JOURNAL OF RESEARCH IN SCIENCE TEACHING VOL. 50, NO. 10, PP. 1143–1179 (2013)

Research Article

Desiring a Career in STEM-Related Fields: How Middle School Girls Articulate and Negotiate Identities-In-Practice in Science

Edna Tan[1] Angela Calabrese Barton[2] Hosun Kang[3] and Tara O'Neill[4]

[1]*University of North Carolina at Greensboro, Greensboro, North Carolina*
[2]*Michigan State University, East Lansing, Michigan*
[3]*University of California, Irvine, Irvine, California*
[4]*University of Hawaii at Manoa, Honolulu, Hawaii*

Received 1 May 2012; Accepted 24 September 2013

Abstract: The underrepresentation of non-White students and girls in STEM fields is an ongoing problem that is well documented. In K-12 science education, girls, and especially non-White girls, often do not identify with science regardless of test scores. In this study, we examine the narrated and embodied identities-in-practice of non-White, middle school girls who articulate future career goals in STEM-related fields. For these girls who desire an STEM-related career, we examine the relationships between their narrated and embodied identities-in-practice. Drawing on interview and ethnographic data in both school and after school science contexts, we examine how STEM-career minded middle school girls articulate and negotiate a path for themselves through their narratives and actions. We present four types of relationships between girls' narrated and embodied identities-in-practice, each with a representative case study: (1) partial overlaps, (2) significant overlaps, (3) contrasting, and (4) transformative. The implications of these relationships with regard to both hurdles and support structures that are needed to equip and empower girls in pursuit of their STEM trajectories are discussed. © 2013 Wiley Periodicals, Inc. J Res Sci Teach 50: 1143–1179, 2013
Keywords: identity; gender; sociocultural; science education

Over the last two decades, it has been shown that more girls in the United States are taking high-level math and science classes in high school then in previous years (National Center for Education Statistics, 2009a). Recent data also show that girls, in general, are performing equal to or better than their male counterparts on math and science state and national assessments at both the middle and the high school level (National Center for Educational Statistics, 2007, 2010). In addition, girls are pursuing post secondary education at rates much higher than their male counterparts. For example, in 2007, women received nearly 60% of all bachelor degrees in the United States (Digest of Educational Statistics, 2009).

However, a closer look at these changing trends indicates concern. As noted by Buchmann and DiPrete (2006), despite the reversal of the gender gap in educational attainment of women, a significantly higher percentage of boys pursue post secondary STEM degrees and careers in STEM fields. In 2008 and 2009, while women were the majority of bachelor and associate degree recipients, they represented fewer than 30% of the total STEM field degrees awarded (National

Contract grant sponsor: National Science Foundation; Contract grant number: HRD 0936692.
Correspondence to: E. Tan; E-mail: e_tan@uncg.edu
DOI 10.1002/tea.21123
Published online 28 October 2013 in Wiley Online Library (wileyonlinelibrary.com).

© 2013 Wiley Periodicals, Inc.

Center for Education Statistics, 2009b). The largest gender gaps are in the physical sciences and engineering. The American Institute of Physics (AIP Statistical Research Center, 2012) reports that only one-fifth of bachelors degrees in physics go to women, and only 7% are African American and Hispanic (combined). In 2010, only 18.1% of 4-year engineering degrees were awarded to women (Gibbons, 2011). In the same year, while women made up 58% of 2-year college enrollment, they received only 15% of the associate degrees in engineering technologies (Milgram, 2011). The rates of movement into the STEM pipeline are even more limited among girls from non-dominant backgrounds (linguistic, ethnic minority, and low-income).

In recent years, the United States has begun to make students' exposure to STEM experiences and pursuit of STEM careers an educational priority. However, despite recent initiatives in the United States to "expand STEM education and career opportunities for underrepresented groups, including women and girls" (whitehouse.gov, White House, 2012), the statistics presented above *clearly indicate a disconnect between girls' science achievement and their desire to pursue STEM careers*. In K-12 science education, girls, and especially non-White girls, often do not identify with science regardless of test scores (e.g., Archer et al., 2013; Sadker, Sadker & Zittleman, 2009). Part of the reason for this disconnect is that while decades have been spent addressing the academic achievement gap between girls and boys, very little time has been spent addressing the *science identity gap*. We argue that it is in part because of this science identity gap that girls' participation in science beyond secondary schooling is limited.

In this study, we are interested in better understanding the disjuncture in girls' academic performance and pursuing STEM-related careers through the lens of identity. All students, including girls, engage in identity work while participating in science, whether such work is intentional or not (Calabrese Barton, Kang, Tan, O'Neill & Brecklin, 2013). In this study, we are interested in the kinds of identity work among *girls who do well in and articulate an interest in future STEM careers* over the course of middle school across school, after school and home. We are interested in making sense of the kinds of experiences that shape the identity work of STEM minded girls in ways that support or work against future STEM trajectories. Our research questions include:

(1) What science identities do middle school girls narrate with respect to who they are and who they want to be in science?
(2) What actions do girls take in support of their developing science identities? How are these actions informed by contexts, in particular the people and resources that make up those contexts (school science, after school science, and home)?
(3) In what ways do girls' narrations of their science identities relate to the actions they take? What are the relationships that exist between the narrated and embodied identities, and what role do contexts play in these relationships?

Theoretical Framework

Identity Construction: Situated Learning, Figured Worlds, and Identities-In-Practice

Lave and Wenger's (1991) framework of situated learning emphasizes the ineluctable link between learning and identity formation. To learn in a particular community means to become "a different person with respect to the possibilities enabled by these systems of relations" (p. 53). Lave and Wenger use the phrase "identities-in-practice" to emphasize that identities take shape as one engages in the practices of a community, and learns the ways of talking, knowing, doing and being of that community. Identity is not merely a label to describe oneself. It is not something one brings to learning or that is a result of learning. As Lave and Wenger (1991) suggest, learning "implies becoming a full participant, a member, a kind of person [. . .] Who you are becoming

shapes crucially and fundamentally what you 'know.' 'What you know' may be better thought of as doing rather than having something" (p. 53, 157). In other words, authoring identities in practice is the work of learning.

A science classroom can be construed as such a community of practice. Students are continually authoring identities-in-practice and developing certain ways of being in the science classroom, while engaging in activities and tasks in relation to the teacher and their peers. These identities-in-practice are related to who students are, who they can be, and who they want to be, as sanctioned by the norms of the classroom. For example, a science teacher may expect a successful student in her class to be a good collaborator, copy neat notes from teacher lectures, and maintain at least an A- grade. Another science teacher may consider students as successful in science if they are curious, ask questions, and design experiments, regardless of their letter grade. Learning science is thus manifested through the transformation of "identity-in-practice" in the science classroom (Carlone, Haun-Frank & Webb, 2011).

In earlier work, we have shown that girls do not merely author a singular identity-in-practice but rather author multiple, fluid identities-in-practice in the science classroom (Tan & Calabrese Barton, 2008a,b). We have also pointed out that while the science classroom can be considered as a community of practice, the different ways in which science classroom activities are set up and carried out creates different "figured worlds" within that community of practice (Holland, Lachiotte, Skinner & Cain, 2001). Each of these figured worlds has its own attending norms and rules for participation that may afford distinctly different opportunities for students' participation in science and identity authoring. Figured worlds are socially situated, and "[are] peopled by the figures, characters, and types who carry out its tasks and who also have styles of interacting within, distinguishable perspectives on, and orientations towards it" (p. 51). An example of a figured world that Holland et al. use is Alcoholics Anonymous (AA), where members are bound by and subscribe to a specific code of conduct, governed by clearly defined relationships (p. 67).

A science classroom is a compendium of many figured worlds (e.g., whole class teacher-led discussions, small groups with different members, student presentation with peers, and teacher as audience). These figured worlds are fluid, have porous boundaries and exist concomitantly with established rules and norms (Price & McNeill, 2013; Seiler, 2013). Thus, each figured world offers girls differing affordances and constraints in terms of resources (human and material) in which they draw upon to author-specific identities-in-practice (Tan & Calabrese Barton, 2008a). For example, a small group setting in a science classroom may have established norms such as specific roles and responsibilities for the group leader and note-taker. However, the make-up of different group members and one's relationship with fellow group members create different dynamics that impact how group work can unfold and what identities-in-practice students can subsequently author. While a girl may always be relegated as note-taker with one group of peers, in another group with more supportive peers, she may have opportunities to take on the role of group leader. This example also illustrates the struggle for agency inherent in carving out one's membership in a particular figured world. On initial entry into a figured world, novices gain social positions that are accorded by the established members of that world. Such "positional identities" (Holland et al., 2001, p. 125) are inextricably entangled with power, status and rank.

Alongside positional identities, there is a set of appropriate dispositions. How novices choose to accept, engage, resist, or ignore such dispositional cues shape their developing identity-in-practice and determines the boundaries of their authoring space, which is driven by a sense of agency. In the struggle to establish an identity in a new figured world, the other worlds one simultaneously inhabits also influence their identity work. The girls in our study are not only science students in school, they are also legitimate members of other out-of-school figured worlds (i.e., dancer, sister, athlete, etc.), and these memberships have bearing on what identities-in-practice

they author in school science. Thus, in moment-to-moment relationships within figured worlds, girls are simultaneously identifying as, and also being identified by other figured world members as particular persons in specific contexts. Taken together, the relationship between identity work and figured worlds illustrates three important points that we have seen in our work with girls: (1) the fluid nature of possible selves (or identities-in-practice one narrates); (2) the influences across figured worlds in which one has concurrent membership; and (3) the dialogic relationships between girls and the power structures of the figured world inherent in contentious local struggles that impact the work of girls' authoring identities-in-practice. For example, we have shown how a Latina sixth grader Amelia's identity-in-practice as the "fieldtrip girl" in the year-long, informal figured world of Saturday family science field trips steadily positioned her as a student knowledgeable in science, a position she then strategically leveraged to negotiate for new ways of participating in the figured world of formal, whole-class sixth grade science (Tan & Calabrese Barton, 2008a).

In this study, we looked across figured worlds in the science classroom, in the informal science club girls attended, and in (some of the cases) the family and peer settings. Looking across these figured worlds enabled us to see how girls' authoring of identities-in-practice is situated in context. Viewing science classrooms, science clubs and home settings as figured worlds (beyond just "spaces") highlighted the complex ways of knowing and doing that the girls can figure in these spaces. It allowed us to explore the relationships between the girls and the community members that affected identity construction, and uncover whether identities constructed in specific figured worlds were recruited as resources in other figured worlds. For example, how girls craft an interest in science through participation in their out of school figured worlds (such as cooking club, recycling club, or Saturday morning family science at the local garden) can impact when and how girls seek to pursue participation in their science classrooms. These figured worlds, which exist outside of school science, provide girls with a wide variety of resources and positioning that girls can and do draw upon to author identities-in-practice in science.

History-In-Person: Narrated and Embodied Identities-In-Practice

History-In-Person. In the previous section, we pointed out how the identities-in-practice that girls author occur in response to context—to the figured worlds in which girls participate and the people and resources available there. At the same time, we further note that while identities-in-practice are authored in the moment, they are also authored against an historical background of both *institutional* and *personal* struggles. For example, Brickhouse and Potter (2001) describe African American girls' struggle in forming a scientific identity in an inequitable playing field where prejudice and stereotyping of their identities in other figured worlds were leveled against them. The girls in their study were not expected to excel in science, and when they did, were treated as anomalies whose success was not acknowledged as enthusiastically by their science teacher. The girls' performance was hampered by the "stereotype threat [. . .] [of] being at risk of confirming, as a self-characteristic, a negative stereotype about one's group" (p. 973). Similarly, Carlone (2004) problematized the complexities of "girl-friendly" reform-based physics curriculum when girls' participation were still constrained by both historical and institutional norms that label their success as lesser than boys, as well as by the girls' own struggles about what kind of science learners they are.

Holland and Lave (2001) would refer to this collision between historical-institutional struggles and historical-personal struggles as the "history-in-person" that one carries with them across space and time. They argue that one is never completely "free" in authoring their identities-in-practice. Rather, such acts of authoring are always enacted within the limitations and

subjectivities of times, spaces, and relationships (Carlone et al., 2011)—the norms and regulations of figured worlds grounded in power dynamics that have been constructed and reinforced over time. We find the idea of history-in-person helpful because it allows us to explicitly incorporate equity concerns—to help us to make sense of how girls from non-White backgrounds author identities-in-practices in response to the power dynamics that shape their experiences. It also helps us to understand the worlds themselves where girls' identity work takes place. Eisenhart and Finkel (1998), drawing upon practice theories and figured worlds in their research on women and science, unpack the ways in which the identities of woman scientists are authored locally in time and space. The authors argue that the identity work of women in science is grounded both in the positions individuals take up (or are assigned) as well as in the tools, relationships and practices available within the communities where they engage in science. For example, women who worked as scientists in a small conservation corporation were as equally valued and respected as the men scientists; however, this professional validation came at the cost of low pay and less academic power as compared to higher status sites of science (Eisenhart & Finkel, 1998).

Just as in the professional work experience of women scientists, the relationship between identity development and figured worlds is also central to unpacking the patterns of interest, participation and the practices girls engage in science among school-aged girls. Girls can, and do, expand their school science identities-in-practice as they engage in practices that afford them with more agency for participation. A normally quiet, non-participatory girl in science class may have an unexpected positive learning experience in an after school science club which then leads to her acquiring a different identity in the science class, that is, a more interested participant. Non-White students may also reject certain discourses and practices in the science classroom to signal their affiliation with a particular group (Brown, Reveles & Kelly, 2005) highlighting the negotiations non-White students have to contend with between their ethnic and academic identities (Nasir & Saxe, 2003).

