturing and attending deeply to students' subjective experiences of the learning environments.

### **Data analysis**

We live storied lives, Bruner (1986) argued, and for educators, the stories we tell shape both what is and what could be (Sengupta-Irving, Redman, and Enyedy 2013). Thus we began our analyses by sharing stories about children's STEM learning drawn from prolonged engagement at our research sites. In these exchanges, we quickly converged on the stories of Stefanie and Amina because their experiences, while echoes of one another, could not be easily captured by readily available STEM learning discourses.

To begin, we each aggregated our data (fieldnotes, interviews, surveys) related to Stefanie and Amina over one year into a single document and organized the data temporally. Drawing on interpretive frameworks (Erickson 1986; Erickson et al. 2008), we then analyzed the experiences and perspectives recounted in the document and created analytic memos (Hatch 2002) that identified where and how various discourses of STEM learning and equity surfaced. Moving between analytic memos and primary sources, we then sought specificity by focusing on: 1) moments when talk, activity, or interactions represented normative STEM learning and equity discourses in the focal learning environment (primarily within fieldnotes); 2) how Amina or Stefanie explicitly made sense of these discourses (fieldnotes, interviews, surveys); and 3) moments when talk, activity or interactions suggested that Amina or Stefanie were reflecting, refracting, or remaking the identified discourses (again, primarily fieldnotes). This conceptual coding (Huberman, Miles, and Saldaña 2013), was then subject to three iterative cycles of interpretation where authors together read, problematized and discussed the data. In what follows, each author offers the interpretation of Amina's (Sengupta-Irving) and Stefanie's (Vossoughi) subjective experiences that resulted from this collaborative effort.

## Analysis

### Amina

#### Beginnings

Amina's first day introduced the normative discourses that circulated all year. Her teacher's opening speech had a functional quality to it as she explained, for example, that students were assigned to seats color-coded by role; given points for good behavior and participation; given a daily log to record homework completion; and were expected to sign a syllabus. Ms. Pankhurst then introduced herself by name and shared her enthusiasm for the upcoming year, especially the use of groupwork. Pankhurst explained that in groups, 'you'll be discussing things, trying to make sense of things, asking each other questions, and getting help from each other' (Fieldnote\_8/21/06). She explained that past performance was irrelevant; what matters is what they did from here. Further, she explained, success meant persisting (like Andrew Wiles); taking risks and participating ('it doesn't take a right answer to present your ideas'); embracing mistakes ('we're going to make lots of mistakes'); and seeing everyone as capable ('we all learn from each other'). The first day thus invoked the normative STEM discourses of individual excellence, interrelated with white masculine excellence (British male mathematician, Andrew Wiles) but also invoked mutuality, where sensemaking and helping were cast as essential to individual success. Pankhurst wanted students to minimize the past although ironically, they were in the class because of poor past performance. Nonetheless, Pankhurst's discourse on the first day reached beyond the individual and functional economy of STEM learning toward one that sought to amplify relationality and community, which would prove challenging.

This dualism of discourses (functional and relational) resurfaced in Amina's reflections throughout the year. In her first interview, for example, Amina reported she was now more collaborative and persevering: 'I've changed by talking to people and helping them out more. my attitude is changed like in a way that, instead of, 'Oh, I quit! I don't want to do this no more!' it's like, 'No, you can do it.' (Interview\_9/7/06). In a year-end survey where students were asked to give a future student advice, Amina responded with a list that was functional in tone: 1) Do your math/class/homework; 2) Don't be late to class; 3) Don't disturb the class; 4) Don't talk outside your group; and 5) Be quiet during warm ups (Survey\_6/6/07). While these self-reports largely reflect the functional aspects of the first day, a closer analysis of Amina's subjective experiences complicates this totalizing view and reveals the ways she was *remaking* and *refracting* normative discourses.

#### Subjective experiences

On repeat administrations of a survey asking students to rank the importance of various statements, Amina's responses to an item about interpersonal dynamics deteriorated over time. With regard to, 'I feel uncomfortable when seeking help from others because they may think I am not as good as them,' she ranked this the *least* of her concerns at the start of the year but her *greatest* concern at year's end. This was the largest shift in her surveyed perceptions, and as important, directly countermands the CI goal of status mitigation.

