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Urban Elementary Single-Sex Math Classrooms: Mitigating Stereotype Threat for African American Girls

Anica G. Bowe\(^1\), Christopher D. Desjardins\(^2\), Lesa M. Covington Clarkson\(^3\), and Frances Lawrenz\(^3\)

Abstract
This study utilized a mixed-methods approach to holistically examine single-sex and coeducational urban elementary mathematics classes through situated cognitive theory. Participants came from two urban low-income Midwestern elementary schools with a high representation of minority students (\(n = 77\) sixth graders, \(n = 4\) teachers, \(n = 2\) principals). Findings demonstrate that African American girls made more math achievement gains in single-sex classrooms; single-sex classrooms might mitigate math academic stereotypes for students and teachers; and that important contextual factors play a role in these outcomes. Testing these factors is a step toward delineating a theory of change for single-sex education in urban public schools.

Keywords
math identities, identity, urban elementary schools, No Child Left Behind, achievement gap, African American students, urban education, single-sex education

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**Context**

Legislation under the No Child Left Behind (NCLB) Act of 2001 was passed in 2006 amending Title IX to authorize single-sex education in public schools as a remedial or affirmative action to improve inequity inside schools (Federal Register, 2006). Two specifics of the amendment were that single-sex education could be offered in schools that received federal funds if the school had an established policy to improve educational achievement through diverse educational opportunities or if it was used to meet students’ particular, identified educational needs. In response to the amendment of Title IX, single-sex education is becoming more present in public schools (Bracey, 2007; U.S. Department of Education, 2005, 2008). The U.S. Department of Education (2008) reported that prior to 2000, there were only six public single-sex schools. More recent statistics from the National Association for Single Sex Public Education show that 560 public schools offered single-sex educational settings, whether in coed or single-sex schools, during the 2011-2012 academic year (http://www.singlesexschools.org).

Attempts to instate public single-sex education in the K-12 schools prior to the NCLB (2001) amendment were considered educational experiments (Boland, 1998). These attempts, often controversial, occurred in urban areas with high populations of minority students (Boland, 1998). Before the amendment, one of the widest scale public implementations of single-sex education was the Single Gender Academies Pilot Program Act of 1996 (Cal. Educ. Code §58524) that was passed to raise student achievement in California. However, a lack of implementation fidelity rendered the experiment somewhat inconclusive (Herr & Arms, 2004). Overall, evidence of the effects of single-sex education remains inconclusive (Bracey, 2007).

One of the difficulties in making an informed decision about single-sex environments is that the research for U.S. schools has not focused on understanding the learning environments that single-sex science, technology, engineering, and mathematics (STEM) classrooms create (Hubbard & Datnow, 2005). Existing research has focused on individual aspects of the environment, but only a few studies (e.g., Hoffman, Badgett, & Parker, 2008; Hubbard & Datnow, 2005) have examined the environment holistically, inductively, or through multiple lenses simultaneously, especially in the case of minority students. Even fewer studies exist at the elementary level.

The present study was designed to provide an in-depth look at single-sex and coeducational urban elementary mathematics classes in two Midwestern public schools. Using both qualitative and quantitative data, this comprehensive mixed-methods approach was designed to provide a holistic year-long
examination of these experiences to identify issues that precipitate due to the context of single-sex learning environments.

Examining Single-Sex Environments: Situated Cognitive Theory

One way to examine single-sex environments is through the framework of situated cognitive theory. According to situated cognitive theory, learning environments play a large role in the learning processes of students, because these learning environments contain social and environmental factors that influence how well students learn (Brown, Collings, & Duguid, 1989). Due the complexities of the learners and their environments, Martin (2012) called for a more integrative approach to traditional approaches such as situated cognitive theory for examining mathematical learning of African American students. Martin suggested that whatever methodological approach is used, it should include a careful examination of identity and how student identities are connected to their knowledge base. In line with his suggestions, this study pays particular attention to administrator, teacher, and students’ beliefs about students’ math abilities using the literature on stereotype, stereotype threat, and math identities as a guiding framework to interpret findings.