Narrated and Embodied Identities-In-Practice. Authoring identities-in-practice involves both narrative and performative work. The identities-in-practice that individuals author are made up of narratives one tells about who one is and might be and the embodied performances or actions one takes, and which exemplify who one is and might be (Goffman, 1959). We think that this distinction between narrating or "telling who one is" (Sfard & Prusak, 2005, p. 14) and performing or embodying identities-in-practice is important because it allows us to more precisely make sense of the identity work that girls do over the course of middle school.

In telling stories, or "telling identities" as Sfard and Prusak (2005) describe it, one authors specific identities by deciding what events and experiences to include or omit in describing who one is in response to a specific moment in time, reflects on one's past actions and also possible future trajectories. In considering history-in-person, however, we argue that narrated identities are not so much "telling who one is" as it is "telling who one is within the constraints of specific contexts." Rather than stories equating to identities, we equate stories told to "how one views oneself in context." This perspective brings to the forefront that girls' stories about themselves and who they are, are always grounded in space and time. In narrating their identities-in-practice, girls are always narrating against the backdrop of contentious local struggles embedded within history-in-person. As such, within one's narrated identities-in-practice, one's "actual identity," and one's "designated identity" are neither static or final, but open-ended and evolving, as well as bounded within the constraints of local struggles. When considering narrated identities-in-practice, we include the girls' verbal and written accounts of who they are in science, who they can be in the future in science, and (for some girls) the pathways they describe to get there. Who girls are in moments in time and want to be are contingent on both girls' own agentic identity authoring acts,

expectations of others with more power (such as parents, teachers, and peers), and the recognition of their identities-in-practice by members of the figured worlds. How girls perceive "what is possible" is also tied to available resources and recognized capabilities in the moment.

In narrating who they want to be in science, girls are constructing possible selves (Markus & Nurius, 1986) in science, the selves one believes one might become in the future. Oyserman, Bybee and Terry (2006) have shown that when possible selves are linked to specific strategies and shown to be compatible with one's salient social identity, low-income and non-White youth are more successful with moving forward towards academic goals linked to a successful possible self. These findings are echoed in other studies that show how the design of learning environments, including how expertise in science is defined and enabled, is tied to identity work (Rahm, Martel-Reny & Moore, 2005).

If narrated identities-in-practice is *telling* how one views oneself in specific contexts, embodied identities-in-practice is *performing* who one is in specific contexts through one's actions and relationships with discourse, tools and resources within social contexts. This includes how girls are creating experiences in science, as they choose to participate across the figured worlds of school science, informal science club, and in their home life, within the affordances and constraints of each figured world. We contend that configuring girls' identities-in-practices necessitates attending to both narrated and performed self(s), although little is known about how narrated identities interact or are related to embodied identities. In her work with young African American students, Kane (2012) found that the young students' performed (what we term "embodied") identities were consistent with their narrated identities. For example, one of the students, Joe, acted in science class in exactly the same way as he described himself in interviews —by listening and learning, and asking questions in demonstration of his "good scientist identity" (p. 26). With our case study girls who narrate a possible future identity as an STEM-related professional, we are keen to explore the relationships between the girls' narrated identities-in-practice and their embodied identities-in-practice, across figured worlds.

We believe a close examination of girls' narrated and embodied identities-in-practice (including the ways in which they inform each other) will enable us to better understand how STEM-minded girls from non-White backgrounds take up identities-in-practice that support or inhibit progress towards this goal. Figure 1 shows how we conceptualize the relationships between girls' narrated and embodied identities-in-practice in science, in relation to their narrated career goals in STEM-related fields. In their narrated identities, girls reveal their identities as informed by their grades in science, their verbal and written accounts of who they are in science, and who they want to be in the future in science. Their embodied identities in both formal and informal science figured worlds reveal the experiences and practices they are engaging in science and the reception of their actions by community members. While it is heartening when non-White middle school girls narrate future STEM-related identities, we want to explore how these narrated identities-in-practice are related to their embodied identities-in-practice in two science figured worlds (formal and informal), in other words, do these STEM-career minded girls "walk their talk" so to speak. Specifically, we want to explore what these relationships are and what they can mean for middle school girls as they consider and negotiate a possible STEM-related trajectory with an STEM-related career goal.

Methodology

We employed a critical ethnographic case study approach (Anderson, 1989) to account for what it means for non-White, middle school girls to pursue an STEM-related career, paying particular attention to the power dynamics involved in their identity work. This is a part of a larger project that has studied middle school girls' science learning at four different research sites from

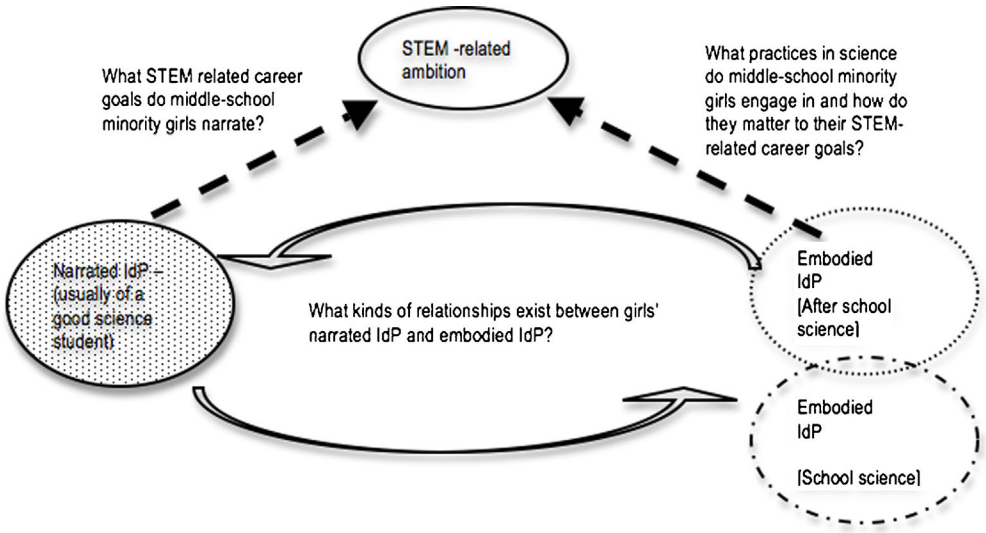

Figure 1. The relationships between non-White middle-school girls' narrated and embodied identities-in-practice.

January 2009 to March 2012. (These research sites are two small Midwestern cities, one large East Coast city, and a Pacific Ocean city.) In the larger project, we have followed 36 girls into formal science classes, informal science spaces (e.g., science club, family science nights), and other informal spaces (e.g., home, community, cafeteria), to document how they have participated and perceived themselves in science, and were recognized by others across time and spaces (and the figured worlds which make up these spaces). In this study, we focus only on the 16 girls *who articulated a desire for a future STEM-related career* to study how non-White, middle school girls articulate and negotiate between their narrated and embodied identities-in-practice in considering an STEM trajectory.

Research Context: Figured Worlds of Schools and After School Science Club

The four schools across four research sites located in urban areas had large populations of students from underrepresented racial, ethnic or linguistic backgrounds, and lower income households. The instructional approaches of the observed science lessons that the case study girls attended were fairly typical showing some mixture of lecture and hands-on activities (i.e., different figured worlds). Despite significant variance in kinds of activities observed in science classrooms, in general, a science teacher held epistemic authority in the classroom communities in that forms of knowledge and outcomes of learning were determined and presented by the teacher. The students were expected to complete their work either individually or as a small group to get the full credits following directions.

All the case study girls participated in after school science clubs in the sixth grade, although not all of the girls remained in after school science clubs (an initial requirement for participation in the study). Two science clubs at two research sites were organized by cooperating science teachers, and took place during lunch period (science lunch club). Generally club activities were co-selected by both the cooperating teacher and case study girls within the constraints of time and material resources. Some examples of activities included planting seed, the explosion of mentos in diet coke, that can be characterized as one-time, stand-alone activities. At the two other sites, the science clubs of the other two research sites took place after school, either as part of after school

activities at the school or in a local community center. The activities were co-selected drawing on local resources within a theme, such as "making a difference using green energy technologies." The case study girls of these clubs participated in a thread of investigations appropriating various roles while positioning themselves as community science experts.

Data Collection and Participant Selection

Most of the data were collected during the 2010–2011 and 2011–2012 school years, although we continued to follow some of the girls into the 2012–2013 school year, as contexts allowed. For each case study we conducted *per year*: (a) interviews (2 hours/girl), (b) 56–90 hours of observation per girl across the three spaces we were interested in (school, club, and home), (c) science artifacts from across the three spaces, and (d) yearly digital "science and me" stories. Table 1 provides more detail regarding the interview foci and observations and other data generation details. We also conducted interviews with the teachers who worked with the girls in school and/or after school clubs, and with the parents who we could approach during the data collection either formally or informally. To understand how non-White girls narrate and negotiate their STEM-related career trajectories, the 16 girls who expressed their interest in pursuing STEM-related careers were selected (see Table 1). These were non-White girls who talked about considering an STEM-related career during interviews at some points of their middle school years.

Data Analysis

Data were analyzed iteratively and collectively over 9 months by the researchers who, themselves, had different cultural, ethnic, and linguistic backgrounds. We believe that the diversity of our research team is essential in helping us to tease out our own subjectivities in data interpretation with respect to how culture and context mattered for the girls in our study. For the narrated identities in practices, girls' verbal responses in interviews (e.g., "What words would you use to describe science?," "What words would you use to describe yourself in science?," and written accounts, i.e., stories they told about themselves and science, in yearly digital stories were used as the primary data sources. Where applicable, we also used interview data of parents and teachers in their descriptions of a girl's engagement in science (e.g., "Describe [girl's] engagement in science," "What words would you use to describe [girl] in science class?"). We identified segments of data that included each of the case study girls' stories about herself and science. Those stories were coded with respect to: (a) each girl's perception on current self (how I think of myself in and with science) and (b) future possible selves in science (what kind of job I would like to have when I grow up and why, whether I am interested in participating in science-related activities in the future). This analysis allowed us to configure a girl's narrated identities-in-practice—through stories of who she is, who she wants to be, and how a girl views herself in specific contexts. Next, each girl's embodied identities-in-practice was analyzed by examining how a girl performed who she was, in and with science across figured worlds in science class, after school, and home. For embodied identities in practice, field notes generated from the observation, interview transcripts with girls, teachers, and other important members, various artifacts including student work, videos, photos, worksheet, and transcripts, and girls' digital stories were used as the source of data. Specifically, we first identified three to five focal events where girls' salient identity work took place both at school science and after school at each grade. Initial analytical portraits were constructed with respect to each focal event. The portraits were discussed and iteratively revised at the research group meeting. Guided by the conceptual framework, the portraits were coded with respect to: (a) how a girl *positioned* (or was positioned) upon participating in activities in each of figured worlds (e.g., how Eunice was constantly positioned as telling irrelevant or inaccurate

Table 1
Data generation methods and sources of data for narrated and embodied identities

	Data Form	Specific Data Generation Strategy			Description
Narrated identities	**Interviews** with case study girls	Views of science and self (year 1)	Views of science and self (year 1)	Views of science and self (end of year 2)	Interviews were semi-structured including both one-to-one and group interviews (2–3 girls).
	Artifact think alouds	Classroom and club work (year 1)	Classroom and club work (year 2)	Retrospective classroom and club work (end of year 2)	Self-selected artifacts from each figured world used for think alouds interviews at least twice each year.
Narrated and embodied identities	**Digital Self-Portrait (DSP)** "science and me"	DSP version 1 (year 1)	DSP version 2 (year 2)	DSP version 3 (end of year 2)	At each succeeding year, previous version(s) of DSP were shown to student and reflected on.
Embodied identities	**Observation** of girls participation in different figured worlds and **Artifact Collection**	**School** figured worlds (i.e., science class, hanging out in science teacher's room during recess, etc.)			Each girl observed for 4 days a month (2 hours/day) for 6 months of the school year (48 hours/year).
		Science-related but out-of-school figured worlds (i.e., Science Club, Summer Scientists program, tutor, etc.)			Each girl observed for 3–4 days a month (1 hour/day) for 6 months of school year (18 hours/year)
		Peer, family, community figured worlds (i.e., church, peers, work, etc.)			Each girl observed for 2 days a month (1–2 hour/day) for 6 months of school year (18 hours/year).
	Interview with teachers and parents	Views of girls in school, club, or family (year 1)	Views of girls in school, club, or family (year 2)	Views of girls in school, club, or family (year 3)	Teachers were interviewed each year. Interviews with parents were conducted informally whenever we could approach to them.

stories in science); (b) what *roles* a girl played in their participation and the ways in which they assumed the roles (e.g., how Meg always being on task and finishing the work as quickly as possible); (c) *leveraged resources* for participation and showing themselves (e.g., how Nan used her experiences from home gardening as a resource and reason to become in charge of the classroom plants); (d) how a girl's participation was *received and responded* to by other important members (e.g., how Kay's ideas at Green Club were always taken into consideration by peers and teachers); and (e) how a girl and her participation were *recognized* (or not) (e.g., how Meg is perceived by peers and teacher as a very successful science student). Data were coded across the case study girls after individual case analysis. As each case study girl's narrated and embodied identities-in-practice were configured, we analyzed the relationship between narrated and embodied identities-in-practice. We examined case study girls' narrated and embodied identities-in-practice over time and space focusing on: (a) the nature of the relationships, (b) any changes or shifts in either form of identities-in-practice. The analysis was led by the first author over 9 months of weekly group meetings, and discussed and debated until consensus was reached. For example, when researchers disagreed on interpretations of events, the raw data were returned to by the research group and discussed until consensus could be reached on revised idea. The recognized identities-in-practice, relationship, and feedback mechanisms between both identities were triangulated by analyzing multiple sources of data.