For Amina, finding her relational footing was bound in part to her classmates commenting on her marked Muslim body (in a room of marked bodies) throughout the year. What follows are a sampling of fieldnotes capturing some of these moments

where, regardless content, Amina's racialized and religious identity rendered her vulnerable to an unrelenting Christian gaze:

[Estela asks], "Do you get in trouble if you don't wear it [the *hijab*]?" Amina explains that she can take it off at home. Estela responds, "You can't show any of it to a boy?" Taye says, "That's weird – it's just your hair." (Fieldnote\_8/24/06)

"Is that head thing a sign of beauty? What happens if you don't [wear it]?" Jacqueline asks if Amina has different colored scarves at home and if she has lots of them. Amina says she does. "Have you ever been shot for it?" James asks. (Fieldnote\_10/04/06)

"Who do you worship?"

"God," Amina replies.

"Really? So you're Catholic or Christian?"

"No, I'm Muslim."

"Muslim? But it's God." (Fieldnote\_10/6/06)

Amina's *hijab* and Islamic faith cast her unwittingly into a sea of interpretations: *hijab* as weird; *hijab* as beauty; Muslim as gunshot victim; Muslim as ungodly. The compulsory vulnerability of her marked body is unmistakable, even when experiencing a pedagogy ostensibly designed to mitigate it. And yet, while at all times a racially and religiously minoritized learner, a closer look at her other subjective experiences make it less clear that that alone sufficiently accounts for what transpired.

Fieldnotes suggest students often struggled to find their relational footing in the early days. During a group activity on variables on the second day, for example, Amina was the Resource Manager and an African American male student named Taye was the Team Captain. When a Latina groupmate was 'caught' speaking outside of the group, Pankhurst reprimanded her. Taye then clarified with Pankhurst that his job was to make sure the others went through him. Shortly thereafter, he thought he caught Amina doing the same thing:

[Taye] threatens to tell on her and she'll lose points. He tells Amina to tell him whatever she doesn't understand so he can know the group's question...Taye and Amina are going back and forth. Taye keeps accusing Amina of speaking out of the group. (Fieldnote\_8/21/06)

Within the logic of CI, Taye's talk and behavior were largely appropriate; and, notably, everyone was still familiarizing themselves with the new groupwork structure. Yet, there was a patriarchal tenor to this exchange in which a boy was positioned to regulate the talk and behaviors of his peers, two-thirds of whom are girls. By midyear, Amina would identify Taye on sociometric surveys as someone to avoid working with and explained that it was, in part, because 'everytime we talk, I talk, he's like "shut up"'. The possibility that group roles can inadvertently reinscribe patriarchal order also surfaced for other girls:

[Pankhurst] calls the students out by name, individually, who are team captains to help her in this effort [of staying in groups]...Ofelia says, "I can't do that," under her breath. (Fieldnote\_11/29/06)

Ofelia, a Mexican immigrant girl in the 10<sup>th</sup> grade who was designated an English Learner, seemed to be problematizing the idea that her assigned role was enough to grant her the authority to command her peers (two boys, one girl).

In the midyear sociometric network survey Amina prioritized respect and helpfulness in identifying ideal collaborators. Circling Ofelia's name, for example, Amina explained, 'I like to help her and she likes to help me,' which markedly contrasted with her explanation of why *not* to circle Katia's name: 'every time I don't know how to do something she's like, "Oh my god!"' In fact, surveys showed that Amina and Ofelia had mutually identified as ideal collaborators, while *no other student* mutually identified either of them (Sengupta-Irving 2009).

A closer look at Amina and Ofelia's interactions suggests their partnership pushed past the functional goal of help with content, to include the relational goal of providing protection. In the following example, the students were doing a group challenge. When finished, the teacher would choose someone at random to explain the solution. If the explanation was satisfactory, the group would receive the highest marks; if not, they deliberated again but were then only eligible for the second highest marks. Having just earned highest marks on the first task based on Selma's explanation, Amina was selected to explain the second. Pankhurst asked Amina to explain the meaning of her numerical solution for a word problem. As Amina struggled to do so, Selma repeatedly attempted to interject and finally barked, 'Hurry up!' Pankhurst told the girls to deliberate further. Knowing they lost points, the following transpired:

Selma asks if she should write down what Amina should say for her, and then laughs at her. Ofelia explains that it is because Amina never read the problem. Selma says something mean to Amina and laughs, then offers to tell her in "Chinese". Maricela leans back and throws her hands up, then shakes her head. Ofelia leans in to help Amina ... Maricela leaves to throw something in the trash. ... Selma tells Amina that Maricela is [actually] just laughing at her. Ofelia tells Selma to back off; Amina knows she made a mistake and [Selma] can be nicer to her. (Fieldnote\_2/6/07)

The peer scrutiny and disrespect Amina experienced for not being fast enough was countered only by Ofelia's compassion, patience, and protection. Ofelia's efforts were not, however, enough to mitigate the relational indignity; Maricela and Selma reiterated their frustration and moved on. When Pankhurst returned, she helped Amina and then reprimanded Selma and Maricela for leaving Amina behind.