Stereotypes, Stereotype Threat, and Math Identities of African American Students

An individual’s beliefs about his or her capabilities are shaped by sociocultural scripts, culturally based stereotypes, personal identities, and perceptions of others (Berry & Thunder, 2012; Nasir, Snyder, Shah, & Ross, 2013; Okeke, Howard, Kurtz-Costes, & Rowley, 2009). Even elementary-aged Black and White students endorse academic racial (Copping, Kurtz-Costes, Rowley, & Wood, 2013) and gender stereotypes (Cvencek, Meltzoff, & Greenwald, 2011). A useful framework for examining the impact of externally imposed academic identities is stereotype threat. Stereotype threat is the experience of being in a situation where one faces judgment based on societal stereotypes about one’s group (Steele & Aronson, 1995). Stereotype threat has been found to affect the academic achievement of minority groups and females (e.g., Kellow & Jones, 2008; Spencer, Steele, & Quinn, 1999; Steele, 1997). It also occurs in testing environments where African American testers may perceive the lower expectations of peers and others present in the testing event (McGee, 2013; Petchauer, 2014).
Teachers may hold stereotypical beliefs about the academic ability of Black students, which can lead to lower expectations (Delpit, 2012; Ladson-Billings, 2009), derogatory stereotypical remarks, and differential treatments (Brand, Glasson, & Green, 2006; Pringle, Lyons, & Booker, 2010). Urban elementary teachers might even neglect to push African American girls into math and science fields because they maintain stereotypical beliefs about the girls’ preferences and interests (e.g., Pringle, Brkich, Adams, West-Olatunji, & Archer-Banks, 2012). Teachers may also hold stereotypical beliefs about the family culture of urban Black students (Lynn, Bacon, Totten, Bridges, & Jennings, 2010). In short, the influences of these racialized scripts at the macro-system level lead researchers and policymakers to conceptualize Black learners at the lowest level in academic ability as compared with everyone else (Ladson-Billings, 2012; Martin, 2009).

Together, these findings suggest that African American students may receive messages of academic incompetency based on race. Furthermore, math is typically perceived as a male-dominated field (Buchmann, DiPrete, & McDaniel, 2008). Thus, elementary African American girls might receive messages of math incompetency based on both race and gender, though some evidence exists to the contrary (Riegle-Crumb & Humphries, 2012).

Academic Self-Concept

Another important identity component is self-concept. Self-concept is an individual’s beliefs about his or her physical, social, or academic abilities (Woolfolk, 2013). An individual’s self-concept can vary by situation and may either plateau or experience a rate of change depending on one’s stage of psychosocial development (Cole et al., 2001). Self-concept is often used interchangeably with self-esteem and self-efficacy, and it has been debated whether or not they are different constructs (Shavelson, Hubner, & Stanton, 1976). The findings of Bong and Skaalvik (2003) and Ferla, Valcke, and Cai (2009), however, demonstrate that distinctions can be made between self-concept and self-efficacy based on the manner in which they are measured (e.g., specificity of task items) and the theoretical frameworks used to examine them. Thus, this study adheres to the definition of academic self-concept as one’s perceived ability in a specific subject area (Marsh, 1990).

Academic self-concept shares a relationship with important education demographics and behaviors. Examples include, but are not limited to, gender and age (Cole et al., 2001; Wigfield & Karpathian, 1991), ethnicity (Singh, Chang, & Dika, 2010), disability status (Zheng, Erickson, Kingston, & Noonan, 2012), special education status (Persson, 2001), and academic anxiety (Ahmed, Minnaert, Kuyper, & van der Werf, 2012). Other demographics...
seemingly important for minority students are parental support, community support, and single-parent versus two-parent households (Sanders, 1998), perceptions of friends’ abilities (Jones, Irvin, & Kibe, 2012), group membership competency ratings (Evans, Copping, Rowley, & Kurtz-Costes, 2011), and vulnerability to stereotype threat (Gerstenberg, Imhoff, & Schmitt, 2012), among others.