Findings

We identified four different relationships between girls' embodied and narrated identities-in-practice which help to explain their middle school STEM trajectories. The four different relationships include: (1) significant overlaps; (2) partial overlaps with no significant overlaps; (3) contrast; and (4) transformative relationships. Table 2 shows the distribution of relationships across 16 cases and sites. In this section, we present one case per relationship to illustrate the kinds of negotiations and insights pertaining to that relationship. The four cases were selected because they are representative and robustly illustrative of the different types of relationships. By focusing on one case each, we intend to provide rich pictures of the nuances of the relationships with particular attention to context. We also deliberately chose two of the cases (1 and 3) from the same classroom in order to delve more deeply into the key role of the science teacher in the girls' identity work. Each case begins with an overview of the relationship type, followed by an introduction of the case study girl. Then their narrated identities-in-practice (RQ1) and embodied identities-in-practice (RQ2) are presented. Each case ends with analysis on the case's relationship type. We then take up RQ3 more thoroughly in the Discussion Section.

Relationship Type 1: Significant Overlaps Between Girls' Narrated and Embodied Identities-In-Practice

Overview. In this section, we look at relationship type 1: significant overlaps between narrated and embodied identities-in-practice. As we illustrate with the case of Meg below, this relationship pattern suggests that there is great symmetry between who the girls say they are and want to be in science and how they practice who they are and want to be in science. For the girls who fall into this category, we note the following characteristics:

- First, in terms of identifications and recognition, the girls in this category *view themselves* as good in science, both in and out-of-school, and are *recognized* by their teachers and peers as good in science.

Table 2
Distribution of case study girls within the four modes of interactions

Mode of Interaction	Case Study Girls	Case-Specific Details on Their Narrated Identities-In-Practice and Embodied Identities-In-Practice
Significant overlaps between narrated and embodied identities	Meg	"Good girl," "smart girl" IdP in school science, very attentive but quiet in the classroom, only asks procedural questions in science class
	Chinese	Very concerned about grades
	Middle class	Joins the club following the friend, legitimately participates
	Science lunch club	Narrated future Id as a veterinarian
	Lin	"Good girl," "smart girl" IdP in school science, very attentive but quiet in the classroom, interacts with only one close friend, views school science as daunting but essential challenge
	Chinese	Joins the club following the friend, legitimately participates
	Lower middle class	Narrated future Id of doctor or artist
	Science lunch club	
	Kelly	"Good girl" IdP in school science, quite and attentive
	White	Joins the club following Ann, quiet and attentive
	Middle class	Narrated future Id of animal trainer
	Science lunch club	
	Ann	"Good girl," "smart girl" IdP in school science, favorite among teachers, strong parental support regarding school work
	White	Actively participates in club activities, views science fun and interesting, brings two friends to the club
	Middle class	Narrated future Id of detective, lawyer, or engineer
	Science lunch club	
	Charon	Social and popular among peers, works hard to get a good grade in science to get onto a medical career
	White	Opts out of participating in club early for socializing with peers during the lunch time
	Middle class	Narrated future Id of a medical doctor
	Science lunch club	
Partial overlaps between narrated and embodied identities	Nan	Good-girl" IdP in school science, active classroom and science lunch club participant,
	Vietnamese	Enjoys doing science at home with her "many pets −2 guinea pigs and a toad"
	Lower middle class	Dynamic Green Club IdP in after school science, creative, shows leadership
	Science lunch club	Narrates future Id of a pharmacist or a school teacher

Table 2. (Continued)

Mode of Interaction	Case Study Girls	Case-Specific Details on Their Narrated Identities-In-Practice and Embodied Identities-In-Practice
	Jana	"Good-girl" IdP in school science, strong and active classroom participant, favorite among teachers
	African American	Dynamic Green Club IdP in after school science, creative, shows leadership
	Middle class	Narrates future Id of environmental engineer
	Green Club	
	MI site 2	
	Carly	"Good girl" IdP in school science, quiet in the classroom, views school science as boring
	African American	Leader in after school, creates her own projects that go beyond expectations
	Middle class	Narrates future Id of an environmental protection lawyer
	Green Club	
	Jackie	"Good girl" IdP in school science, quiet in the classroom
	African American	Community builder in after school, strong supporter of struggling students, and actively brings in-home experiences to investigations
	Middle class	
	Green Club	
	MI site 2	
	Makel	"Good girl" IdP in school science, shows strong leadership, recognized leader by both teachers and peers
	African American	Active participant, make a strong and critical voice to express her opinion
	Middle class	Narrates future Id of doctor
	Science lunch club	
Contrasting narrated and embodied identities	Eunice	Curious about the world, "in awe" of nature, thinks that science is necessary to life
	African American	Active participant in school science but not recognized
	Very low SES	Makes A+ grades in science but not recognized
	Science lunch club	Narrated future Id of a veterinarian, Olympic swimmer or actress
	Finna	Curious about the world, thinks that science helps her to figure out something and actively participates, does not think of herself as a good science student because of her grades
	African American	Active participant, brings Lin to the club
	Middle class	Narrated future Id of a doctor or pharmacist
	Science lunch club	

	Diana	Active participant in group work or projects, views science as figuring things out, neither thinks of herself as a good science student nor is recognized by others
	African American	Active and inquisitive participant until stopping coming to school
	Low SES	Narrated future Id of a kindergarten teacher
	Science lunch club	
Transformative interactions between narrated and embodied identities	Kay	Started off as a strong science student in fifth grade but grades dropped significantly in seventh and eighth grades
	African American	Challenging family situation, was homeless for a large amount of time
	Very low SES	Outgoing and sociable, strong leader in Green Club
	Green Club	Won summer science internship at local university from Green Club participation
		Narrated future Id as a doctor
	Chantell	Quiet student who, while initially struggling, later teachers want to "clone"
	African American	Volunteers ideas in school science that link after school science club with school
	Middle class	Uses dance to position herself as expert in after school
	Green Club	Narrated future Id as a singer or dancer and later green designer
	Janis	Quiet student who does well enough in school to not be noticed
	African American	Uses art to position herself as expert in after school and later school science; peers use art to position Janis as expert in science
	Middle class	Wins state-wide competition for making a video rap about climate change
	Green Club	Narrated future Id as Green energy engineer or artist
	Jessie	Struggling student in school science, known for being highly social and for getting frustrated with academic tasks
		Protective of how her community is positioned in the news and desires to make a difference through science
	African American	Organizes a large community fair to make "green energy" fun, free, and meaningful to her community
	Lower middle class	Narrated future Id as a science teacher or "environmental helper"
	Green Club	
	MI site 2	

- Second, in terms of priorities and performances, all of these girls figure science as a subject to be learned or mastered. They strongly emphasize getting good grades (e.g., getting good grades matters more than actually understanding the material). They play the role of the "good girl science student" in both the classroom and in the informal science space. They also highly value performances that advance their place in the figuring of science: they complete tasks and assignments at a high level, and receive good grades. These girls typically do not step outside of the designed task to challenge or bring something new/different to it: They "do as they are told."
- Third, in terms of movement of resources and practices across spaces, the girls in this category tend to figure school science and informal science as discrete worlds, not bringing one to bear on the other in obvious ways.
- Lastly, the relationships between narrated and embodied identities-in-practice are primarily *sustaining*. That is, the relationships between these identities-in-practice help the girls to maintain interest in science over the course of middle school. Indeed, each of the girls in this category enters and leaves middle school with a strong interest in science. However (in our view), these overlaps are not always productive in what we hope for the girls—that is these girls have figured a science world that positions them passively, as consumers, but not producers, of science. Their job is to get the work done and attain the grade, rather than deeper engagement in science.

Introducing Meg—Who Aspires to Be a Veterinarian. Meg is a slight Asian girl who lives with a single mother and one younger sister. Meg and her sister were adopted when they were young, and her mother is a special education teacher in a nearby elementary school. Meg is neither vocal nor outwardly confident, but she likes directions to be clear and always makes sure to get things done. Meg's science teacher, Mrs. D knew Meg's mother well through several conversations, both over face-to-face conversations and phone calls. Mrs. D told us that Meg's mother is "very supportive." Her mother could afford to give her a National Geographic science kit when Meg was little and she had experiences of playing with a telescope. Meg likes dancing, and spends her time after school practicing dancing. Meg's younger sister plays violin. During the seventh grade science family night, there was an "egg drop challenge" where students designed protective coverings for a raw egg that has to be dropped from a certain height. Meg, together with her mother and sister, came with designs that she and her mother had researched about online that they thought would work well, although she did not end up winning the contest. When we asked Meg what prompted her to research designs online she indicated that the designs would be more likely be successful than if she just came up with one herself. She also said that she did not test her design because she believed it would work just as described on the website.

When we first met Meg in the seventh grade, Meg seemed to be more interested in hanging around with Linda, her only close friend, than doing science at the science lunch club. For example, we observed that during science club, they would engage in social conversations rather than engage with the science activities, until the teacher gently intervened. Meg joined the science lunch club because her mother told her "it would be good to have more science after school." While Meg liked science, mathematics was her favorite subject because the answer is always clear. Meg was the only seventh grade girl in the school who went to the district mathematics competition as one of school representatives. Getting good grades in both mathematics and science was important to Meg because she wanted to be a veterinarian and those are the subjects required to pursue a veterinarian career. Meg stopped coming to science club in the eighth grade as she grew apart from Linda. Across seventh and eighth grade, Meg consistently narrated a future career identity as a veterinarian.

Meg's Narrated Identities-In-Practice. Meg's science identities-in-practice merged science and school science. For Meg, doing well in science is all about test scores and grades. It is not so much related to the work one does in science or what one understands. Meg elaborated that science is important to her because she needs good grades in science for her future job as a veterinarian. She also noted that, according to a job description for veterinarian that she saw in her sixth grade, she also needed to have advanced math. In her digital science story of "science and me" Meg stated, "Science means a lot to me. Since I want to be a veterinarian, I need to know a lot about science." Meg mostly talked about her school science experiences, rarely mentioning any science-related experiences outside school. Meg thought that science class gives her a good look into what "real" science is. She got good test scores, especially when the tests are multiple-choice questions. Meg stated that she preferred multiple-choice questions over open-ended ones because she received better grades on these kinds of exams. Meg narrated, "science is interesting if that catches my attention." But at the same time, science is "hard sometimes if we have to do test [for] the lesson that I don't understand." Science is boring sometimes "if we just read a lot of books, packets, and we don't do anything." Even though Meg consistently achieved an A+ grade in science throughout the marking periods for seventh grade, she did not rate herself 7 out of 7 for science. Instead, she talked about other classmates, including Rachel, who "gets lots of As and Bs" in science.

Meg's Embodied Identities-In-Practice. In our observations of Meg in the science classroom figured worlds, she consistently embodied her narrated identities-in-practice. They were the same to her—being on task, doing the work well to make sure she got the best grade, which were also norms of her seventh and eighth grades science classes. In every lesson we observed, we saw her working on worksheets properly and quickly, so that she could either spend the rest of the time doing extra credit work, or work on some other assignment from another class, which Mrs. D allowed for. Meg did not engage in idle chatter with her friends during science class, she was always working on something. It also did not seem to matter who she was partnered with in group work. Interestingly, even though she was an A+ science student, Meg did not always show understanding of the lesson material. One episode that stood out was a lesson on invasive species. Mrs. D had the students research local invasive species and explore how they tilt the balance of local ecosystems. The students had to write their explanations down on a worksheet. Meg was one of the first to finish after which she quickly turned her attention to extra-credit work (which usually consist of more worksheets). She correctly organized all of the material, and received a grade of 100%. However, immediately after the assignment when we asked her what she learned, she shrugged her shoulders and said "I don't know. Invasive species?" When pressed for more information Meg was unable to elaborate on the different invasive species of the nearby Lake covered in the assignment, or why it mattered. This stood in contrast to some of the other girls we interviewed after this assignment (e.g., Diana, Relationship Type 3).

Meg's concern for the right answers and getting the best grades was clearly displayed in another class episode. The class was learning about weather precipitation and Mrs. D had them analyze some data on a worksheet. They had to calculate the snowfall during specific months of the year. Meg, who was recognized as someone very good in Math, did her calculations very quickly. She was confident and even helped one other classmate re-do her calculations after she concluded that her classmate was wrong after checking their answers. Without any questions, Meg's classmate changed her answers according to Meg's suggestion. Meg then turned both their worksheets in, far in advance of the rest of the class. On her way back to her seat, Meg decided to check her answers with a "smart boy" whom she had ranked, during an interview, as someone who would score 7/7 for performance in science. When she realized that her answers were not the same

as the boy's, Meg quickly retrieved both hers and her friend's worksheets from Mrs. D's desk and recalculated the measurements. She realized that she had made an error and that the boy's answers were correct. Meg ensured that her friend also corrected the answers before returning both worksheets to Mrs. D's table, and turning her attention to extra credit work.