Amina's desire for respect, a remaking of learning to be something more than individual achievement or outperforming others, extended to her classmates, especially Carmen. Carmen struggled with the CI norm of not speaking outside of one's group. When reprimanded, she would roll her eyes, toss her pencil, or exclaim that she hated the class. And yet, I also observed Carmen to be deeply engaged:

This is what strikes me most about Carmen – she seems to be genuinely motivated by the mathematics, to enjoy the problem solving. It's not really the math that she is rebelling against; it is the format of the class or Pankhurst, specifically. (Fieldnote\_8/25/06)

The dynamic between Pankhurst and Carmen worsened and soon Carmen was being sent out of class regularly until, by second semester, she was transferred out entirely. While Carmen is not the focus of this analysis, her experiences were significant for what they meant to Amina. At the end of the first interview Amina asked, 'What do you think of Pankhurst?' I was unprepared for a question that I thought put me in a position to judge Pankhurst. Rather than answer, I asked Amina her thoughts and she said:

Sometimes to me she like she's nice...she looks nice. But sometimes...she kind of gets a bit mean, which kind of gets me mad because...She's being mean to other people. I don't think that's right...I don't do anything, it's my feelings – I feel for them too. I think [about] Carmen...sometimes she doesn't do anything and [Pankhurst] just gets mad at her. (Interview\_9/7/06)

For Amina, witnessing Carmen's experiences appeared to refract the functional goal of groupwork as getting help with content: asking Amina to learn with others meant Amina also felt for others. In fact, what Amina might have wanted to hear from me was quite simple – that I too was bearing witness to something that felt unfair, undignified, and inequitable.

Amina's subjective experiences thus speak to her remaking and refracting normative discourses of individual excellence (and the CI-modified version of groupwork to advance individual excellence) toward a desire for relational respect and mutually affirmed dignity. Her exchanges with Selma, however, complicate this seemingly coherent telling. Selma was a Mexican student and a 9<sup>th</sup> grader who was also designated an English Learner, like Amina. Unlike Amina, Selma came to the U.S. one year prior. As seen in a previous example, Selma and Amina's interactions were often antagonistic, and drew others into the dynamic. In another example, Amina was working with Selma and two popular upperclassmen, Jacqueline and Katrina. Amina determined a solution with Jacqueline and looked on as Selma consulted with Katrina. Amina called out that Selma was wrong to which Katrina countered, '[we] haven't looked at that part yet so you better check yourself, homeboy.' Amina looked to Jacqueline who pointed at Selma because she was laughing loudly and saying, 'Homeboy! She call you homeboy!' Looking desperate, Amina then noticed paper in Selma's hair and shouted back, 'You have something in your hair!' As the others helped Selma remove it, Amina laughed hysterically (Fieldnote\_1/16/07). Such exchanges, which reflect Amina and Selma (with others) belittling each other while learning, countermand prior evidence that Amina sought respect for herself and others. One interpretation of these countervailing instances is that they prevent romanticizing the subjective experiences of students. That is, Amina can at once seek respect while being disrespectful of another. Alternatively or perhaps relatedly, Amina may have learned that mitigating her vulnerability required her to render another person more vulnerable and Selma, as the newest immigrant to arrive, may have seemed the obvious choice. If smartness as an ideology serves to stratify (Leonardo and Broderick 2011), and stratification necessitates an experience of disrespect or vulnerability for *someone*, then the desire to be respected may very well require the disrespecting of another. And, amplified by their position in the lowest track, moves at asserting smartness and hierarchy were further charged if not preordained.

I end with a story of Amina that was, in fact, the genesis of this analysis. In the first interview, I asked students what they saw as the purpose for learning Algebra. In the main, students described normative discourses about STEM education: the pragmatic pay off of earning credit to complete high school or enter University, for getting a good job, or as necessary for a future STEM career. Amina, however, answered my question in a profoundly different way:

Yeah, [Algebra] does matter [for future life]...For example, when you get kids they need help with their math homework and you want to explain; you don't want to just sit there and say, 'I don't know, do it yourself,' or just, if someone asks [them] in school if [their] mom helped [them] with this [you do not want them to say:] 'Oh, my mom doesn't know anything,' or stuff like that.

