

Fighting for Desired Versions of a Future Self: Young African American Women's STEM-related Identity Negotiations in High School

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Abstract: In this paper, we investigate how the national narrative of increasing opportunities for and broadening participation of young women of color in STEM was taken up locally at one racially-diverse, urban high school. Using ethnographic and longitudinal data, we focus on two young women of color as they negotiated and maintained STEM-related identities in the discursive and practice contexts of their lives at school. Using Holland and Lave's concept of history-in-person (2001), we view the young women as fighting for particular versions of a future self, while entangled in discursive and social relations that threatened to position them differently than they wished to be. Our findings suggest a need for an explicit naming and examination of the "double bind" that young women of color experience as they move through school environments and special support to prepare them for the challenges they may face in STEM-related college programs or workplaces.

Keywords: youth identities, STEM education, urban education, social practice

Introduction

Katie sat across from me (Allen), her face bright with enthusiasm, hands pressed against the tabletop as she leaned forward into the conversation. It was the summer after Katie's senior year in high school. We were sitting together outside a Starbucks near her home, and she was in mid-story explaining why she had decided to pursue a degree in engineering:

[In AP Calculus] we started doing these revolutions about y and x axes. If you look at a graph, and you take a three dimensional shape - like a cone or a cup - and you want to know the volume, you can put it on a graph and you can calculate the volume from revolving it around an x or y axis...it was a really hard math concept, but it was also one of the only exciting ones...it was just so exciting for me! So I started thinking, Where can I do this [kind of math] all the time?...I started talking to my dad and he was like, "Well engineering is somewhere where you could do this...if you want to do the math all the time, then go into engineering."

As an African American female, Katie's tenor as an excited and interested young woman in pursuit of math knowledge and an engineering career tells a story that contradicts the dominant historical narrative about women of color in STEM (science, technology, engineering, and mathematics) in the United States. This narrative positions females of color (Black, Latina, and Native American) as *disinterested*, *underprepared*, and unlikely to pursue STEM or succeed in these fields (Ong, Wright, Espinosa, & Orfield, 2010). Throughout high school, however, Katie took advanced STEM courses, achieved high grades in these classes, and in college she pursued a STEM-related degree. In fact, in our five-year longitudinal, ethnographic study, we observed a trend similar to Katie's across the majority (18) of our 23 female participants. These young women expressed interest in STEM-related fields at the start of high school and maintained that interest into their first year of college.

One way we could interpret the successes of these young women is to say that they were aware of and intentionally resisting the historical narrative regarding women of color in STEM that positions them as something other than what they were or wished to be. After all, their actions and self-descriptions reflect alternatives to the ways that national narratives position them. This interpretation is in fact how we approached our analysis initially. However, as we began to look more closely at the lives of these young women throughout high school, what we found instead was that their fight was not with this national narrative, but with local school narratives that negatively positioned students of color more broadly and remained silent on issues of gender, the intersection of gender and race, and the implications for STEM.

In this article, we illustrate the local struggles these young women engaged in to construct and maintain STEM-related identities in the context of their high school lives. In particular, we focus on the local discourses

and practices of one school learning environment within and against which two of the young women in the larger study engaged in STEM identity work.

Conceptual framework

Following Holland and Lave's development of the concept of "history in person" (2001), we view the young women in our study as engaged in a struggle with historical narratives about the trajectories of women and people of color within STEM. That is, when young women of color consider possible futures in STEM, their efforts can be viewed as a struggle or fight "for particular versions of the future" (Holland & Lave, 2001, p. 28), and for particular versions of a *future self*. When young women of color construct science, engineering, or math identities in school, they must do so in the presence of robust and enduring narratives and practices that may define them in ways they do not wish to be. Similar to other identity work, these self-negotiations are continually contested in local practice "as history is constituted in the space that encompasses both social participation and self-authoring" (Holland & Lave, 2001, p. 29). In this article, we examine how social participation and self-authoring in school can be 'pulled through time' into STEM interest, identity, and pursuit.