In the science, lunch club that was run by her science teacher, Meg always sat next to Linda, and largely participated in conversation and activities following the instructions. She was, however, distracted by social conversations with Linda more often (in contrast to her behavior in science class). The club activities were often decided by the girls based on their interests, such as testing the effect of water versus soda on flower longevity. Meg did not suggest any activities that she would be interested to do in the club although she always did what she was told to do.

Relationships Between Meg's Narrated and Embodied Identities-In-Practice. From our observations, Meg's narrated and embodied identities-in-practice aligned quite well. Meg is very test score oriented and seems to see science as a means to an end—her career goal as a veterinarian. She like animals (included a clip of her feeding turtles in her digital story), but does not seem to genuinely participate or enjoy science in class or in the science lunch club. For example, compared to her participation in Math class where she was clearly more animated, smiling and raising her hands constantly to ask the teacher questions and volunteering answers, Meg was quiet and "business like" in science. In her seventh grade science class, we did not observe her ask the teacher any content questions (vs. in math class), only procedural questions related to testing. Even though she said science could be boring or interesting depending on what they were doing, she consistently displayed a neutral, get-all-my-work-done-and-get-the-grade stance throughout the year. When it came to doing something in science such as hands-on experiments, Meg was driven by writing down the correct answers rather than by carefully carrying out the experiment and asking genuine questions. While Meg certainly deserves her teacher's high regard as a very good science student via her achievement in test scores, it seems that the context of science does not really matter to her. She simply wants to achieve the best grade possible and whether she learns something of interest to her or not is of secondary importance. Supporting Information Figure S1 provides a visual representation of relationship pattern 1.

Relationship Type 2: Partial Overlaps Between Narrated and Embodied Identities-In-Practice

Overview. In this section, we look at relationship type 2: partial overlaps between narrated and embodied identities-in-practice. As we illustrate with the case of Jana below, this relationship pattern suggests that there are *critical gaps* between who the girls say they are and want to be in science and how they practice who they are and want to be in science. These gaps are most evident in the contrast between in school and out-of-school performances. For the girls who fall into this category, we note the following characteristics:

- First, in terms of identifications and recognition, the girls in this category *view themselves* as good in science, both in and out-of-school, and are *recognized* by their teachers and peers as good in science. This is similar to relationship type 1.
- Second, in terms of priorities and performances, unlike relationship type 1, the girls in this category figure science as a place of exploring or investigating the world in ways that demand question asking and thinking critically about ideas, and they tend to direct these efforts towards understanding what is taught in school (rather than questions of their own). These girls will seek out help and ask questions if they do not understand, even if it slows down their efforts or positions them, for the moment, as not knowing. They tend to

be fairly quiet in school and often, but not always, play the role of the "good girl science student" in school science. However, they play much stronger leading roles in informal science (in contrast to relationship type 1 girls). In informal science, they also figure science as a place of acting upon their ideas—where they "do" in addition to "think." They will sometimes bring ideas that may challenge or change the out-of-school task so that it is more interesting, relevant, etc., suggesting a desire to engage meaningfully in science.

- Third, in terms of movement of resources and practices across spaces, all of the girls in this category figure science as a place where their out-of-school science knowledge and experience matter, even when it is not solicited or recognized by the teacher. Refiguring the role (and value) of their own experiences in school science seems to be a major way in which some of the girls in this category are able to close the gaps between narrated and embodied identities-in-practice in the context of school science.
- Lastly, the relationships between narrated and embodied identities are primarily *sustaining*, as was also the case in the first relationship pattern, helping the girls to maintain interest in science over the course of middle school. However, we also noted that the girls in this category developed deeper interest in exploring new areas of science than the girls in the first category. We noted that the gaps between the narrated and embodied identities-in-practice appear to productively support the girls in being more active in their science learning (unlike relationship type 1). That is, the gaps between narrated and embodied identities reflect differences in how the girls experience and figure science in school (e.g., girls being good girls) and out-of-school (e.g., girls being active scientists and science experts). The kinds of cross over sometimes seen between informal and formal science almost always further help to position the girls as smart and capable.

Introducing Jana—Who Aspires to Be a Singer and an Environmental Engineer. Jana is a vivacious African American girl who is tiny in stature but exuberant in personality. Highly enthusiastic, Jana is a model student in school. Her science teacher described as a student to "clone" and a student who "has it all." Jana and her sister spend an equal amount of time with both parents, though her parents are divorced.

When we first met Jana in the fifth grade, she was excited about science, and she remained excited about science through middle school. In particular, she was interested in learning more about different technologies, such as electric cars, for helping to make the environment better, and to create jobs in her community. According to Jana, science and jobs went hand in hand because through science, new ideas can be created to build new things. She refers to herself as hardworking, and "an educated person who cares." When asked about science in school, Jana referred to it as a class she needed to meet her future career goals, which were to be an engineer "maybe for a car company," an environmental lawyer, a doctor, or a singer. She had to do well—"get all As"—if she was going to get a scholarship for college and be ready for the science classes there.

For a young person, Jana is confident, serious, and wise. Her father is an elementary school teacher, which might help to explain the importance she places on school. Her mother is a secretary in the city's transportation department. Jana is also matter-of-fact and shows depth of thought and conviction in her opinions. For example, when talking about reducing one's carbon footprint as related to family size in Green Club (a community-based science club), Jana opined that people should "think seriously before they have children, especially if you['re] not gonna spend time with them."

Jana's Narrated Identities-In-Practice. Jana narrates an identity in science that sometimes, but not always, distinguishes between "science" and "school science." She has a vast interest in

science, describes it as part of her future, and has told us that what she learns in class is essential to meeting her goals. The overlap appears to have more to do with the content of what she is learning in science, whereas the non-overlap has more to do with purpose or outcome. For example, Jana often told us or wrote about the overlaps between what she learned outside of school and school science in ways that were oftentimes synergistic for her science future. In a reflection on science learning from eighth grade, she wrote that "[after school science club] helped me with measuring and finding area, which I did not know how to do before [I joined the club]. In science, it helped me with understanding the atmosphere and the importance of carbon dioxide. This year in school, we are talking about the hydrosphere, the geosphere, and the atmosphere, and I feel like I already have a handle on that because of [after school club]." Jana rated herself a 6 out of 7 for science, noting that she did not always do well on the tests, even though she completed all of her work.

Jana's Embodied Identities-In-Practice. Jana embodies the traditional "good girl" student identities-in-practice in her school science classroom. She enacts and is recognized as a very good science student, a hard worker, and a smart student. Jana's science teacher, Mrs. C, is thrilled with her. Mrs. C told us, "If I could clone her, I would." In our observations, Jana was consistently one of the target students Mrs. C called on for answers and with whom she had extended discussions, in a whole class context. For example, in a class where the students were learning about infectious diseases like leprosy, Jana participated in the following ways: she shared a story about being out with her dad and meeting a man with a condition that looked like leprosy; when asked by Mrs. C about what stood out to her in the article they were reading about the disease, Jana talked about how interesting it is that the armadillo is a vector for the disease, and the fact that the article was talking about leprosy "in the 1600s, not today. That was a long time ago." Later, Jana discussed with Mrs. C why she thought people with infectious diseases should not be excluded from society:

> Mrs. C to class: What do you think about people being quarantined?
> Jana: I don't think people should be quarantined because we are all humans. Plus the evidence in the book said most people don't get it from others.
> Mrs. C: Ok, would you be ok sitting next to someone with an infectious disease?
> Jana: Yeah, the book said 90% of people are immune to it. It is not fair to remove all the people.
> Mrs. C: What about chicken pox? If you had an infectious disease that could be cured, should you be quarantined until you are cured and no longer contagious?
> Jana: I think yes and no. Yes because it is a short period of time. I said no because just because you are sick you shouldn't have to stay away from people.

Although she is sociable and has many friends in school, Jana often chooses to do independent work in the classroom. She is meticulous and always on-task, often working quietly by herself until the teacher calls the class together again.

At Green Club, however, Jana seems to be bolder in asking for different forms of participation, and always chooses to work in a group with friends. For example, Jana's after school club hosted a community forum on alternative energy, which was attended by several experts on renewable energy and green jobs. The purpose of this forum was for youth in the after school club to learn more about what was going on in their own community related to green energy. Before the session youth were asked to construct questions for the experts, so they could be sent to the experts in advance, helping them plan what to share with the youth. When the day of the forum arrived, Jana decided she had more unanswered questions. She picked up a note pad and immediately began to

construct her own question. She raised her hand and interjected her question to the experts in the following exchange:

> Jana: Why do you think green energy is so important to the earth and the economy?
> Kyle (Wind expert): Which question number is that [in reference to the list of prepared questions]?
> Teacher: Jana just added that.
> As Kyle and the other experts began to answer her question, Jana interjected again, and the following exchange took place:
> Jana: On the news they're talking about the car industry (inaudible) bankruptcy and people from [State] are trying to go to Washington (inaudible) bail them out. Do you think that since the GM and Chrysler . . . do you think because of the machines they put in to take away people's jobs and they cost money, do you think that's part of the reason why they're going into bankruptcy and that's why people don't have a lot of jobs?
> Leroy (Energy Expert): Well, that might be part of it. I also think that cars (inaudible) cars that are selling right now are like electric hybrids.
> Dennis: Fuel efficient cars [. . .].
> Leroy: How do we do it? Exactly what you guys are doing. Making PSAs. Doing what you're doing. Especially students, like you guys. People don't necessarily have the time to make those calls. You know what you want? Get the phone number and call. And keep doing those PSAs.
> Leroy: So think out of the box.
> Jana: I was gonna ask you, do you think after like, well, after, do you think, do you think that the people like at GM and stuff, do you think that like if they do get this bailout, do you think they're gonna start paying more attention to the economy and build more fuel efficient cars or do you think they're just gonna take the money?

Later, after the session, Jana sought out Leroy to learn more about the auto bailout and how it was impacting the auto industry and their ability to invent newer, greener cars. At the next after school club session, Jana arrived with a letter she had composed to Leroy and asked the teachers to mail it for her. A portion of letter read as follows: "I am interested in the car industry. I am worried that if the car companies fail, alot of people will lose their jobs. But on the other hand, if we do give them the bailout will they build fuel-efficient cars or will they stay the same and not improve on the fuel efficiency of the car. I have question to ask you: Do you think that we should give GM, Ford, Chrysler the bailout? Why or why not?"

This is not an isolated incident for Jana. She was instrumental, for example, in persuading two peers to conduct a light bulb audit of her school to determine if switching from incandescent to compact fluorescent bulbs would save the school enough money to keep their after school programs running. She and two other girls created a short video about their audit, arranged to share their video with the student congress at their school (with the help of the school principal), and got every member of the student congress to sign a pledge that they would get their school's bulbs changed. She suggests that these investigations, and resulting science movies, provide others with the evidence they need to persuade them to make a change. As she told us: "What you have to do is to convince people. First of all, you have to have a plan and you have to stick to it and be determined. After you have that figured out, you get the proof, then make a video and then back it up with information, and then show it to the highest people in charge."

At Green Club, Jana's embodied identities-in-practice include leader, community science expert, creative Green Club member, and very smart girl. In addition to engaging in practices that

author these identities-in-practice, Jana is also recognized by others at Green Club (and the Boys and Girls Club) as a youth who embodies these identities.

Relationships Between Jana's Narrated and Embodied Identities-In-Practice. While Jana is rather assertive in after school Green Club, taking up a position as a science expert who can converse on a level field with scientists in her community, she is rather quiet at school, carefully taking notes, and offering ideas in class that contribute to (rather than challenge) the teacher. This suggests to us that Green Club figured worlds (that include carrying out scientific investigations with peers, presenting PSAs to local experts, talking to community members) have provided opportunities for her to enact identities that are more commensurate with her narrated descriptions of herself. While she made the connection between doing well in school and learning science content as a part of who she desired to be, she did not always connect her big ideas for using science to make a difference in the world with what she learned in school. In fact, Jana noted that one big difference between school and after school was the opportunity to do "science that matters," "science that is real," and "research" that she can share with others. This is different from school where her work focuses on "just learning." She also felt that her after school club made science more real because she met "people in different careers, and really just see all the different ways the environment and engineering are involved. The Surplus and Recycling Center, the hydroelectric power plant in [location], the solar panels and wind turbines. I got to see how all of this green energy stuff is happening right here." These real connections between science and her life in her local community gave science an authenticity that had deep salience for her. Supporting Information Figure S2 provides a visual representation of relationship type 2.

Relationship Type 3: Conflicts Between Narrated and Embodied Identities

Overview. In this section, we look at relationship type 3: conflicts between narrated and embodied identities-in-practice. As we illustrate with the case of Eunice below, this relationship pattern suggests that there are significant differences between who the girls say they are and want to be in science and how they practice who they are and want to be in science. For the girls who fall into this category, we note the following characteristics:

- First, in terms of identifications and recognition, the girls in this category *view themselves* as good in science out of school but are mixed about their in school performances. They are rarely recognized for what they know and can do in school science settings, even when their performances suggest such recognition is warranted.
- Second, in terms of priorities and performances, all of the girls in this category figure science as a place to figure things out about their worlds, to solve problems, and to be curious. These girls prefer to spend time and value problem solving more than getting a good grade.
- Third, in terms of movement of resources and practices across spaces, the girls author agentic roles in science when they find personally relevant connections to it. Often times, these contributions are not recognized by the teacher and the girls are not socially positioned as the experts they desire to be.
- Lastly, the gaps between narrated and embodied identities are fairly broad, and neither the teachers nor the girls appear to have the tools to close the gap. A particular challenge here is that these girls tend to eschew being a "good girl" (doing the work as required for the good grade) in favor of problem solving. While the girls' embodied identities-in-practice support meaningful engagement in science, the structure and/or expectation of the classroom environments prevents these more authentic actions from positioning the girls as knowledgeable/experts, severely limiting opportunities for recognition work.