For Amina, Algebra represented something good for the relationship she would someday have with her children, that she wanted her children to have with their teachers and perhaps, for the respectability and dignity that knowing mathematics bestows on a mother. Just before this question, Amina had reflected on her own mother:

I want to go to college and finish and graduate and get good grades and keep studying more. And even though I get married and haven't finished college I won't stop and do housework and stuff; I'll go to college just like my mom's doing. She's doing that. And yeah, and she has like, five kids, so.

Drawing on a relationship in her home that embodies the syncretism of dignity, motherhood, and learning is existence proof of what being a STEM educated woman might represent for Amina, and that the pedagogy of CI or the creation of a yearlong Algebra class, could not reach. Amina's experiences and perspectives suggest an enduring incompleteness in our understandings of how to design equity-minded learning environments that also anticipate and respond to the complexity in children's subjective experiences of such spaces.

## **Stefanie**

### **Beginnings**

TAP was working to contest and widen normative definitions of STEM learning, and to connect science to children's histories and everyday lives. An example of what this looked like emerged on Stefanie's first day, during opening circle time. Meg, the lead educator, was introducing the day's activity (making fused-plastic science notebooks) by discussing the purposes of scientific documentation. She asked each student to describe a photograph of family or friends that they held dear. When they had finished, Meg explained:

Pictures, they're like history, right? History books are full of pictures but you have your own histories at home too, that's the history of your own life...so your notebooks are gonna be kind of like that. they're gonna be a place for you to go back, all throughout the semester and draw or write about discoveries you had, or things you were excited about that you were building.

Meg went on to discuss the larger purpose of TAP activities:

So sometimes the scribbling machines don't last that long, or the rockets don't last that long, but what happens to the ideas you had while you were making that? Do they go away too when you take it apart?" Shauna said, "Nooo." Meg: "Nooo, that's right. So you hold on to those ideas and just like a family picture if you write down some of those ideas or you draw about what you made, it will help you later when you are working on more problems and more projects. (Fieldnote\_9/24/12)

Here, Meg positioned students as poised to work on significant problems, contribute ideas that were worthy of documentation, and placed value on what they got excited about in the process of making. Further, the science notebooks were metaphorically connected to students' histories through the initial invitation to share a cherished photo. These 'purpose narratives' (Bang, personal communication) offered a way to ground the activity, trouble normative definitions of science as distinct from everyday

life and family, and emphasize idea development over and above a final product. Thus, on her first day, Stefanie encountered a narrative of science learning that privileged what feels meaningful to students; a promise was made.

### *'Still it doesn't feel like science'*

One month into Stefanie's participation in the program, we were taking apart old machines to investigate how they worked, when Stefanie reflected on 'science night' at the Boys and Girls Club a few weeks prior. Science night included numerous presentations by local groups, one of which focused on promoting girls and women of color in science. As part of their introduction, two Black women wearing white lab coats and goggles demonstrated an experiment that included sticking a long needle through a balloon. As Stefanie and I (Vossoughi) worked to unscrew the lid of an old answering machine, we had the following exchange along with Shauna, another seven year old:

- 1 Shirin: You got it, keep going.
- 2 Stefanie: Still it doesn't feel like science.
- 3 Shirin: It doesn't feel like science? How come you think it doesn't feel like science?
- 4 Stefanie: It doesn't have any like um science stuff.
- 5 Shirin: What is science stuff, you think?
- 6 Stefanie: Like making a balloon, like putting a – [*gesturing a needle through a balloon with her hands*]
- 7 Shirin: Needle through a balloon. Like at that one science night?
- 8 Stefanie: Yeah.
- 9 Shirin: Have you ever dissected an animal?
- 10 Stefanie: What's that?
- 11 Shirin: Like when you open up an animal and go inside to see its guts.
- 12 Shauna: Ew No.
- 13 Stefanie: No – Yeeess.
- 14 Shirin: Have you seen people do that? Or have you done that?
- 15 Stefanie: My, my mom and dad do that...
- 16 Shauna: Some people do that when they want to get a turkey for Thanksgiving.
- 17 Shirin: That's right. That's sometimes for cooking reasons.
- 18 Stefanie: My mom usually does that with um, what's it called?
- 19 Shauna: But I have touched the brains before of animals.
- 20 Shirin: Which animals?
- 21 Shauna: I don't remember. And I've touched a horse skull.
- 22 Shirin: Whoa! [*Turning back to Stefanie*] You were saying about your mom...
- 23 Stefanie: Yeah, she like takes out all the organs of a [chicken].