As one example of a historical structure of privilege, schools "infuse and restrain local practice" (p. 5) in ways that have consequences for how students come to view themselves and author selves within STEM. In particular, research points to academic, social, structural aspects of the school learning environment that negatively impact the experiences of women of color within STEM. For example, schooling practices can make it seem that science is the province of people who are privileged in society—upper middle class, White, and male (Bang, Warren, Rosebery, et al., 2013; Carlone, et al., 2014). School science is often treated as neutral with respect to cultural and social experiences (Bang et al., 2013), and instruction tends to focus on achieving established answers in uniform ways (Calabrese Barton et al., 2012; Carlone et al., 2014). Such practices shape students' views of *who* or *what* is "scientific" and whether they fit such depictions.

As young women negotiate STEM identities in their schools, they can also carve out spaces for new or different storylines (Holland et al., 1998). In their analysis of middle school girls' identity work across multiple social contexts (such as the classroom and an after-school program), Calabrese Barton and colleagues (2012) describe the case of Chantelle, who, by the end of the study had developed a self-identity as someone who might pursue a career in science. An African American girl and someone who aspired to be a dancer and singer, Chantelle was positioned by her teacher as "a student in the middle," "easy" because of her quiet and compliant behavior in class, and as someone who "struggled" with content, particularly in math. However, her active membership in an after-school science club supported Chantelle in successfully positioning herself as someone who was "hard working" and "engaged in science," as she presented to her class what she was learning about energy efficiency in the after-school club. Further, in their analysis of the identity work of successful women of color in science, Carlone and Johnson (2007) found that undergraduate women with an "altruistic" science identity broke from the historical script of those who pursue and succeed in science. By emphasizing their commitment to serving others over more familiar characteristics of a scientist, they created spaces for constructing a different kind of science identity.

Examining students' instantiations and negotiations of STEM selves within their learning environments offers one way to theorize how to better support females of color in STEM fields and in their pursuit of STEM careers, while highlighting the work these students must engage in to answer hegemonic institutional practices and the historical narratives that allow these practices to persist. This is our primary aim here. Further, by following young women's STEM identity negotiations through high school and into college, we have a view of STEM identity development during a crucial moment in young people's lives.

Methods

This article employs an embedded multiple-case methodology (Yin, 2013) to explore (1) the ways that the historical narrative regarding STEM and STEM pathways gets taken up in local discourse and practices at the young women's high schools; (2) the kinds of identities these women construct over the course of high school and into college; and (3) how these young women instantiated and negotiated STEM identities in the context of their schools.

Research context

The study described in this paper comes from a larger longitudinal and ethnographic study examining high school STEM opportunity structures and students' figured worlds of STEM (see Eisenhart et al, 2015) in Denver and Buffalo. The ethnographic study took place between 2010-2013 in eight high schools (4 in Denver, 4 in Buffalo) that served mostly students of color and mostly students on free or reduced-price lunch. Both authors participated

actively in collecting and analyzing these data. In 2014 and 2015, we conducted follow-up surveys with students to learn about their post-high school graduation experiences (college choice, major in college, work experience).

Near the start of the larger study, in late 2010, the research team recruited approximately 12 focal students (ages 15-16; 6 girls and 6 boys) from each of four high schools in each city. The intent was to follow closely the focal students' experiences in STEM from 10th through 12th grade. The focal students were selected from volunteers among the largely minority population of students who were in the top 20% of their high school class in math and science based on their grade point averages (GPA) and scores on state standardized proficiency tests after their first year of high school (9th grade). The research team chose high-achieving students in math and science because they seemed the most likely to be interested and to participate in STEM education opportunities offered by the high schools.

Participants and school site

We selected the two students highlighted in this article through a multi-stage process aimed at identifying representative cases of young women of color who succeeded in high-level STEM courses and anticipated pursuing a STEM-related college major. First, we created a data display for all female participants in the larger study; the data display included students' demographic information as well as characteristics we identified as important to students' STEM authoring and positioning in school. These included STEM courses taken, years of STEM courses taken, grades in STEM courses, anticipated college major from 10th-12th grade, post-secondary plans (as of grade 12), and actual post-secondary decisions (during their first year post-high school). From this table, we identified students who took STEM courses all four years of high school and who maintained interest in a STEM major through their senior year of high school. From this list, we then selected underrepresented students of color (Black or Latino students), excluding those who were White or Asian. This list included seven students from three of the four Denver schools. We selected for comparison cases 4 students (2 Latinas, 2 African Americans) from the two high schools that were most comparable in terms of graduation requirements, Advanced Placement (AP) and advanced course offerings, and strong school leadership: Capital and Southside. In this paper, we present the case of Katie and Naomi, two African American females from Capital who elected to study engineering in college.