Academic self-concept has traditionally been perceived as sharing a positive direct relationship with achievement (Marsh & Martin, 2011) or reciprocal relationship with achievement (Guay, Marsh, & Boivin, 2003). However, interestingly, Ferla et al. (2009) found that academic self-efficacy is a better predictor of academic achievement whereas academic self-concept is a better predictor of affective motivational variables. This inconsistency in findings might be partially due to the manner in which self-concept has been operationally defined, measured, or the theoretical models imposed in these studies.

Studies regarding the academic self-concept of minority students at the elementary level are sparse; therefore, this literature review includes studies from all levels of K-12 education. In addition, the terms self-concept and self-efficacy are often used interchangeably. This literature review limited its search to the term academic self-concept to avoid confusing the constructs and the misappropriation of the findings of prior studies. Previous research demonstrates that African American high school students have high academic self-concepts, though this is not a predictor of their academic achievements (Singh et al., 2010). This is an interesting finding given that lower academic achievement is traditionally associated with lower academic self-concept. Other research demonstrates that the relationship between academic self-concept and academic achievement of African American students is possibly mediated or moderated by other factors such as racial composition of the classroom (Martin, 1972) and ethnic identity (Cokley & Chapman, 2008).

Grier (2013) demonstrated that there are no differences in academic ability beliefs between upper elementary African American girls and boys. In contrast, early adolescent African American boys tend to have higher math self-concept and math success expectations compared to their female counterparts (McClendon & Wigfield, 1998). There is evidence that at the high school and college levels, African American females tend to have higher academic self-concepts than their male counterparts (Awad, 2007; Williams & Chung, 2013). Taken together, the literature suggests that at some point academic self-concept trends for African American students change directions during stages of psychosocial development.

In short, academic stereotypes and academic self-concept shape students’ academic identities. Although this study did not seek to experimentally
examine the extent to which classroom gender composition moderated stereotype threat for girls’ math ability, it did seek to explore how the specific social and environmental factors in the context of gender-specific classrooms might facilitate certain attitudes, beliefs, and perceptions about single-sex classrooms. This study acknowledges, however, that aside from stereotype threat, other theories, for example, *social learning theory* (Bandura, 1977), might explain the findings just as well. Due to the limited research on gender stereotypes and academic self-concept among urban elementary minority students, this present study adds to the body of knowledge on these constructs for this demographic group of students. It also provides evidence as to whether or not these types of environments embody promising remedial interventions in STEM subjects for urban elementary students attending high needs schools.

The research questions that guided this study were as follows:

**Research Question 1:** What are initial student, teacher, and administrator beliefs about single-sex and coeducational mathematics classes within these urban school settings?

**Research Question 2:** How were initial beliefs affected over time?

**Research Question 3:** To what extent does quantitative evidence support academic benefits of single-sex environments for urban elementary students attending high needs schools?

**Method**

We used a mixed-methods case study approach following the guidelines suggested by Yin (2003) with the expectation that observational and interview data would provide insight into the beliefs, stereotypes, and sociocultural contexts of the learning environments whereas achievement scores would allow us to examine and compare learning over time.

There were clear identifiable boundaries for each case. Therefore, the goal was to provide a comparison of the classrooms involved without attempting to generalize from one context to another. Both cases were located in the same urban Midwestern school district, used the same math curriculum, and had the same district-wide support systems. The sites were selected on a volunteer basis and because we had already established relationships with the schools. The single-sex site was selected because it had single-sex classrooms at the sixth-grade level. There were no coed sixth-grade classrooms at this site; hence, we had to choose an alternative coed site. The coed site was selected because it was in the same district, used the same math curriculum, was of similar socioeconomic status, had similar student mobility rates,
and—like the single-sex site—did not make annual progress the previous academic year.