[Video 10/22/12]

Stefanie's initial remark, 'still it doesn't feel like science' suggests that she was making sense of TAP as having different expectations for science experiences. When I inquired into what constitutes 'science stuff', she recalled the balloon experiment (Lines 6–10). Her response belies the complex and sometimes contradictory meanings conveyed through various discourses of equity in STEM. The science night activity appears to have made an impression on Stefanie, becoming a reference point for what counts as



‘science.’ This reflects the power of representational approaches, such that Stefanie associated *Science* with the Black, female scientists in the presentation. At the same time, we want to consider the meanings of this approach within a landscape heavily weighted towards narrow definitions of science: science as experiments that take place in a lab, scientists as lab-coat, goggle-wearing experts who demonstrate their knowledge to others. While acknowledging the public occupation of these roles by women of color as potentially transgressive, and holding space for the ways the organizers’ approach may have accurately reflected their own experiences in the domain, a critical lens on representational and respectability politics also pushes us to consider how a sense of legitimate belonging in STEM, within this scene, was limited to recognizably ‘official’ (or normative) science. The *who* of science changed, but the *what* and *where* did not, reflecting the ways representational politics often stop short of structural transformation. Thus, in this moment, representational models were not only distinct from efforts to enact epistemic heterogeneity (Rosebery et al. 2010), they functioned to contain the questioning and widening of the disciplinary domain.

Returning to the transcript, I then attempted to highlight the science of the activity by drawing a parallel to the dissection of animals (Line 11). By defining dissection in ways that transcend the bounds of clinical experiments (Lines 13–14,) a discursive opening was created for Stefanie to share that her parents had engaged in similar practices (Line 18). There are also a few ways to interpret Stefanie’s final use of the word ‘organs’ (in contrast to my use of ‘guts’) that are not trivial. Stefanie can be seen as storying her parents’ activity in ‘scientific’ terms, perhaps taking up my invitation to locate science beyond the lab. She was also amending my phrasing to take a respectful stance towards more-than-human beings, a potential link to relational (rather than hierarchical) human-nature relations common within Indigenous epistemologies of science (Medin and Bang 2014). That these two moves were made by the same statement suggests that a kind of onto-epistemic navigation was emergent (Bang and Medin 2010).

Thus, Stefanie’s initial assertion of a more narrow definition of science was not fixed, and may have shifted in subtle ways in and through the exchange. We are struck in particular by the juxtaposition of the lab-coat scene with the image of Stefanie’s mother dissecting a chicken – two distinct (and differently valued) ways of recognizing women of color engaged in scientific activity. The representational framework positioned Stefanie as potentially *aspiring towards* STEM, while the subsequent exchange invited her to see STEM as embedded in her everyday life, a move *towards* family. Stefanie’s wonderings still push us to consider what her expressed desire to delineate and perhaps engage in ‘real science’ meant to her, and our subsequent analysis suggests that it may have been tied to notions of intellectual respect. Yet these yearnings on the part of students do not live outside available discourses of STEM and equity; indeed they are often crafted from that material.

### **Fun vs. science**

Eight months later, I interviewed Stefanie about her experiences in TAP. We watched the preceding video clip together, after which the following exchange took place:

Shirin: So one thing I wanted to ask you about the video is that you said it doesn’t feel like science. And I was wondering if your opinion about that changed

after we did more tinkering activities, or if you still feel like it doesn't feel like science, or both?

Stefanie: Hmm. I don't think it feels like science. It feels like fun! You know.

Shirin: Do you feel like science doesn't usually feel like fun?

Stefanie: Well a little, but that was a lot!

[Interview 5/20/13]

Stefanie's response brings an additional layer of complexity to her earlier 'still it doesn't feel like science' insight. Here Stefanie conveyed her sense of a binary between 'fun' and 'science,' such that the more fun an activity is, the less scientific it is. A resonant discussion emerged in my interview with Jessica, a teen facilitator whose family was from El Salvador, a few months after she joined the staff:

Shirin: So since at the beginning you thought it was going to be like a certain kind of science, what is your impression of Tinkering now that you've been with us for a little while?