Data collection and sources

Data for this analysis were collected over a 5-year period: students' second year of high school (grade 10, 2010-11) through their second year of college (2014-15). During the students' high school years (Years 1-3 of the study), the research team conducted face-to-face student, parent, and school personnel semi-structured interviews, observed selected math and science classrooms, and collected students' high school transcripts. Interviews typically lasted 45-60 minutes in length and were recorded and transcribed. During the students' first two years after high school, online surveys were administered to all student participants. These data sources are described in more detail below.

Students in the study were interviewed 5 times over the course of the three-year ethnographic study: once during the spring of 2011 (Year 1), and then in the fall and spring of following years (Years 2 & 3; 2011-2013). The Year 1 (students' 10th grade year) spring interview focused on establishing a baseline of students' perceptions of their schools and themselves as students at the school. Students were asked to describe their school, their academic strengths, the courses they were taking and how they decided on those, and what they intended to study in college. During Year 2 (students' 11th grade year), interview questions asked students specifically about their views of math and science, characteristics of those who are good at math and science, and students' views of themselves in relation to these ideas. In the spring of Year 2, students were additionally asked about their plans for college applications and college majors. Interviews in the final year shifted to college plans and preparation. Students were asked if they still intended to study a STEM-related major, what colleges they had applied to, and, in spring, what their final post-high school plans were. Because of their involvement in an earlier analysis, one of the participants discussed in this paper - Naomi - additionally participated in a follow-up phone interview during the spring of their freshman year in college (Year 4 of our study). This interview was intended to clarify their decision-making about what colleges to attend and majors to pursue; we additionally asked about what courses they were taking at the time.

Further, we conducted school-personnel interviews, which included math and science teachers, counselors, and school administrators (principals or assistant principals). Math and science teachers who taught one or more focal students at each school were interviewed once per year (Years 1-3), as were the focal students' counselors and school administrators. Interview questions asked about the recent history of the school, views of the school and its students, academic proficiency indicators, opportunities for high achieving students, post-high

school preparation, and graduation and college enrollment rates. We drew on these interviews as a way to identify and later substantiate claims about school practices, challenges, and influential discourses.

In addition to school personnel interviews, we conducted interviews with at least one parent of each student participant each year of the ethnographic study. Parent interview questions asked about parents' views of the school, the students at the school, and their child's experiences at the school; additional questions focused on parents' views of how well the school was preparing students for college and work. These data served as an important additional data source regarding school practices and discourses about the school.

Analysis

Because we were interested in both the ways historical narratives about women of color in STEM were taken up locally at students' schools as well as students' identity authoring and negotiation within these contexts, we conducted our analysis through a multi-stage process. First, we coded student, parent, and school-personnel interviews for views of the student with regard to academics, STEM, future plans, college, how positioned socially and academically, decisions about courses to take, relationships to family, and decisions about major. Compiling these coded data and students' transcript, we developed case summaries for each student that aimed to trace students' positioning, authoring, and interests within school and related to STEM over the course of their high school years. We then created data displays for each student of *critical moments*, *STEM/academic instantiations*, and *college/future instantiations*, organized temporally and based on all 5 years of student data (including student surveys). "Critical moments" were defined as moments that students name as being significant in shaping their interests in, pursuits of, and views of self within STEM. These displays allowed us to identify themes regarding (1) each student's authoring of academic and STEM identities over time; and (2) the schooling practices that students engaged in. After discussing and finding agreement regarding student authoring, we then looked for the schooling practices themes that emerged in the student data within the school and parent interviews to confirm or disconfirm our emerging claims. We discussed each claim, interrogated them for alternative explanations.

Findings

Although we set out to understand how narratives about young women of color were taken up locally in the school's practices and discourses, we found, instead, a dominant school narrative predominantly about race but not gender. The narrative at Capital focused on "decreasing the gap" through recruiting Black students to take more advanced courses and through motivating these students to challenge themselves more academically. Further, Capital's discourse and practices frame the low academic achievement of Black students as a result of students missing or, at times, intentionally skipping opportunities. Additionally, as Katie and Naomi authored themselves as good students, those capable in STEM, and those intending to pursue STEM careers, they had to do this in direct response to and in contrast with the local discourses and practices that positioned them otherwise.