We conducted classroom observations and held interviews (the appendix) with students, teachers, and principals at both sites. In addition, we collected quantitative data, including pre- and post test scores and longitudinal standardized test scores at the single-sex site.

Sites

An overview of the demographics of the single-sex and coed sites is found in Table 1. All students came from the surrounding communities of the schools they attended. These communities were low-income, inner-city communities comprised of predominantly ethnic minority populations (African American, Hmong, and Latino). All of the girls at the single-sex site were African Americans and 16 of the 18 boys were African American. The students at the coed site were proportionally representative of their schools’ ethnic demographics.

Table 1. Demographics of School Sites.

<table>
<thead>
<tr>
<th>Site demographics</th>
<th>Single-sex site</th>
<th>Coed site</th>
</tr>
</thead>
<tbody>
<tr>
<td>Types of classrooms</td>
<td>All-girls ( n = 22 )</td>
<td>Coed 1 ( n = 20 )</td>
</tr>
<tr>
<td></td>
<td>All-boys ( n = 18 )</td>
<td>Coed 2 ( n = 17 )</td>
</tr>
<tr>
<td>School % free or reduced-price lunch</td>
<td>96</td>
<td>90</td>
</tr>
<tr>
<td>Met adequate yearly progress</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>previous academic year</td>
<td></td>
<td></td>
</tr>
<tr>
<td>School mobility rate(^a) (%)</td>
<td>66</td>
<td>61</td>
</tr>
<tr>
<td>Student body ethnicity (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>88</td>
<td>32</td>
</tr>
<tr>
<td>Asian</td>
<td>6</td>
<td>36</td>
</tr>
<tr>
<td>Hispanic</td>
<td>2</td>
<td>19</td>
</tr>
<tr>
<td>White</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>American Indian</td>
<td>&lt;1</td>
<td>1</td>
</tr>
<tr>
<td>Teacher ethnicity (years of teaching experience)</td>
<td>Young White female (5+ years)</td>
<td>Middle-aged White female (5+ years)</td>
</tr>
<tr>
<td></td>
<td>Young White male (5+ years)</td>
<td>Middle-aged White male (5+ years)</td>
</tr>
<tr>
<td>Principal’s sex and ethnicity</td>
<td>Middle-aged African American female</td>
<td>Middle-aged African American male</td>
</tr>
</tbody>
</table>

\(^a\)Mobility rate is the percentage of students who either transferred in or out of the school the previous academic year.
Throughout this article, we refer to the teacher of the all-girls classroom as Amy, the teacher of the all-boys classroom as David, the principal at the single-sex site as Bernice, the female coed teacher as Sharon, the male coed teacher as Bill, and the principal at the coed site as Ernest.

**Description of Learning Environments**

Both sites were in the same school district, used the same mathematics curriculum, and had the same district-wide support structures. All of the teachers were experienced and had been in their respective schools for at least 3 years. Single-sex classes had been offered at the sixth-grade level at the single-sex site for 3 years whereas the rest of the school remained coed. Bernice, the principal, intended to transition the entire upper elementary to single-sex classrooms for the upcoming school years. In contrast, the sixth-grade classes at the coed site were coed; however, single-sex classes were already established at the kindergarten to Grade 3 levels. Furthermore, this school was already in the process of transitioning to single-sex classes one consecutive grade level per year.

From the observers’ perspectives (who are experienced secondary teachers), all of the teachers who participated in this study had well-managed classrooms, used teacher-lead instruction as their main method of instruction, and made use of technology in their lessons. Amy and David at the single-sex site as well as Sharon at the coed site incorporated substantial amounts of group work and various math activities into their lessons whereas Bill, the other coed teacher, had a more traditional approach.