Introducing Eunice—Who Aspires to Be a Veterinarian, Olympic Swimmer, or Actress. Eunice is a skinny girl from a very low SES family, who self identifies as "mixed race." She lives with her mother, one brother, and two sisters in what she refers to as an old house. Eunice often looked tired to us, especially in the morning class periods. We noticed that she often sought out the free yogurts and fruit provided by Mrs. D at the science lunch club. Mrs. D brought these snacks in because she worried the girls did not eat enough, as several eschewed the school lunch. Mrs. D was particularly worried about Eunice. She frequently pointed out to us how tired Eunice looked, and wondered to us about the kind of support that Eunice received at home. Mrs. D also took up a collection during the 2010–2011 school year among the sixth grade teachers in order to get Eunice a gift card for a popular clothing store. When we asked why she did this, Mrs. D told us that she noticed that Eunice wore the same clothes everyday, and worried about both the social and personal health implications of doing so. We, too, noticed that Eunice wore the same threadbare winter coat all through the long winter season, and then even on warm days in April.

While talking about herself in science in our interview with her in the seventh grade, Eunice said that science makes her "hungry" because some activities of her science class used food, such as candy pretzel chips and M&M's. Eunice's mother, who was pursuing a degree at a local college, valued education and wanted her four children to do well in school. Eunice said, "[My mom] hates it when we get in trouble [at school]. My brother and sister are grounded right now for getting Ds." Eunice wanted to follow in her mother's footsteps, aspiring to attend her mother's alma mater, a small local college serving nontraditional students. Eunice joined Mrs. D's science lunch club in her seventh grade year, and continued to come in her eighth grade year. She could not attend family science nights because she did not have any adult family member who could come with her. Eunice still managed to achieve all A+ grades in science. In her seventh grade year, Eunice said that she wanted to be an Olympic swimmer, actress, and veterinarian all together because she was interested in all of them. In eighth grade, Eunice said that she wanted to be an actress.

Eunice's Narrated Identities-In-Practice. Eunice recognizes that her mother wants her to do well in school, and she has been making an effort. She has a clear goal of going to college just like her mother. Eunice opened an interview conversation with us by expressing her strong wish to get an A in science. She said, "I am getting a B in science. I'm trying to get to an A, so I'll have five As and one B." Eunice ranked herself 6 out of 7 in terms of how good she is at science because she did not have an A at that point. She picked two other female peers as ones who would be ranked as 7 because "[they] are very smart, and they'd rather do work than watch a movie." Eunice was also a committed group member. She explained in an interview how she was upset when her alarm failed to work and she missed school because she was working on a project with her small group.

Eunice narrates a strong science identity-in-practice as a curious inquirer and careful observer who is impressed by nature. She wrote in her science notebook, "Science to me is universal. It can be about all different kinds of stuff [. . .] Rockets, astronauts, scientists more all related to science. As a matter of fact without science there would be no solved mysteries in life. I enjoy experiment[ing] in science." In her digital stories in the both seventh and eighth grade years, she plays the role of a reporter who documents activities happening in detail. She filmed various kinds of outdoor scenes (including a swan on the lake, her brother's fishing, movement of clouds in the sky, a squirrel and a spider, a burnt house in her neighborhood) while narrating the detailed observation about each phenomenon on the scene for the audience. For example, Eunice filmed clouds observed through the window of her old house in three clips of movie, narrating the changes of its shape, size, and movement: "There we have a bigger cloud, Huge! Look at that funnel! This cloud is big. This is all one cloud, ladies and gentleman! [. . .] No certain changes occur. Just

moving and spinning, apparently. You gotta look at it closely, though. As a matter of fact I am zooming in."

Despite her stories describing the "amazing" and "mysterious" science found in nature and her exciting experiences outdoors, Eunice also narrated science as "both fun and boring" mostly in relation to her experiences at school. On the one hand Eunice is "always happy whenever [she is] having experiments." On the other hand science is "hard" and makes her "angry" if she "has to read this huge packet and remember what you read."

Eunice's Embodied Identities-In-Practice. We observed Eunice in both her formal science class and informal lunch science club over 2 years. We also observed her periodically in the lunchroom with her peers. Eunice continuously made an effort to be—in the practices she engages in—a student who is good at science and who makes important contributions both in the figured worlds of science class and lunch science club. For example, during whole class lectures, Eunice regularly put up her hand to ask questions or share comments. In small groups, she is an interested and committed group member. However, in spite of her actions, Eunice was not recognized as a smart science student by her teachers or peers. Thus, even as Eunice tried to embody positive science identities-in-practice such as hard working and inquisitive, these embodied identities-in-practice were not validated by other members of the figured worlds. As a result, Eunice repeatedly tried to approach the adult authoritative figures, such as teachers or researchers, to let them know the good work she has done/is doing. For example, in one lesson on rainfall, students, working in small groups, predicted the number of water drops cotton balls could absorb until the cotton balls began to "drizzle," before the actual measurement. After the experiment Eunice voluntarily and proudly told us that her prediction was closer to the actual measurement than her partner's. In another lesson, students worked by themselves in the computer lab to write a paper on the question "How does the sun provide energy to the earth?" After Mrs. D's gave instructions, students began to work. After a couple of minutes, Eunice called Mrs. D to show her a picture that she found on the Internet. This picture illustrated how water circulates from air to the earth, powered by sunlight. Eunice seemed proud that she found this picture by herself and wanted to show it to Mrs. D. However, Mrs. D, who had already given detailed instruction on how to write the essay at the beginning of the class, was frustrated. Mrs. D told Eunice in a rather stern voice, "How does this picture help you to provide answers?" Eunice did not answer, and Mrs. D said, "Listen. You should answer to the question of the essay topic, not explain the water cycle itself." Eunice deleted the picture from the paper after this conversation. At the end of the marking period Eunice and a few other students asked Mrs. D about their grades. Mrs. D found that Eunice earned A+ grades in science and every other subject except social studies, and expressed her surprise. Mrs. D commented to us that Eunice's grades were quite impressive and that she would never expect such stellar grades from her.

Eunice worked hard to make connections between her interest, experiences and what was being studied in the classroom. However, for Eunice, these connections were not always valued by her teacher and peers in productive ways. Sometimes, such as in the example, which follows, her teacher did pick up on the connection, but ultimately used this connection in a way that (we believe unintentionally) positioned Eunice in a negative way. For example, during the invasive species unit, Mrs. D was describing to the class how the problem of invasive species was "close to home" with some of the problems the Lakes were experiencing due to shipping channels. Mrs. D told a story about a boat coming from Spain to get iron ore pellets from the state's northern region. Eunice energetically raised her hand to contribute. When called upon, she told a story about a shark that was released into one of the major lakes. Many of her classmates laughed at the story. The story was entertaining, but the laughter suggested the students found the story

unbelievable. Mrs. D, however, supported Eunice and told the class that Eunice's story was a good example of how invasive species are sometimes introduced to new environments, even if the shark could not survive in the lake. This led to further commentary by Mrs. D about why sharks could not survive in the great lake, and why sharks would never be an invasive species in the lake. Thus, even though Mrs. D acknowledged Eunice's contribution, Eunice was inadvertently pegged as the girl who told implausible stories, instead of someone who could engage in science discussions.

Eunice was an active participant of Mrs. D's lunch science club in both seventh and eighth grades. She was the one who always raised her hand first whenever Mrs. D asked questions or volunteers to help. Eunice shared a lot of science-related stories from her everyday experiences exuberantly, such as dead fishes in the tank that she saw at the local grocery market and hot air balloons that fly up high in the sky. For example, when Mrs. D and the girls in the club were talking about planting flowers and the function of water, it was Eunice who suggested doing an experiment that would compare the longevity of flowers in water with flowers in a soda drink, which became a club activity the following week. Despite her persistent efforts to participate, Eunice's stories from her outdoor experiences often ended in silence during classroom conversations. Her stories seemed to elicit discomfort from her peers as they were usually dramatic and dealt with violence, risks, and survival (such as almost getting electrocuted on a power line)—issues that featured in her personal life—living in an extremely poor neighborhood that had many burnt houses, spending most of her time hanging around those neighborhood after school. While Mrs. D tried to create a more student-friendly and informal atmosphere during the club by waiving regular classroom norms such as hand raising and waiting to be called on, Eunice persisted in these school practices rather than quickly adapting to the new practices of the club, which again made Eunice's ways of participating feel odd to the other members.

Relationships Between Eunice's Narrated and Embodied Identities. Despite Eunice's persistent attempts, she did not seem to be successful in performing the kinds of identities-in-practice that she narrated across school and her lunch science club. Her narrated identities-in-practice were contradictory to her embodied identities in that no one ever thought or described Eunice as a good science student, nor recognized her excellent performance in science. Eunice was quite knowledgeable about fish, insects, and squirrels as demonstrated in her digital stories. She was also a keen observer and deeply appreciative of her everyday experiences with nature. Her embodied identities-in-practice that were authored through her participation and social interaction with people in her particular school contexts were contradictory in terms of her actual school performance, interests, and participation. Instead of being recognized as a curious, keen, and high-achieving science student (with consistent A+ grades), she was positioned by both her science teacher and her peers as a somewhat strange African American girl who told peculiar stories, and who did not get along well with others. More significantly, and sadly, Mrs. D did not seem to notice Eunice's consistent A+ grades in science. Indeed, Mrs. D seemed stunned by them.

Eunice's narrated identities-in-practice changed in her eighth grade year along with her embodied identities-in-practice. During an interview in her eighth grade year, Eunice stated that she still wants to be an actress. However, the STEM-related career aspiration—being a veterinarian—was not included in her stories any more. She still described science as both fun and boring. But Eunice's school performance in science was much lower than her seventh grade year (she got Cs in science in her eighth grade year), and nobody in her school thought that Eunice was a smart science student. Supporting Information Figure S3 provides a visual representation of relationship pattern 3.

Relationship Type 4: Transformative Relationships Between Girls' Narrated and Embodied Identities

Overview. In this section, we look at relationship type 4: transformative relationships between girls' narrated and embodied identities. As we illustrate with the case of Kay below, for the small set of girls in this relationship pattern, we have noted that who girls say they are and want to be (narrated identities-in-practice) and how they practice this (embodied identities-in-practice) informs the other iteratively in positive ways. We also note that the informal figured worlds play a critical role in this transformation. For the girls who fall into this category, we note the following characteristics:

- First, in terms of identifications and recognition, the girls in this category enjoy science but they do not necessarily view themselves as good in science either in or out-of-school. Early on in middle school, these girls were rarely recognized for what they know and can do in science in school settings, although they do strive to be recognized. However, over the course of middle school this pattern changed, as the girls became recognized for their out-of-school performances in science. Most, but not all of the girls are recognized for their success in non-science-related activities, such as art, music, sports, or social life.
- Second, in terms of priorities and performances, the girls in this category figure science as a place of learning ideas and taking action on things that matter. The typical dimensions of school science that play pivotal roles in dominant views of success are not a part of how these girls figure science, either in or out-of-school. They do not perform in class with a goal of getting good grades, even if their grades do concern them. They are most interested in doing science "that matters."
- Third, in terms of movement of resources and practices across spaces, the out-of-school figured worlds serve prominently in supporting the girls science success, and this seems to be because these spaces allow girls to leverage their non-science expertise to address science issues that matter in their community (see points 1 and 2 above).
- Lastly, the relationships between narrated and embodied identities are *strongly productive*, in that they reinforce one another to both sustain and deepen the girls' desire to pursue an STEM-related career.

Introducing Kay—Who Aspires to Be a Medical Doctor. Kay is an African American girl who was the youngest to join the informal science club called Green Club in the summer of 2007, which was held at her local boys and girls club. She was 10 years old when she came to Green Club in the middle of an intensive 5-week program. In spite of being the youngest and joining Green Club midway, Kay was neither shy nor retiring. On her first day at Green Club, she chose a group of girls to work with and sat down at their table. She immediately turned to one of the teachers and asked purposefully, "So, what are we doing today?" That day, the youth were in the midst of their initial investigation into whether River City was an urban heat island, and were preparing to conduct an ethnographic investigation in downtown River City to ascertain if members of the community were aware of it being an urban heat island. Kay jumped right into the planning on her first day and ended up being the reporter for her group's 8-minute mini-documentary on urban heat islands.

For the past 6 years, Kay has attended an arts-focused middle school that lies adjacent to the Club. It is therefore easy for her to walk to the club after school lets out every afternoon. She describes school as "sometimes interesting but mostly boring." Sociable and vivacious, Kay is popular among the youth at the club and counts many of the youth who attend the club her friends. She is never lacking in confidantes. She can be loud and short-tempered at times, but she is also

quick to make up with friends. She is an avid consumer of popular culture, adept at social networking sites such as MySpace. In her second year at Green Club, Kay's mother had a new baby whom Kay was expected to help care for. Their housing situation was also in flux at that time and Kay was shuffled between staying at her grandmother's house (which was fairly near the Club) and staying with her mother and siblings wherever their temporary abode may be at the moment. Her attendance at Green Club during this time was more erratic but she made an effort to attend as many sessions as she could. When it became apparent that Kay's mother could not spare her babysitting help, Kay asked the teachers at Green Club for help in transportation so that she could keep attending the club. In this way, Kay was able to keep up her participation and engagement at Green Club.