Motivating students to "challenge" themselves

Capital High School serves a diverse population of students (23 percent Latino/a, 45 percent White, 25 percent Black) and was generally known as a "good" school within the surrounding community and the state. Students from Capital performed well, overall, on standardized exams, the school had a longstanding and successful Advanced Placement program, and many students who graduated from Capital continued on to competitive or highly selective colleges.

Although considered academically "successful" and highly ranked, Capital's narrative about students of color manifested in pervasive discourses about the "achievement gap" between students of color and White students. Capital's principal stated:

...if you look at how the kids are scoring on state standardized tests, our Latino and African American students are not testing nearly as high as our White students. And so...we want to fix the gaps here and help kids catch up and be on par with their other classmates...I think it's egregious that our kids...that there are those gaps. (130109_INT)

Naomi's mother (culturally Jewish with children who identify as African American) referenced the achievement "gulf" as a reason she and her husband elected to send their two older sons to a private school instead of Capital: "When we were looking at different high schools, what we kept hearing about [Capital] was that there was this gulf in achievement between the Caucasian students and the minority students" (110727_INT). Further, when Katie was asked why she thought she was often times one of the few Black students in her advanced courses, she responded, "Um, I think that there's definitely...we need to close the achievement gap, because it, like, it's not

because [Black students] are not smart enough to be in these classes... I feel like it, it, has a bit more to do with like, if someone is generally looking out for you" (121130_INT).

The gap was described by teachers, parents, and students as something "egregious," that should be "closed," and that primarily existed because of the low academic expectations students of color, and others, set for them. For example, students of color were described as not wanting to "challenge themselves" and "assuming" they "could not be successful" in advanced courses. As Katie stated in the above text, "most [Black] kids just assume... 'I probably can't [take harder courses].'" And, so, they don't. As we discuss later, Katie's comment points to the important role of social supports in addressing and resisting this historical narrative regarding Black students' academic ability. This depiction of Black students not challenging themselves is further described by Capital's principal:

[We] found that...a lot of kids, especially the minority students were saying, 'I don't want to challenge myself. I'm a B student in middle school,' you know, blah blah blah. And we said, 'you know what, in order to get these kids to try to achieve higher and try to get them in the [AP] class when they're juniors and seniors, we've got to get them to challenge themselves, go into the honors classes, find out that they can be successful and then move up.

Further, Naomi's mother stated, "I wouldn't say that the cultural norm is for there to be high achievement among [Black females at Capital]. It starts with something as simple [as] what classes they sign up for freshman year and whether [the students] are taking advantage of the honors and AP classes" (130109_INT).

However, student course-taking patterns were not simply viewed as an individual choice. Rather, shared ideas about what courses a student should take and the kinds of students who generally take them were viewed as also shaping these decisions. As Katie suggested, students of color hear from "everyone" that they "probably can't" be successful in advanced courses. And, to Katie, students of color hear this "you-can't" message "everywhere":

Allen: So "everyone" in that instance [is who]? Do you feel like it's, like a way that people talk at the school, or-?

Katie: I think definitely [it's the way people talk]; it's also peers, it's...maybe even [students'] parents. It's literally *everywhere*. Like in my speech and debate class, it's been...tons of upper middle class [kids] and...it's been predominantly White. And the teacher last year...she was like, "I'm sick of AP, because if you ask a lot of kids, 'Would you wanna [take AP speech]?', they're like, 'Oh, you gotta have a lot of money to do that.'" (121130_INT)

What's described here by Katie are shared ideas about the kinds of students - White, upper middle class - who take advanced or higher-level courses at the school, and the consequences this has for the Black and Latino students at the school.

One institutional practice that worked to maintain racial segregation at Capital while reinforcing the notion that White students were more academically capable and motivated (i.e., choosing to "challenge themselves") was what the principal called "blockers". Several years before our study, students at Capital had to receive a teacher recommendation in order to register for advanced-level courses: "I remember the first year [I worked at Capital]...the students only got into the [advanced-level] class with a teacher recommendation. Well what happens? Only White kids were getting into the honors classes and [AP] classes" (120120_INT).