There was high active participation and high enthusiasm in the less traditional classrooms and students typically waved their hands to get their teachers’ attention and asked to be called on with an insistent “Me! Me!” Conversely, students in the more traditional classroom tended to participate more passively with the majority of the students answering only if Bill singled them out. In general, the students were attentive during instruction, cooperative, and helped each other solve problems when the opportunity arose. In all of the classrooms, most students displayed positive sentiments toward their peers and shared a sense of camaraderie. Finally, the walls of each classroom were decorated with students’ work, curriculum goals, and learning materials, as well as reminders of the values or code of conduct of its members.

**Observations and Interviews**

One-hour observations were spaced throughout the school year and only took place during math class. The first block of observations took place at the
beginning of the academic year (September and October), the second block at the middle of the academic year (January through March), and the final block occurred at the end of the academic year (April and June). Each participating classroom was observed at least once during each block of time. We conducted five observations in each of the single-sex classrooms and a total of nine in the coed classrooms throughout the school year. The observations and interviews were conducted primarily by one of the authors; however, at the beginning of the school year another project member also conducted observations and interviews.

During the observations, we took descriptive field notes guided by an observation protocol and sat unobtrusively toward the back of the classroom. The observation protocol directed us to collect data on the physical structure of the classroom, teacher pedagogical strategies, student grouping, student cognitive and behavioral activities, student–student interactions, and teacher–student interactions.

Structured interviews of students occurred at the beginning, middle, and end of the school year. In total, there were 32 student interviews at the single-sex site (12 boys and 20 girls) and 13 student interviews at the coed site (7 boys and 6 girls). All students in each of the four classrooms were given parental consent and student assent forms at the beginning of the school year. Students who were interviewed were ones who returned signed parental consent and student assent forms back to the classroom teachers. We also conducted one structured interview with each of the classroom teachers and principals at both sites during the school year. We took extensive notes during the observations and recorded and transcribed all interviews verbatim. We made minor punctuation additions to interview data presented to preserve the clarity of meaning.

**Data Analysis**

First, we analyzed the data from the single-sex site using a within-case analyses approach, thereby treating each classroom as its own entity or subcase. The analyses involved open coding of the observations and interviews in NVivo and developing descriptive subthemes. In line with situated cognitive theory and Martin’s (2012) integrative approach, we proceeded to conduct selective coding and delineated social, environmental, and cognitive factors that seemed to uniquely contribute to the single-sex classroom learning experience. These factors were grouped into four categories: Beliefs and Attitudes About Single-Sex Classrooms, Classroom Culture, Stereotypes, and Beliefs That Changed.

We then analyzed the data from the coed site in a similar manner, using the same categories that emerged from the single-sex site, for the purpose of
comparing and contrasting elements of the single-sex and coed classrooms. We compared the classrooms for similarities and differences through cross-case analyses. From these final comparisons, three antithetical differences between the sites emerged. These themes were Single-Sex Classrooms May Facilitate Learning Versus Single-Sex Classrooms May Hinder Learning, Brotherhood/Sisterhood Versus Cordial Acquaintances, and Boys THINK Boys Are Better in Math Versus Boys ARE Better in Math.

For the purposes of this article, note that we do not discuss the Classroom Culture here or its emerging antithetical theme of Brotherhood/Sisterhood Versus Cordial Acquaintances for the sake of focusing attention on beliefs, attitudes, and perceptions only. All other categories and antithetical themes are presented in the section below. These qualitative findings are discussed in relation to the research question they addressed.

We also provide the results of the quantitative analyses of the pre- and post-test scores of students at the single-sex site to provide evidence of learning that took place over time.