Jessica: It has science in, like within, but it's fun. It's not like, you know like in the room, like a high school, like classroom, you're like taking notes on literally like scientific methods that like I have no idea about. So like coming here, we do like small experiments, and which they relate to science in a really like simple and complex way and which everyone is able to understand. So now, I don't know, I love tinkering. It's so fun!

One interpretation of these comments is that 'fun' was associated with 'easy' in a way that negated girls of color's interests in being challenged intellectually. As a facilitator who was also developing a meta-reflective view of learning in the space, Jessica's comments seemed to productively trouble the association between 'fun' and 'easy.' Though she also wrestled with the fun-science binary, Jessica moved beyond it by connecting the 'small experiments' in TAP 'to science in a really simple and complex way and which everyone is able to understand.' Here, it seems, the local democratization of knowledge was intertwined with (rather than apart from) its intellectual complexity, a counter-move that may push on broader entanglements of smartness with hierarchy.

### ***Self-realization***

How did science learning matter to Stefanie? Resonant with Meg's ongoing emphasis on the development of ideas, Stefanie's comments in a number of instances suggest that the material realization of her own ideas was of prime importance to her. During the aforementioned interview, I asked Stefanie what kept her coming back to tinkering. She responded: 'Well it was first that I liked to make things, like out of myself.' This notion of making things 'out of herself' cohered with an instance during a scribbling machine workshop when Stefanie expressed a preference for working on her own so that the project could be 'her idea.' On this same day, I had been talking with Stefanie when a boy she was friends with began working alongside her and engaging with her project. A few moments later, Stefanie approached me and said, 'It's like he's doing it for me.' I asked her what she thought would help and she decided to get him materials so he could make his own machine alongside her, which reflected a generous response to his

efforts to help her, and her recreation of a common participation structure within the setting. When I went back to check on them, Stefanie playfully declared that he was doing his own project rather than ‘making me do his ideas.’ When I asked Stefanie a few months later if she had any thoughts on what she’d like to be when she gets older she said, ‘Yes. An engineer. Cause the boys are taking over on it.’

These instances tender a number of interpretations. First, that the material actualization of her ideas felt meaningful to Stefanie, and that she was both aware of and prepared to contest systematic restrictions on girls’ intellectual autonomy. It is worth remembering that Stefanie was seven years old at the time, and that seven years was long enough to ascertain and critique the narrow terms of racialized and gendered personhood she had inherited. Second, we were struck by the potential distinctions between the kind of representational politics Stefanie recounted with regard to the field of engineering (‘the boys are taking over on it’), and the messages conveyed by efforts to increase the interest and potentials of girls of color in STEM. Here, Stefanie’s comment was not about her overcoming a deficit in interest or potential; rather it seems that Stefanie felt a duty to check boys’ takeover of engineering by choosing to participate in that domain. Finally, Stefanie’s reasoning does not include reference to her earlier excitement about the realization of her ideas. We read this omission as a reminder of the ways representational politics can occlude the deeper meanings of STEM learning for students.

A final lens on the purposes of science for Stefanie emerged in stories she shared about working on electronics with her father:

Shirin: When you first heard we were gonna work with wires and batteries and stuff, what did you think? Were you nervous about it, or did you feel excited, or both?

Stefanie: I felt excited. Because I always like, I used to help my dad like fix his car, like when it wasn’t running. I had to turn on the thing...When I came back and I heard like we’re gonna use wires, when I came home my dad, I saw my dad, he was, he had to work with something that had wires in it, like a lot of wires, he had attached them, but they kept moving. And then I helped. Like he had to use both hands to like grab it, and tried to use the tape but he couldn’t. And I had to hold the wire.

Stefanie connected her excitement about electricity to her role as someone who could meaningfully help her father fix the car and other electronics. In contrast to the ways she initially experienced the earlier interaction with the boy who engaged in her project, and in contrast to the general positioning of children as receptacles of STEM knowledge, Stefanie’s father asked for her help within the context of fulfilling a practical need. Stefanie’s ‘I was excited’ also suggests that she understood these familial experiences as equipping her with a level of expertise that made working with electricity more interesting than duanting. Here, aspiring towards STEM emerged as more firmly intertwined (rather than in conflict) with a move towards family.