At the time of our study, eradicating these "blockers" and encouraging teachers to "recruit" students of color into honors and advanced placed courses had become a school-wide emphasis, at least rhetorically:

So [because teacher recommendation resulted in only White students being in advanced courses], we [the school administration] said, 'No more blockers. If you [the student] feel you are strong enough to [take an advanced course] then [do that].' And we encourage teachers: 'If you see someone, especially a minority student, that you think has some potential, that you think could maybe be successful, to try to encourage them to take [Advanced Placement courses].'
Or encourage them to at least take an honors class. (120120_INT)

And although Capital staff had been working on this issue, Naomi and Katie were still navigating an advanced-course landscape that at least appeared glaringly White. During her sophomore year, Katie stated, "There's a lot

of ...well in some of my classes there are only like 5 Black kids, and I am in all honors classes except for Spanish. In my AP [Geography] class and my advanced Algebra II, I am the only Black kid" (110421_INT_Katie).

Discourses at Capital about the "achievement gap" favoring White students, the shared beliefs about the kinds of students who take advanced courses and eventually attend college, and the institutional practices that tracked students of color into lower-level courses seemed to be consistent with the ways most students of color thought about and navigated academic, and particularly advanced course-taking, decisions. As we will demonstrate further, these local discourses and practices, mediate their practice with a broader historical narrative about the personal shortcomings of students of color at Capital, played a critical role in the self-authoring Katie and Naomi engaged in.

Authoring identities within and against locally-embodied historical narratives

As Naomi and Katie, two young Black women, authored identities as "good students" at Capital, they did so in seeming contrast to the prevailing discourse about the underachievement of students of color and the pattern of racial segregation in advanced courses at the school. Katie and Naomi described themselves as "good students," emphasizing their hard work, enjoyment of learning, and their ability to succeed in their courses. They took honors courses (in various subjects) throughout their four years of high school, and AP courses their junior and senior years. By their senior year they had taken AP or honors Chemistry, AP Biology, or Honors Physics and AP Calculus.

However, in constructing themselves as good students, they drew from the school's discourse about students of color. Katie, for example, authored herself as one of the few Black students to take advanced courses, and as one who was able to overcome institutional barriers and discursive practices that her peers could not. She described other Black students as "believing that they can't do things and [believing] that they aren't smart." In contrast, Katie described herself as capable and not deterred by low grades or challenging courses: "...in some of my classes, like in math, sometimes I don't get the grades that I want, but because I like it so much and really want to understand it, that's what keeps me coming in everyday to my algebra teacher asking for help (110421_INT_Katie). Although Katie characterized other students of color as those who often were not motivated in school and did not challenge themselves, she authored herself as someone who enjoyed learning, wanted to learn more, and was willing to put in the extra effort (e.g. coming in everyday for help).

Naomi similarly drew on the prevailing discourse at Capital to distinguish herself: "I still think [doing math] is fun, and people are like, 'You have *fun* doing your math homework?' And I'm like, 'Yes I do.' People were like, 'The AP Calc[ulus] test sucks so much.' And I was like, 'I kind of enjoyed it.' I don't mind doing three hours of math" (130528_INT_Naomi). In both cases, Katie and Naomi took up the prevailing discourse about the low achievement and motivation of students of color at their school, and they did so as a means of distinguishing themselves from others who shared their racial characteristics. They accepted the denigration of students of color and used it to single themselves out as special.

As Katie and Naomi constructed their identities in contrast to the embodied narratives at their school, they simultaneously did work to support their identities as those good at math and science and capable of going into STEM fields. That is, as these young women authored selves who were good students they aligned themselves with culturally constructed characteristics (and those adopted by these students) of those individuals who navigated both school and STEM successfully. Students who took advanced courses, knew the material well, got good grades, worked hard, and pursued opportunities to learn more were ways that these two described both *themselves* as good students and *others* who were good at math and science.