**Findings**

**Research Question 1: Beliefs and Attitudes About Single-Sex Classrooms**

**Single-sex classrooms may facilitate learning**

*Bernice.* Bernice, the principal at the single-sex site, believed that single-sex classrooms promoted the success of students due to the sense of confidence, identity, and self-awareness it engendered in them. She claimed, “The boy and the girl thing can take away from that focus on the academics, that focus on the intellectual, that focus on even wanting to do schooling.” Furthermore, she stated,

The confidence is phenomenal all by itself because it allows both genders to not feel—for girls in particular—there’s that piece that says the boys are gonna know how to do math better than I know how to do math. They don’t have to contend with that competition at all in that place.

As noted above, Bernice intended to transition the entire upper elementary to single-sex classrooms for the upcoming school years.

*Amy.* Likewise, Amy, the female teacher at the single-sex site, was very much in support of single-sex classrooms, exclaiming, “I love it!” during her interview. Amy had also taught heterogeneous groups at the school in previous
years and thus been able to see, by comparison, the benefits of a single-sex classroom. She stated,

We had so many distractions. I would have my community and they [another coed classroom] would be the other community, and they would be so against each other. There would be so much conflict. Since we’ve brought the all—the girls—together each year, it’s been neat to see them come together like a sisterhood.

She added, “Of course, they still have a little conflict and drama, but when don’t you?”

Amy thought that in an all-girls classroom it was easier to establish a sense of community, a sense of sisterhood, and to set goals. She contended that these three factors were important to have so that her students function as a team. She believed that single-sex classrooms engendered an increased confidence and self-esteem in girls. Amy explained, “What I’ve observed . . . in the last 3 years is [that] the [girls] level of confidence shoots through the roof in terms of, in all their academic areas.” She believed that due to the absence of boys, the girls refrained from “dumbing themselves down” in fear of looking too smart. She also noted that the girls experienced less fear of being teased if they gave a wrong answer.

Amy did caution, however, that at the beginning of the school year an all-girls classroom may be accompanied with a pronounced “pecking order.” She described pecking order as one girl trying to assert herself as the “leader of this pack” or “queen of the scene” and wanting to have followers.

Amy also noted that not all her colleagues were in favor of single-sex classrooms and willing to try it at their grade level. She cautioned that this was an obstacle to their effectiveness.

David. David, the male teacher at the single-sex site, stated that at first when approached about single-sex classrooms three years ago he was concerned about implications regarding fairness and equity. He confessed,

It took me a little while because I was worried about the separate but equal type thing, so I was real apprehensive at first. But now I have seen a lot of benefits from it . . . taking a little bit of the boy-girl drama out of the mix.

Like Amy, part of David’s perspective was based upon the contrast to coed classrooms. He continued,
But before and when we do mix the classes together, the boys . . . put down other people to make themselves look better in front of the girls. And I even see some of the girls kinda going from . . . 12 year olds to 22—just in the way like they walk and act in front of the boys.

David felt that single-sex classrooms gave the teacher more opportunities to incorporate gender-specific interest into the lessons to better engage students. He also believed that in an all-boys setting, it was easier for him to serve as a role model and to point out things in the dominant culture that were not conducive to building positive relationships between the sexes. He explained,

We talk a lot about how to be respectful to ladies. And how to treat the women that are important to us. . . . Let’s be real, a lot of the music and movies that we’re watching are calling [ladies] B’s and H’s. . . . We’ve got to stop that.

When asked whether or not he believed single-sex education had an effect on achievement, he argued,

I think it could. . . . I think a single-gender, at least in sixth grade, makes it just a little easier to reach [achievement]. It’s not a silver bullet. You know, like I say, nothing is going to mask crappy teaching.

Similarly to Amy, David cautioned that an all-boys classroom may have pronounced “show-boating.” He described this as boys trying to act more macho in front of the other boys. In addition, he also cautioned that a pedagogical concern for teachers of single-sex classrooms is that they might be tempted to have a “one size fits all” approach to their lesson plan and fail to recognize that not all students are interested in gender-typical learning activities.