During her 3rd year at Green Club, the uncertainty in Kay's life increased. Her family experienced extreme upheaval due to the economic downturn and other personal crises. Kay turned to e-mail (using a computer at her school) and text messages (on friends' phones) to keep in touch with Green Club instructors. Usually she would ask what was up each week and about rides home from the club. She would sometimes ask for homework help or for help mediating school requests with her mother (i.e., calling and explaining the value or importance of certain activities, and so forth). Kay's school grades suffered during this time, falling from straight A's to primarily B's, throughout this prolonged time of uncertainty in her personal life (e.g., no stable housing). However, Kay maintained her enthusiasm and confidence at Green Club and towards the value of schooling.

Kay's Narrated Identities-In-Practice. Kay narrates an identity-in-practice in school as someone who is bored with science, and bored with school. She feels that she does not do anything interesting in school, or in school science. However, in the years, we have known Kay, she has also consistently narrated a future identity as a doctor. Interestingly, she also speaks constantly of the value of schooling (in contrast to the "boredom" speech) and articulates a plausible path towards medical school by first attending a local community college.

In the figured worlds of Green Club, Kay narrates an identity of someone who is a "make-a-difference" expert. In her description, she is such an expert because she creates videos and public service announcements to educate her community about important socio-scientific issues such as energy conservation and the urban heat island phenomenon. Kay opined that the work she is doing, and has done so far in Green Club could be something that students read about in a social studies textbook in her school someday.

Kay's Embodied Identities-In-Practice. Kay started off as an 'A' student in school science as a fifth grader. However, she experienced significant upheavals in her personal life, which negatively impacted her performance in school. By the time she was in seventh grade, her grades had slipped to a 'C' in science and a 'D' in math. Kay's science teacher, Mr. A, called her a "big behavioral problem." We describe Kay's participation in a science class that is representative of her participation that year in school science. The class was learning about planets, and consisted of the students independently reading information from a textbook and answering questions.

At the start of class, Mr. A had trouble getting the students to settle down and start work. Students were chatting and not paying much attention to him. Kay was rocking back and forth in her seat and passing notes with a female classmate sitting near her. Mr. A gave a general warning to the class and then singled Kay out with this admonishment, "Ms. Kay, the conversation we had yesterday will go into effect today. No more warnings." Kay was upset that he picked on her and retorted with "Mr. A, why aren't you yelling at anyone else?" The teacher did not reply. Kay then gets into a "you-shut-up" match with a male student.

The class finally settles down and Kay opened her book to work on the questions. She concentrated on working by herself for the next 17 minutes without talking to anyone. Kay gets up to go to the bathroom before returning to continue her work. A boy who uses the bathroom after her starts teasing her rather cruelly, saying loudly, "Dang woman, what did you do in there?" Other classmates laugh at her. Kay, clearly embarrassed, retorted with "Nothing, I didn't even do anything!" When her classmates continued to laugh at her, she switched tactics and tried to laugh alongside with them before resuming her work, leaving her classmates to continue their jeering. While still working, Kay calls out to Mr. A, "Do you see this?," using her index finger to draw a circle in the air around her desk, thereby asking the teacher to recognize her hard work. Mr. A recognized her efforts with "Yes, you are getting some work done today. I did notice that." Kay then asked Mr. K a question.

> Kay: Mr. A, what is Io?
> Mr. A: It is pronounced I-o
> Mr. A.: [walking over to Kay] Did you find it?
> Kay: Yep

After this exchange, Kay then helps a female classmate locate the answer for I-o. The class packs up and gets ready to transition to Mathematics.

At Green Club, Kay was an active participant and part of the core group of Green Clubbers. For example, Kay created several science artifacts at Green Club, including a mini-documentary on urban heat islands, a public service announcement on the energy crisis (which was shown on a local television channel) and conducted community "needs assessment" surveys on what people know about greening their city, analyzing the results and presenting the results, with recommendations on how to increase public awareness of these issues to the mayor's office.

Kay was especially proud to be one of the presenters at the mayor's office, reporting on a "needs assessment" survey findings regarding community member's energy practices. The purpose of the needs assessment survey was to determine what River City residents knew of the city's Go Green initiative and to identify some important awareness activities the city might do to help educate River city residents about the importance of the Go Green Initiative. The Green Club youth conducted 187 surveys in four locations in the city, analyzed their results using the program Microsoft excel, and then prepared a PowerPoint presentation showing their findings and suggested recommendations for the mayor's office. In the audience were members of the mayor's office and representatives from the public bus company, Board of water and light, as well as a local Recycling services company. Kay appreciated being able to be a presenter at a "professional" setting (another unique figured world of Green Club) at the mayor's office. She said she was "proud to be there," that she was "nervous" in the beginning but very "excited." She appreciated having met the different adult representatives and felt that what she had to say to them was important. She was especially proud to be one of two youth chosen to hold the plaque that the mayor's office awarded the Green Club for their contribution towards greening River City.

Kay played key roles in all these Green Club projects. Her embodied identities included group leader, investigator, interviewer, scriptwriter, narrator, researcher, and presenter. In short, Kay delved completely into the scientific tasks at Green Club in her all-rounded engagement and in so doing, authentically authored and embodied the identity of a community science expert.

Relationships Between Kay's Narrated and Embodied Identities-In-Practice. We first see how Kay had very different embodied identities-in-practice in Green Club and in school science. She also narrates her identities-in-practice differently in these two figured worlds. However, she is

consistent in her narrated future goal to be a doctor, and we see she is aware that she needs to succeed in school science in order to do that. There are transformative relationships between Kay's narrated and embodied identities (Supporting Information Figure S4). Although we do not see very explicitly how she imports Green Club expertise into school science, we do see her trying to get teacher recognition for her work in science, in repositioning herself and authoring a more teacher positive identity to shed the "big behavioral problem" identity. We also see how Kay's narrated identity as a future doctor causes her to seek out plausible paths forward. At Green Club, where outstanding youth have the opportunity to apply for a competitive scholarship to a residential summer science and engineering program at a local university, Kay lobbied hard for why she should be the one chosen to go, even though she may not be the most outstanding Green Clubber. Kay made her case so well with the Green Club teachers, the boys and girls club President, and the professor in charge of the science and engineering summer program that she did end up being selected for the scholarship. Since she is more obviously successful in the figured worlds of Green Club versus school science, Kay had more agency to position herself at Green Club in seeking for opportunities that will aid her goal in becoming a medical doctor. Supporting Information Figure S4 provides a visual representation of relationship pattern 4.

Discussion

Addressing the Identity Gap: The Importance of Paying Attention to Middle School Girls Who Articulate a Future Self in Science

Previous research has shown that the majority of girls do not identify with science, even girls who do well and achieve good grades in science (e.g., Fordham, 1996). It has been argued that girls choose not to go into science because it is too masculine, clinical, impersonal, or individualistic—characteristics that are in sharp contrast to the soft, feminine qualities that girls purportedly value and embody. Many studies have shown that this masculine–feminine dichotomy is too essentialistic and simplistic an explanation. However, these same studies argue that we would be remiss to ignore the very real and pervasive power relations inherent in the culture of school science that often marginalizes girls and inadvertently renders them as spectators on the sidelines (Brickhouse, 2001; Brickhouse, Lowery & Schultz, 2000; Carlone, 2004; Eisenhart & Finkel, 1998).

Our investigation reveals that girls in middle school with STEM-related career aspirations identify with, and participate in science in many different ways. As part of these aspirations, they have narrated a possible future in science that both aligns with, and contradicts these stereotypes. We echo the call by Brickhouse and colleagues (2000) that individual stories "about the diverse roles and paths girls take" (p. 442) need to be told as race, class, and socioeconomic status of girls interact in complex ways to influence how they engage in science. The girls in our case studies developed identities-in-practice in science through the stories they narrated about themselves and through their performances. How these stories and performances were recognized by others across the figured worlds in which they have membership was critical to how girls moved forward (or not) with an interest in science. Such recognition work was mediated through racialized and classed (as well as gendered) experiences and assumptions of who these girls are and want to be.

Our approach to making sense of the relationships among narrated and embodied identities-in-practice helps to provide more nuanced explanations as to why it may seem that not as many girls are interested in science, or why the girls who are interested may not pursue opportunities to increase their success in STEM trajectories (as evidenced in course enrollment, compensatory experiences, etc.). We think this is especially important when considering issues of girls leaving the STEM pipeline at every juncture (Bickenstaff, 2005) and the lack of representation of minority

women in STEM and STEM-related careers, that we pay close attention to middle school girls who *do* articulate a possible future identity in STEM-related fields.

In many ways, we view this problem as that of an "identity gap." In other words, we believe that our data show that while many girls do well in middle school science and profess an interest in an STEM trajectory, school science has not yet provided the tools or resources to help girls reconcile who they are and want to be with what they do (and think they should do) in science class. Understanding the articulation, or lack thereof, between narrated identities—who I think I am and want to be, and embodied identities—what I do, is critical to designing better learning experiences for girls interested in science.

Indeed, interest in science has been shown to be a product of children's experiences by a very young age, between 4 and 7 (Alexander, Johnson & Kelley, 2012). Based on interviews with 116 scientists and graduate students, it has also been reported that 65% showed interest in a future science career before middle school and 30% in middle and high school (Maltese & Tai, 2008). Lindahl (2007) found in a longitudinal study with Swedish youth that their career aspirations were largely formed by age 13, and that it would be progressively more difficult to engage students in science. Such data point to the importance of not making light of career aspirations articulated by youth before they enter high school or college, if we are serious about addressing the identity gap. It is therefore crucial to understand the formative experiences of youth and their career aspirations between the ages of 10–14 and to elucidate how to support their aspirations and interest in science, particularly those of girls (Archer et al., 2010).

We have worked with just such a cohort of case study girls in this study—middle school non-White girls who narrate a possible future identity in STEM-related fields. In teasing out and juxtaposing their narrated and embodied identities-in-practice in both formal and informal science, we have gained a more nuanced understanding of the relationships between these identities and the implications these relationships surface for us in terms of supporting the girls' STEM trajectories. Below we discuss three important considerations which emerge from our findings: the role of salient figured worlds, the role of institutional narratives, and the significance of contentious local struggles in girls' identity work (history-in-person).

How Girls Become Interested in an STEM-Related Career—The Roles of Salient Figured Worlds

Across the cases, the girls narrate science identities-in-practice such as curious learner (Eunice and Jana), hard worker (Jana, Meg, Kay), and bored student (Meg, Eunice, Kay). They also all narrate possible future identities as an STEM-related career professional—environmental engineer (Jana), veterinarian (Meg and Eunice), and medical doctor (Kay). The girls developed their STEM-related career aspirations from various experiences not necessarily based in school science. In fact, none of the 16 case study girls invoked any significant experiences in school science that triggered their STEM-related career aspirations. *Inspiration for STEM related careers for all of the girls in our study—except those in relationship category #1, significant overlaps—arose from success in figuring science in out-of-school worlds in ways that positioned them as smart, capable and powerful girls with relevant ideas and experiences*.

The science that the girls get to figure across home, informal science and school science were different. Most of the 16 case study girls spoke of the role of family as important inspiration, citing familial role models in their relatives (uncles, mother, and sister) who work in science-related fields. Family members with STEM careers serve as role models to whom the girls could ask questions about specific science careers. For example, Markel (a case study student not discussed above) has two uncles who are doctors with whom she spends her school holidays in Ghana. Markel credits her uncles with her interests in science and her ambition to also become a medical doctor.

For girls that fall under the partial overlap and transformative relationship categories, they often cited the role of an informal science club like Green Club, where positive experiences have led them to consider possible future identities as green energy engineers. While we agree with Swarat, Ortony and Revelle (2012) that "hands on" activities and opportunities to interact with technology strongly affects students' developing interest in science far beyond content topics or specific learning goals, we believe that, in addition to these activities, it is the unique affordances and resources in the figured worlds of home and informal science club that helped these girls develop an interest in a possible future STEM-related career. The less hierarchical, more flexible and youth-centered norms that undergird the figured worlds of informal, community-based science clubs like Green Club supported and broadened ways of engaging in science for girls like Jana and Kay. Across the figured worlds at Green Club, they researched science phenomena, conducted experiments, collected and analyzed data. They also could sing songs, choreograph dances, write raps, make movies, engage in conversation with adult experts and local government authority figures both in and out of the club space, *while learning and teaching others* about green energy issues. These are the actions they took (and the embodied identities-in-practice they authored), and the figured worlds of Green Club supported these actions (and embodied identities-in-practice), i.e., Green Club figured worlds facilitated youth infusing art and other interests into science, in addition to more "plain" investigative science where youth designed and carried out experiments. Or take Nan, for example, who did investigations with plants in her lunchtime science club, and told stories of growing and cooking with traditional Vietnamese greens at home. Over time, she later designated herself as the plant caretaker in her science classroom, with teacher supported. The affordances to engage in home gardening and kitchen science in Nan's home figured worlds translated into resources for her in the science club figured world.