For these young women, part of authoring a STEM-related identity was instantiating their ability to do well in math and science classes. For both students, math prowess was an integral part of their STEM identities. Consistently the girls authored selves who had natural math ability, being able to "get" math content, and math being a subject that "always makes sense" to them. Naomi, for example, stated that math "comes really easy" for her (121121_INT). Additionally, Katie described herself as "really good in math, the logic [of it]. [I'm good at] looking at a problem and seeing if it makes sense. She also described herself as "liking [math] so much" that she "really wanted to understand it" and so, "that's what keeps [her] coming in everyday to [her] algebra teacher asking for help" (110421_INT). Further, Katie's ability to do well in AP Calculus during her senior year prompted her exploration into (and eventually decision to pursue) a career in engineering. With the support of her father she was able to see the ways that solutions in AP Calculus related to engineering practices. She described working on a problem for class that involved a "really hard math concept" that was "exciting" to her: "...it was just so exciting for me [to work on this problem], and so I started thinking, 'Where can I do this all the time? If I want to do this kind of math, where can I do it?'" Math ability seemed to provide students with an academic leverage that bolstered their engineering identities.

Apparent in both Katie and Naomi's descriptions is an authoring of someone who takes pride in performing well academically and who enjoys learning in STEM, particularly math. These depictions stand in stark contrast to the characterizations of students of color at Capital as those who do not want to challenge themselves or those who take "easy classes" to graduate with higher grades.

Conclusions and implications

Our initial frame of reference for analyzing the two cases described in this article was to view them as examples of young women of color who successfully resisted the historical discourse that positions them as disinterested in STEM or unprepared to pursue STEM in college and beyond. We found that these young women were encouraged to pursue advanced math and science by many of their teachers, administrators, and friends; they took advantage of these advanced course opportunities; and they excelled in them. By the end of high school, both were proud of their accomplishments and still interested in math and science and the possibility of a future in a STEM field. Both had chosen a STEM major in college and were pursuing it at least through their second year of college.

However, from the perspective of Holland and Lave's concept of history-in-person (2001) and in light of our ethnographic data, these young people did not portray themselves as engaged in a struggle with a historical discourse about women in STEM. Rather, their struggle was with racial discourses at school that positioned them differently than they were or wished to be. A discourse about encouraging young women or students of color to pursue STEM was not present at Capital. The women's success in school, particularly in math, and their consequent positioning (qualifications, interests, identities) to go on in STEM were byproducts of their struggles and cultural productions regarding race.

Discourses of racial underachievement, nonetheless, were pervasive at the girls' school. As many other researchers have shown, these discourses affected the students academically and racially (e.g., Davidson, 1996). With a relatively diverse population, students of color at Capital were positioned as underachieving in comparison to Whites: lacking motivation, doubting their academic ability, and missing the social supports needed to navigate high school successfully. Teachers, administrators, parents and students engaged in discourses about the social and academic segregation, de facto tracking, and motivational shortcomings of students of color compared to Whites. The imperative for the school to "fix the achievement gap" was pronounced, but the onus was primarily on the students of color to step up to opportunities provided at school.

In the discursive context of racial underachievement, these young women fought to define themselves as different, i.e., to author themselves as "good students" in contrast to peers who shared their racial designation. They successfully challenged their expected positioning as historically racialized subjects, and in doing so, they gained valuable academic capital. As they enacted good student identities, they simultaneously came to identify as good in math or science or both and to be identified by others as "good students" in part because of their prowess in math and science. But they achieved this identity by accepting the validity of their schools' (and society's) negative representations of students of color as a group. They utilized features of the negative representation to distinguish themselves from their group—to make their racial peers the "other," and to author themselves as better than those others.

In authoring selves in contrast to others at their schools and authoring identities as those capable of going into STEM, these young women did create opportunities for their continued pursuit of STEM. However, their authoring of identities as good students in STEM did not engage with national narratives regarding women of color in STEM or the very consequential reality of the marginalization, isolation, and, at times, outright abuse that women of color often face as they pursue STEM in higher education and careers. We worry about the limited resources these women will have to support them as they try and navigate these spaces in the future. High STEM drop-out or push-out rates among women of color may be one consequence.

Further, with regard to our original aim in this analysis, these findings suggest a need to address the intersections of race, gender, and STEM more explicitly in schools. We wonder what it might have meant for young women in our study to be equipped with an awareness of the "double bind" women of color face (discrimination as a "double" minority) in STEM (Malcolm, Hall, & Brown, 1976; Williams, Phillips, & Hall, 2014); and what it might look like to equip students with strategies that enable them to challenge not just their positioning within local discourses, but to challenge the discourses themselves.

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