Stefanie further expressed this sense of technical expertise when I asked if she had ever used anything she learned in TAP outside of the program. Stefanie described

a time when she noticed that the family bunny had chewed through the DS wire ('I got evidence that he chewed it cause there was like these little holes in it'). After investigating the problem, she got electrical tape, fixed the wire, and tested to make sure that it was working again. She connected this skill to a moment when she had accidentally snipped a wire during a nature bots activity in TAP and one of the facilitators had taught her how to use the electrical tape. She then continued:

But then when I looked at it, it was only one wire so I knew what to do because I saw my dad do it multiple times before. When my dad works, he fix computers, he fixed the phone one time, he fixed the TV, which is the biggest 'cause the antennae always moves.

Stefanie moved fluidly between the after-school program and her father as sources of knowledge and skill that supported her problem solving in the context of the chewed wire. In line with the previous narratives of helping her father, Stefanie's recounting of the bunny story was also tied to her ability to fulfill a practical need. This sense of competence and usefulness may be seen as another form of self-realization, one that positions Stefanie's understandings of science as integral to the ongoing sustenance of family life. Similar to the connection Stefanie made to her mother's dissection of chickens for cooking purposes, these linkages not only connect 'home' with the afterschool program, they do so in ways that hold specific cultural, political and economic resonance. Stefanie narrates forms of labor – fixing cars and electronics, cleaning and preparing chickens – that are often performed by Indigenous, Black and Immigrant hands and minds, outsourced by white middle and upper-class families, and treated as less intellectually complex (Rose 2005). While these hierarchies speak to Melamed's argument about the persistence of racial capitalism, Stefanie's expressions of competence also mirror a sense of pride in work (and in the *know-how* that goes into such work) that refuses and potentially flips such assumptions on their head. Though discourses of representation and respectability might cast programs like TAP as exposing girls and children of color to 'science,' Stefanie's reflections on her parents paint a more complex picture of where and how knowledge lives, and of what it is for.

## Discussion

The stories of Amina and Stefanie – separated by time, place, age, social histories, and learning contexts – imagine new possibilities for a system of STEM education that, absent its stratifying privilege, still proves meaningful for learners. This imagining contests U.S. hegemony as the primary rationale; refuses individual gain at the expense of another; problematizes what counts as science while insisting on its creative convergence with joy; and reclaims the ingenuity and humanity that goes unseen when children are conscripted in representational and respectability politics. What follows is a discussion of Amina and Stefanie's experiences with an eye to developing and sustaining learning environments that safeguard children's dignity and create the conditions for cultivating new discourses on the nature and purpose of STEM learning in and beyond schools.

### ***Patriarchy and discourses of STEM learning and equity***

STEM education research has found great explanatory power in interrogating how sexism and stereotyping have perniciously impacted the experiences of female and gender nonconforming students (see e.g. Brotman and Moore 2008; Leyva 2017). The work makes visible how the sexism and racism that buoy white male privilege permeate in curricular materials, expectations of performance, and pedagogy. In this analysis, we gravitate to the notion of *patriarchy*, refracted and reflected through white supremacy, for its capacity to address microinteractions *as well as* the normative discourses that structure men's needs, desires, and ways of seeing the world as reasons to invest in the STEM education of racially minoritized girls. Consider Amina's exchanges with Taye, in which CI – a pedagogy designed to mitigate sexism, for example – sanctions Taye's attempts to control the talk of his (all female) group. Ostensibly, the remedy built into this pedagogy is that eventually a girl will be captain. And yet, as Ofelia remarked, imagining herself in the position of controlling the behaviors of her group was decidedly uncomfortable if not impossible. This moment of 'surveillance from beneath' (Erickson et al. 2008, 22) shows that Ofelia recognizes the possibility of limited power no matter the role she is given. Indeed, sex-swapping who is 'in charge' leaves untroubled the requirement of being 'in charge' of others. This risks re-inscribing ideologies of smartness, whiteness (Leonardo and Broderick 2011) *and* patriarchy, where men's domination extends from the organization of groupwork to U.S. global ascendancy and national calls for more women of color in STEM with little regard to what women want from a STEM experience. Or, for that matter, to the selective recognition of the 'right women,' given that poor women of color make up as much as 70% of the workers in technology producing border factories (or *maquiladoras*) in Juarez, Mexico (Fusco 2013) – the unspoken *overrepresentation* of women in STEM. As Stefanie deftly intuits in her own moment of surveillance from beneath, the 'boys are taking over' and, we may add, *have* taken over. New discourses of STEM must therefore engage with patriarchy in its simplest and grandest instantiations, which begins by thinking through girls' and women's lives (Harding 2016).