For girls (e.g., Jackie and Janis, in addition to Jana, Kay, and Nan) who are in the partial overlap and transformative relationships groups, we see a continuous feedback loop between their embodied identities-in-practice (mediated by activities and people in informal science figured worlds) and their narrated identities-in-practice as their possible future selves expanded to include careers that merge an array of interests with STEM. For example, Janis (see Table 2, under "Transformative mode"), a very quiet African American sixth grader when she first joined Green Club, had an ambition to be an artist and was not particularly interested in science. Janis joined Green Club at the behest of her mother. However, after using her considerable artistic talents consistently in Green Club projects (supported by Green Club's figured worlds) Janis blossomed to become a leader in Green Club, becoming more vocal and interested in the science content. Among her many creative Green Club projects (which garnered both admiration and validation from Green Club peers and teachers) was a rap she wrote on climate change that won a statewide competition. In seventh and eighth grades, Janis expanded her career ambitions to include becoming a Green energy engineer, in addition to an artist. Janis also became more vocal and confident in her school science participation, speaking up more often with both questions and answers and asking her school science teacher questions related to Green Club science investigations. It is plausible that Janis's school science embodied identities-in-practice transformed in part due to the science positive, Green Club embodied identities-in-practice she was concurrently authoring. This positive feedback loop was also evident in her narrated identities-in-practice, when she started seriously considering a future career as a Green energy engineer.

Although the school science figured worlds we observed (including small group work and whole class settings) did not directly inspire STEM-related career aspirations in the girls of our study, it is critical to note that school science experiences played important roles in sustaining the interests of girls if and when the girls' experiences in school science drew upon their out-of-school interests and experiences (e.g., Jana, Carly), or if the girls viewed the work of school science as

important to their career trajectory (e.g., Meg, Lin). However, when school science did not recognize or support girls' identity work, then school science appeared to facilitate STEM minded girls in moving away from their envisioned STEM-related trajectories (e.g., Eunice—conflict), unless they had access to other sources to help them sustain their interest (Kay—transformative). Without additional support for identity work, it is less likely for even STEM minded non-White girls, especially with African American and low SES backgrounds, to pursue STEM trajectories given the current institutional, historical, cultural narratives and limited resources for identity work provided by school science.

The Role of Institutional Narratives on Girls' Designated Identities as Future STEM-Related Professionals

Just as girls' narrated identities-in-practice of a "smart girl," "community science expert" and "future doctor" enable them "to cope with new situations in terms of past experiences and helps [them] plan for the future" (Sfard & Prusak, 2005, p. 16), institutional narratives in the forms of grades, certificates or a teacher's labeling of a student wield much power in reifying or supplanting girls' embodied identities-in-practice. We see how Kay's positive experiences and recognition by authority figures (club teachers and President of the Boys and Girls Club) at Green Club served to reify and strengthen her narrated and embodied identities-in-practice, acting as positive reinforcement between what she narrates herself to be and the practices she can actually enact at Green Club, that align and "flesh out" her narrated identities-in-practice. These contextual science identity resource—specific only to the figured worlds of Green Club—further serve to encourage her continued pursuit of a future identity as a medical doctor, in spite of considerable obstacles from her unstable home life and the negative institutional narratives in the form of her formal school science teacher's pronouncements of her lack of ability and in her less than stellar grades in school. Kay repeatedly discusses, with Green Club teachers, possible routes to achieve her goal. She plans to attend a community college to take more science classes before transferring to a 4-year college. Even as the negative institutional narratives appear to erode her path towards her possible future identity as a medical doctor, Kay is bolstered by the positive institutional narratives from Green Club to continually seek out a path for herself. The question is how long she can continue to do that, and to what extent such alternative (non school-based) science experiences can sustain her in persevering with school science, the ultimate gatekeeper.

Institutional narratives from school also appeared to have supplanted Eunice's actual embodied identity-in-practice as someone who enjoys science and who is good at science, as well as her possible identity of a future veterinarian. Mrs. D. was surprised when she looked at Eunice's grades to realize that she is an A+ student, and Eunice's peers did not recognize her work and accomplishment in school science or in the lunch science club. Her teacher is consistently worried about Eunice's situation—having no clean clothes and a lack of parent support for school work—but these worries seem to eclipse the teacher's ability to see what Eunice has brought to science, and what she has done with the few resources she has. Eunice's case is especially troubling because, in spite of her embodied identities-in-practice as a serious science student who is both interested and who succeeds in authentic, inquiry-based science both in terms of how she participates and in the A+ grades she achieves, she remains invisible to both her science teacher and her peers. Without institutional support, it is difficult to imagine how Eunice could sustain and advance her pursuit of an STEM-related trajectory. Oyserman et al. (2006) have found that youth tend to commit to a sustained, self-regulatory effort to a possible self when there are strategies and social context supports working on that possible self. Eunice appears to lack such support.

In Meg's case, however, institutional narratives in the form of good grades (A+) and Mrs. D's glowing opinion seem to obliterate the fact that she did not, as far as we can tell from our 2-year

observations, embody identities-in-practice of an authentic science learner in either formal school science or the science lunch club. By conflating her school-based identity with her school science identity (i.e., not distinguishing between the practices of science as a discipline with other school subjects), Meg authored an embodied identity-in-practice in school science as a student whose sole concern was getting all the answers on a test correct, seemingly with or without real understanding of the material. In lunch science club, Meg authored an embodied identity-in-practice as a disinterested participant, probably because no grades were handed out and she was not genuinely interested in the investigations at hand. The cases of Eunice and Meg not only highlight the importance of the impact of institutional narratives on girls' possible future identities in STEM-related fields (and their identity trajectories), they also illustrate the insights we gain when we tease apart narrated and embodied identities-in-practice.

In the cases of Eunice and Meg, if we focus solely on the girls' narrated identities-in-practice and the most obvious institutional narrative of their performance in science—their science grades—we would see two non-White girls who both made A+ grades in science and who both aspire to become veterinarians. We may conclude that both girls must be sufficiently equipped, at least at this stage of middle school, for continued success in their STEM trajectory since they are doing well (on paper) in science, and that it is heartening that at age 13, they have STEM-related career aspirations. In reality, Meg seems equipped for success given both her stellar science grades, teacher support and recognition even as she seems to lack genuine interest in science and also deeper knowledge and practices of science. Yet she is considered, and has the narrated identity-in-practice of a successful, science student. On the other hand, Eunice, who as far as we have evidence for, both narrates and embodies (though without validation, and therefore, without success) the identities-in-practice of an authentic science student who actively engages in meaningful science activities, is not recognized nor given any level of institutional support by the same science teacher. For Eunice, excelling in science tests and achieving the top grade is still insufficient to garner her any resources (e.g., teacher recognition) that could position her as a more powerful member of the science classroom figured worlds.

Eunice and Megs' cases also highlight the importance of not homogenizing them as "minority girls." The school both girls attend is racially segregated in that students group themselves into affinity groups with other students of their own race and ethnicity, with very clearly defined power dynamics. The dominant group of students is White and working to middle class. Eunice's embodied identities-in-practice as an African American girl from a very low SES household with particular struggles positioned her negatively with her peers and science teacher, who chose to focus on and reify these aspects of Eunice's identities-in-practice rather than the ones of her as an A+ student and a curious science learner. After constantly being sidelined, Eunice seemed to "give up" her possible future of a veterinarian in eighth grade, narrating only a possible future identity as an actress. Why are Eunice's background identities (low SES, African American ethnicity) more immediately visible and dominant, compared to her embodied science identities-in-practice, such that they eclipse her positive science identity work? We suggest that perhaps stereotype threat is at work here. Perhaps to Mrs. D and the other students, it is improbable that a poor, African American girl like Eunice can excel in science. Stereotype threat may also be at work in Meg's case. Meg, who is ethnically Chinese and adopted into a White middle class family, is recognized by her peers and teacher as someone very good in science, possibly due to them subscribing to the myth of the "model minority" (Chou & Feagin, 2008). Being ethnically Chinese, Meg may have the attributes of a model minority ascribed to her, regardless of whether she possessed them or not. Asian model minority identities such as "very hard working," "family values education," "higher I.Q.," "whiz kid" (Lee, 1996) may have been conferred on Meg by Mrs. D and her peers. No doubt, her identity as a "Math genius" may also have influenced such

perceptions. Thus perceived, Meg is a high achieving student (confirmed through test scores) whose excellence in science is expected and normalized. It is not our intention to trivialize Meg's many excellent school abilities—her efficiency, Math competencies and task-oriented nature. However, we argue, even as Meg is *lacking* in the deeper knowledge and practices of authentic science, she appears to have both familial and institutional (school science) support in her narrated possible science trajectory to become a veterinarian.

The Significance of Contentious Local Struggles—History-In-Person—in Supporting Positive Relationships Between Girls' Narrated and Embodied Identities-In-Practice

Across the four relationship patterns we also see how contentious local struggles exert a significant influence on both the nature and the extent of positive relationships between girls' narrated and embodied identities-in-practice. These struggles are made manifest in the tensions between who girls are (as defined by their race and class) and want to be, and the expectations of who they should be (or ascribed to be), according to normalized, institutional scripts. Jana's case illustrates one way in which these tensions can play out. Although Jana maintains her enthusiasm in both the figured worlds of Green Club and school science, we see differences in her embodied identities-in-practice in the different figured worlds. Jana's narrated identities-in-science as a hardworking, "educated person who cares" and who is deeply interested in science is embodied in qualitatively different, figured-world-specific identities-in-practice, aligned to the norms and perceived expectations of each figured world. In school science where students are expected to adhere to certain behavioral codes, Jana embodies the good girl student to such a high standard that Mrs. C wished she could be "cloned." Jana is thus regarded as the "perfect student" and recognized as such (much like how Meg is recognized by Mrs. D). Such recognition by the authority figure reinforces the embodied identities-in-practice Jana authors in the science classroom figured worlds. While Jana displays obvious enthusiasm in her participation (unlike Meg), she is careful to "stay within the classroom lines" in her modes of participation. This can be seen in how she chooses to do individual work (which is Mrs. C's preferred mode of student participation) and generally does as she is told. She does embody the identity of an "educated person who cares," as evinced in her discussion with Mrs. C about how society should treat people with infectious diseases. However, we argue that we are witnessing a somewhat diminished version of Jana's abilities and potentials in science as she so carefully hews to the norms of the classroom figured world. The expectations of how a good student should be seem to have constrained the kind of embodied identities-in-practice Jana authors in the science classroom. It can be argued that Jana, a student her teacher clearly adores, is someone well positioned to take the risk in authoring new embodied identities-in-practice in school science through asking for opportunities to engage in "science that matters" and "science that is real" (refer Case 2, what Jana said) like in Green Club. However, inspite of her favorable positioning and high regard from Mrs. C, Jana did not have absolute freedom to author herself, reflecting the struggles inherent in history-in-person, the silent, historical backdrop of institutional and personal struggles that inevitably contained her sense of agency.

We see how Jana's narrated identities-in-practice are embodied differently at the after school Green Club figured worlds. In this context, there appear to be less of a struggle between institutional norms (at the Boys and Girls Club serving predominantly, >90%, non-White youth) and who Jana can be in Green Club. The culture, rules and norms of being at Green Club are grounded in the values of the Boys and Girls Club, where youth interests and agency are highly emphasized and leveraged upon. It is also important to note that not only in the figured worlds of Green Club but also in the figured worlds of the larger Boys and Girls Club (where Green Club is housed), Jana is a youth with much positional authority, popular with both peers and club teachers.

With these institutional, relational, and positional resources at her disposal, it is not surprising that Jana embodied identities-in-practice at Green Club that are both scientific but also youth-centered, drawing on other talents and interests such as dancing and movie-making.

Similarly, in the figured worlds of Green Club, Kay was supported in reifying and reinforcing her narrated identities-in-practice through repeatedly authoring embodied identities-in-practice that positioned her as someone capable and knowledgeable in science, who has a possible route to becoming a medical doctor. In the figured world of school science, however, Kay had to contend with the other identities-in-practice she embodied—those of an "off task" student, that were difficult to dispel, in spite of her efforts. She was constrained in how she could figure science in school.

Jana and Kay's cases raise the question of why interactive feedback loops between girls' narrated and embodied identities-in-practice look so different between informal science figured worlds and formal classrooms. Connected to stereotype threat previously discussed, it seems plausible that both race and class impacted the nature of relationships between girls' narrated and embodied identities-in-practice, particularly in the school science-figured worlds. Returning to the cases of Eunice and Meg, we see Eunice, who self identifies as "mixed race" but is recognized as "African American" from a family with a very low socioeconomic status. Meg is ethnically Chinese and comes from a middle-class White family. Both girls make A+ grades in school science, both articulated future STEM-related careers as veterinarians, but only Meg's grades and embodied identities-in-practice as a "good science student" is validated by Mrs. D and her peers. Eunice's struggles to be recognized as a good science student yields no results. Similarly, Kay, who is African American and from an equally challenging family background as Eunice, is labeled as a behavioral problem by Mr. A, at the same time that Kay is engaging in robust science in the Green Club figured worlds. At Green Club, where most of the youth are African American and non-White, Kay's ethnicity and class status may not be so pronounced as to immediately elicit stereotype threat, including race and class based judgments. Jana, who is also African American but who comes from a (divorced but stable) middle class family, garners support from both Green Club and school science figured worlds. As these cases illustrate, issues pertaining to stereotype threat, race and class need to be more critically examined as they can severely affect girls' science identity work, contributing to the "identity gap" problem. These cases further challenge us to think about how formal classroom figured worlds, with the specific nature of local struggles, could be transformed into a hybrid space that go beyond reform-based curricular that more readily facilitates girls' cross-leveraging of identities and resources across figured worlds (see Figure 2).

Conclusions and Implications

In the current climate where women and especially non-White women are under-represented in the STEM fields, it seems particularly important that we pay attention to the science education of all girls, and especially girls who do narrate possible future identities in STEM and STEM-related fields. This study raises two important issues for us that require continued attention. First, in teasing out the relationships between girls' narrated and embodied identities-in-practice, we are better informed on the mechanisms inherent in the contentious local struggles that reflect the particular contexts and histories of each girl that can significantly affect how they are supported in their science engagement and possible future science trajectories. Without uncovering and understanding these mechanisms, these girls who, on paper, make outstanding science grades and articulate future career goals in STEM-related fields, could be considered exemplary female science students who are "on track" and who need no special attention, when in fact, they very much do. Our study reveals the necessity to dig deeper into *how* high achieving girls in school science are actually engaging in the processes of authentic science, and what teachers can do to

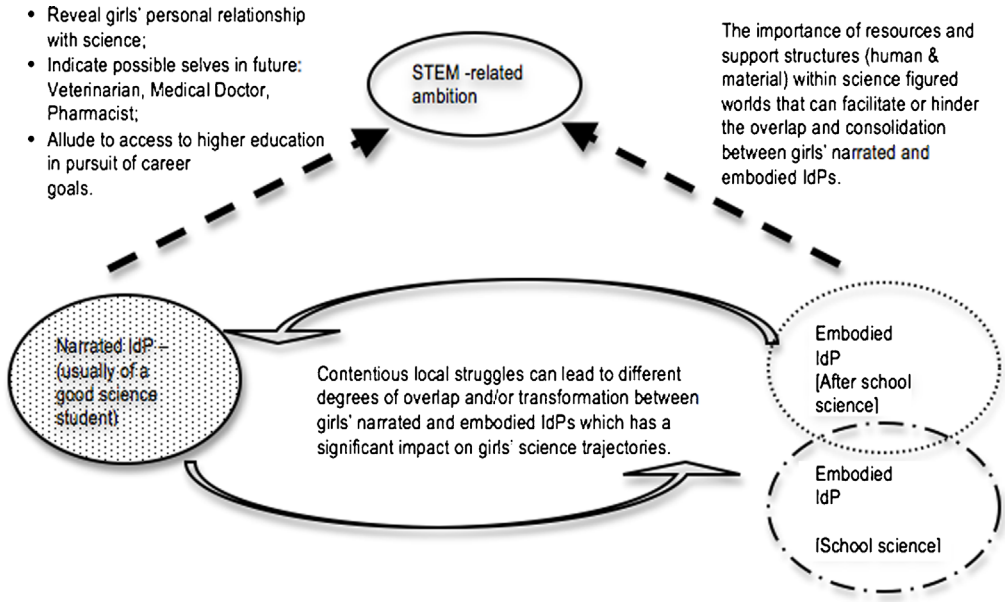

Figure 2. Insights about the relationships between non-White middle-school girls' narrated and embodied identities-in-practice.

encourage and strengthen a robust engagement. A science achievement grade snapshot taken in seventh grade will show Eunice and Meg both as A+ science students. However, as we have shown, the girls' embodied science identities-in-practice, and their potential to sustain their career goals and achievement in science are vastly different. Connected to this point, our study also highlights the need to reconsider what counts as authentic learning outcomes in school science that extend beyond test scores.

This brings us to the second issue. If we are serious about supporting girls in science in both encouraging and keeping girls in the STEM pipeline, it is incumbent upon us as science educators, researchers, and teachers to rethink what we really mean by equitable experiences when considering science education reform that support girls. We have to bear in mind the complex and ineluctable entanglements between girls' engagement in science and their racial/ethnic identities, socioeconomic status, personal struggles and how these factors play out daily against historical institutional struggles as girls negotiate for meaningful science participation in their science classrooms and other science-related figured worlds. Our study has illustrated how such entanglements can play out and the consequences to girls' sustained interest and performance in STEM. While it is heartening that Mrs. D showed her care for Eunice with a faculty-sponsored gift card to a clothing store, we argue that it would have been even more empowering to Eunice, had Mrs. D engaged with her in school science in ways that recognized and validated the positive embodied identities-in-practice Eunice was trying to author. We also want to point out that explicitly being aware of, and paying attention to race and class issues, prejudices and stereotype threats is critical for all students, even those who are seemingly doing very well and fully supported. For example, it would have been immensely beneficial to Meg if Mrs. D had been more observant of her embodied-identities-in-practice and challenged her to engage more deeply in hands-on activities by asking her more scaffolding questions during these activities, in addition to grading the "final product" worksheets Meg is so adept at excelling in. Meg should be held

accountable both to the practices of science as well as to content knowledge mastery (albeit narrowly gauged through standardized tests, in Meg's case). For a girl who desires to be a veterinarian, Meg would have been better served if she learned how to engage in authentic science practices in middle school instead of merely questing after the right answers. Such pedagogical support, and in turn, teacher support to develop the ability to render such pedagogical scaffolding, is particularly necessary in light of the Next Generation Science Standards (2013) that call for an in-depth knowledge of connected core-concepts, demonstrated in inquiry-based science and problem-solving engineering practices.

To better support STEM minded girls to pursue their career, we recommend that science teachers pay close attention to the institutional narratives created in their own science classroom, and how these narratives are applied to different girls. It is challenging for science teachers because institutional narratives are not only affected by the norms and expectations of the activities with teachers' pedagogical decisions, but also reflect the historical and cultural practices of sciences that are normalized in a particular way. Attending to and recognizing those narratives, however, provides opportunities for science teachers to shift the discourses at the classroom level. We also recommend science teachers and teacher educators to take recognition work seriously to support STEM minded girls, as girls' identity work necessitates such recognition to be reified. Providing equitable experiences involves both creating porous hybrid spaces where girls can leverage various resources from other figured worlds as well as supporting girls' agency to maintain, build, and re-author possible selves in pursuit of an STEM-related career. These experiences can include expanding learning outcomes beyond paper and pencil assessments to more holistically and rigorously capture and build on girls' science engagement and identity work.

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. The authors would like to thank the *JRST* editors and reviewers for their insightful comments.

References

Alexander, J., Johnson, K., & Kelley, K. (2012). Longitudinal analysis of the relations between opportunities to learn about science and the development of interests related to science. Science Education, 96(5), 763–786.

American Institute of Physics. (2012). Statistical Research Center. Retrieved from http://www.aip.org/statistics/

Anderson, G. L. (1989). Critical ethnography in education: Origins, current status, and new directions. Review of Educational Research, 59(3), 249–270.

Archer, L., Dewitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2010). "Doing" science versus "Being" a scientist: Examining 10/11-year-old schoolchildren's constructions of science through the lens of identity. Science Education, 94(4), 617–639.

Archer, L., Dewitt, J., Osborne, J., Justin, D., Willis, B., & Wong, B. (2013). 'Not girly, not sexy, not glamorous': Primary schools girls' and parents' constructions of science aspirations. Pedagogy, Culture & Society, 21(1), 171–194.

Bickenstaff, J. C. (2005). Women and science careers: Leaky pipeline or gender filter? Gender and Education, 17(3), 369–386.

Brickhouse, N. W. (2001). Embodying science: A feminist perspective on learning. Journal of Research in Science Teaching, 38(3), 282–295.

Brickhouse, N. W., Lowery, P., & Schultz, K. (2000). What kind of a girl does science? The construction of school science identities. Journal of Research in Science Teaching, 37(5), 441–458.

Brickhouse, N. W., & Potter, J. T. (2001). Young women's scientific identity formation in an urban context. Journal of Research in Science Teaching, 38(8), 965–980.

Brown, B. A., Reveles, J. M., & Kelly, G. J. (2005). Scientific literacy and discursive identity: A theoretical framework for understanding science learning. Science Education, 89, 779–802.

Buchmann, C., & DiPrete, T. (2006). The growing female advantage in college completion: The role of family background and academic achievement. American Sociological Review, 71, 515–541.

Calabrese Barton, A., Kang, H., Tan, E., O'Neill, T., & Brecklin, C. (2013). Urban girls identity trajectories through the participation between figured worlds. American Educational Research Journal, 50(1), 37–75.

Carlone, H. B. (2004). The cultural production of science in reform-based physics: Girls' access, participation, and resistance. Journal of Research in Science Teaching, 41(4), 392–414.

Carlone, H. B., Haun-Frank, J., & Webb, A. (2011). Assessing equity beyond knowledge- and skills-based outcomes: A comparative ethnography of two fourth-grade reform-based science classrooms. Journal of Research in Science Teaching, 48, 459–485.

Chou, R. S., & Feagin, J. R. (2008). The myth of the model minority: Asian Americans facing racism. Boulder, Colorado: Paradigm Publishers.

Digest of Educational Statistics. (2009). Percentage of persons age 25 and over and 25 to 29, by race/ethnicity, years of school completed, and sex. Retrieved from http://nces.ed.gov/programs/digest/d09/tables/dt09_008.asp?referrer=list

Eisenhart, M. A., & Finkel, E. (1998). Women's science: Learning and succeeding from the margins. Chicago, IL: University of Chicago Press.

Fordham, S. (1996). Blacked out: Dilemmas of race, identity, and success at Capital High. Chicago, IL: University of Chicago Press.

Gibbons, M. T. (2011). Engineering by the numbers. Retrieved from American Society of Engineering Education (ASEE): www.asee.org/papers-and-publications/publications/college-profiles/2010-profile-engineering-statistics.pdf.

Goffman, E. (1959). The presentation of self in everyday life. Garden City, NY: Doubleday.

Holland, D., Lachiotte, D., Skinner, D., & Cain, C. (2001). Identity and agency in cultural worlds. Cambridge, MA: Harvard University Press.

D. Holland & J. Lave (Eds.), (2001). History in person: Enduring struggles, contentious practice, intimate identities. Albuquerque: School of American Research Press.

Kane, J. (2012). Young African American children constructing academic and disciplinary identities in an urban science classroom. Science Education, 96(3), 457–487.

Lave, J., & Wenger, E. (1991). Situated learning: Legitimate peripheral participation. Cambridge: Cambridge University Press.

Lee, S. J. (1996). Unraveling the "model minority" stereotype: Listening to Asian American youth. New York, NY: Teachers College Press.

Lindahl, B. (2007). Alongitudinal study of student's attitudes towards science and choice of career. Paper presented at the 80th NARST International Conference, New Orleans, LA.

Maltese, A., & Tai, R. (2008). Eyeballs in the fridge: Sources of early interest in Science. Annual Meeting of the American. New York, NY: Educational Research Association.

Markus, H., & Nurius, P. (1986). Possible selves. American Psychologist, 41, 954–969.

Milgram, D. (2011). How to recruit women and girls to the science, technology, engineering, and math (STEM) classroom. Technology & Engineering Teacher, 71(3), 4–11.

Nasir, N. S., & Saxe, G. B. (2003). Ethnic and academic identities: A cultural practice perspective on emerging tensions and their management in the lives of minority students. Educational Researcher, 32, 14–18.

National Center for Education Statistics. (2007). National assessment of educational progress report. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2009a). NAEP high school transcript study 2009. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2009b). Digest of educational statistics 2009. Washington, DC: U.S. Department of Education.

National Center for Education Statistics. (2010). Digest of educational statistics 2009. Washington, DC: U.S. Department of Education.

Next Generation Science Standards. (2013). Next Generation Science Standards. Retrieved from http://www.nextgenscience.org/next-generation-science-standards

Oyserman, D., Bybee, D., & Terry, K. (2006). Possible selves and academic outcomes: How and when possible selves impel action. Journal of Personality & Social Psychology, 91, 188–204.

Price, J. F., & McNeill, K. L. (2013). Toward a lived science curriculum in intersecting figured worlds: An exploration of individual meanings in science education. Journal of Research in Science Teaching, 50(5), 501–529.

Rahm, J., Martel-Reny, M. P., & Moore, J. C. (2005). The role of afterschool and community science programs in the lives of urban youth. School Science and Mathematics, 105(6), 283–291.

Sadker, D., Sadker, M., & Zittleman, K. (2009). Still failing at fairness: How gender bias cheats boys and girls in school and what we can do about it. New York, NY: Simonand and Schuster.

Seiler, G. (2013). New metaphors about culture: Implications for research in science teacher preparation. Journal of Research in Science Teaching, 50(1), 104–121.

Sfard, A., & Prusak, A. (2005). Telling identities: In search of an analytic tool for investigating learning as a culturally shaped activity. Educational Researcher, 34, 14–22.

Swarat, S., Ortony, A., & Revelle, W. (2012). Activity matters: Understanding student interest in school science. Journal of Research in Science Teaching, 49(4), 515–537.

Tan, E., & Calabrese Barton, A. (2008a). Unpacking science for all through the lens of identities-in-practice. Cultural Studies of Science Education, 3, 43–71.

Tan, E., & Calabrese Barton, A. (2008b). From peripheral to central, the story of Melanie's metamorphosis. Science Education, 92(4), 567–590.

The White House. (2012). Education: Knowledge and Skills for Jobs of the Future. Retrieved from http://www.whitehouse.gov/issues/education/educate-innovate

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web-site.