### ***Widening representational and respectability politics***

While we reserve the right to imagine a future in which representational and respectability politics do not motivate learning, we ask: Given that these frameworks are baked into normative STEM discourses, what more must we demand? Consider the idea of introducing girls to more women of color scientists. The experience of seeing oneself reflected in these intellectual and professional domains is undoubtedly powerful. Yet we might extract more from this power than just representation by also broadening *what* it means to be scientific and *where* science happens. As research efforts to do this latter work continue to grow (e.g. Warrant et al., 2001), here we note something else. Amina looks to her mother, and Stefanie to her mother and father, as representational resources in their sensemaking. So whereas there may be a need to introduce women of color into the lives of girls of color, we must not overlook the women (or men) who are raising them. Racially minoritized women have continuously innovated and created against the tight constraints of racial, class, and gender oppression; they are innovators

and creators bone-deep. While historically, we may look to the Women's Convention of the Black Baptist church, here we look to Amina's immigrant mother raising five children and attending college. Immigrants often embody the adage, necessity is the mother of invention; and, notably, *mother* is not a coincidental turn of phrase for this analysis. There is something deeply feminist and anti-racist in pushing against the binary of 'book smart' (women in lab coats) versus 'street smart' (mom preparing a chicken dinner) as mutually exclusive options embedded in the representational politics of 'Women in STEM'. The hybridity Amina and Stefanie embody widens the functional knowledge economy of STEM to recognize the relational knowledge economies girls participate in daily (see also Cervantes-Soon 2016). Any syncretism in new discourses that allow for mother *and* woman scientist are all but denied in respectability politics and obscured by representational ones. In this new discourse, mothers or fathers are not rehabilitated or rendered more respectable *because* their work approximates a scientist's but rather, science is rehabilitated through its association with our elders.

The paradigmatic shift that comes from centering children's subjective experiences not only transforms where we look to imagine new possibilities, but also pedagogy and design – e.g. self-esteem pedagogies (i.e. programs to raise confidence and self-efficacy in girls – e.g. Denner, Werner, and Ortiz 2012) are remade to amplify girls' *already existing* political capacities to pursue STEM in ways we may not yet know how to name or anticipate.

### ***The challenge of entanglement***

We understand social transformation as a process that demands changing structures and cultivating new forms of learning, relating, and being in the here-and-now (Bang and Vossoughi, 2016). This view suggests that our efforts to democratize STEM (through new purposes, relations and forms of epistemic heterogeneity) must contend with – rather than only critique – the respectability carved out by normative discourses (that is, to wrangle, as Higginbotham described, both its 'conservative and radical impulse' as a strategy of reform). Though Amina's first day signaled a functional economy of learning and Stefanie's signaled a valuing of epistemic heterogeneity, both girls wrestled with the complexities of respectability as a place of refuge *and* a potential loss of self. Amina's analysis of the relations in her classroom reveal a desire for intellectual standing that was not premised on the degradation of others, while her functional list of do's and don'ts belied her desire to engage mathematics as a relational knowledge economy. Stefanie's 'still it doesn't feel like science' illuminates her insistence on experiencing the disciplinary 'real thing' as both the assertion of intellectual capacity *and* the ongoing entanglement of smartness with whiteness and masculinity. A similar idea emerges in the binary of science and fun, where science activities that are too much fun may be experienced as less sophisticated. Yet, as Jessica intuited, it is possible to imagine and enact science education in which ideas are complex *and* 'everyone is able to understand'; where excellence in science is defined rather than diluted by its democratization.

If experiences of learning are always also experiences of the self, these insights make visible the need to disentangle children's worth from the normative discourses of STEM, from a view of joy as mindless (Scipio 2017), and from the social calculations that treat smartness as a scarce commodity. Attunement to the subjective experiences of

children and youth is important in making this move. Amina and Stefanie's stories matter because they ask that we not be deceived by the limited promises of representation and respectability. Dignity, instead, is enmeshed with ethical relations (Bang et al. 2016); it demands deep attention to minoritized students' subjective experiences as we learn what it takes to create places of refuge and joy that refuse a loss of self.

## Note

1. All proper names have been anonymized with the exception of Meg Escudé who, by permission, is identified as the Director of the Tinkering Afterschool Program. Escudé has engaged in a long-standing research-practice partnership with Vossoughi.

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