**Ernest.** Ernest, the principal at the coed site, was a proponent of single-sex classrooms. During the time of this study, the lower elementary classes were single-sex classes, and Ernest was in the process of transitioning the entire elementary school to single-sex education. He contended,

What benefits it offers is that the girls are more relaxed and can answer questions. The girls can feel they could be successful in different fields that are predominantly dominated by boys. And then, they are not being distracted by the boys. . . . I’ve noticed that boys are distracted by girls and girls are distracted by boys. But particularly with my referral rates, [I’ve noticed that] I don’t have as many referral rates as I did last year with boys and girls badgering each other.
Ernest anticipated that his quest to transition the elementary school into single-sex education was going to be challenging. He acknowledged that aside from parent and teacher buy-in, there were many other resources needed to make single-sex education successful. Ernest had already begun the process of providing professional development for his teachers in preparation for their transition into single-sex classrooms.

**Single-sex classrooms may hinder learning**

*Sharon and Bill.* Neither Sharon nor Bill, the coed teachers, had experience in a single-sex classroom, therefore their responses were speculative. Sharon thought that single-sex classrooms might give girls a chance to participate more. She said,

I think that if the girls were all together I’d get more of them that would volunteer to participate. . . . [The boys] participate more than the girls. So I don’t think it would matter so much with the boys, but I think if the girls were all together [they] would feel more comfortable sharing.

Bill expressed dissimilar beliefs. He proposed,

Now I understand the argument that if you put all girls in the same room then they would participate more in discussion. So it would be interesting to see if that holds true, or [if] they become more quiet. Or maybe not more quiet, but if they maintained their quietness.

Both coed teachers believed that teaching an all-boys classroom would be more challenging because boys tended to be more physically active. Both were undecided as to whether single-sex classrooms would affect student achievement. Sharon pointed out that as her students had the natural tendency to form segregated groups, a single-sex setting might not be that different. Bill pointed out that less diversity in the classroom might actually hinder learning. He stated, “Again, that variety is there [in coed classrooms] where different sexes maybe take different angles on a math problem, how to solve it. [Single-sex classrooms] might handicap the classroom a little bit, or negatively affect the achievement.”

**Stereotypes.** During interviews, gender-typical stereotypes were voiced by students, teachers, and principals. At the single-sex site, David said that he and Amy were working together to combat gender stereotypes. He stated, “We’re going to work together to not perpetuate gender stereotypes. Trying to break it down, even though we’re separate, we’re trying to break it down.” The stereotypes were grouped into two subthemes: *academic* and *behavioral.*
**Academic: Boys THINK they are better in math versus boys ARE better in math.** During the school year at the single-sex site, an academic stereotype voiced by a girl was, “The boys think they have what it got to be more successful than girls.” Similarly, another girl at the same site responded, “They think they have more potential than girls.” Likewise, one boy responded, “Some boys would say that girls can’t play sports and like during math and stuff it always seems like a lot of boys say that boys are smarter than girls.” When probed to expound upon boy beliefs another boy said, “. . . because [of] the term boys are stronger than girls. So a lot of times that goes along with saying that boys are smarter than girls.” Similarly, during her interview, Bernice, the principal, also discussed girls being intimidated by their perceptions of boys’ math ability.

Boys and girls at the coed site also expressed academic gender stereotypes, but this was more often voiced by girls than boys there. For example, during her interview one girl said, “Well, some boys are usually smarter than girls in math class.” Similarly, another coed girl said, “Boys are better in math.” A third coed girl went into a little more detail about the disadvantages about an all-girls classroom. She explained,

> It’s not that good because when I don’t know any of the questions—and some girls don’t like it when I say “some boys are kinda of smart and you can ask them.” But then maybe [we can] ask the teacher, but maybe they don’t know it too. But maybe the boys know, but they are not in there [in an all-girls classroom].

Likewise, when prodded about the types of teasing that goes on in class, one coed boy responded, “sexist things.” The interviewer asked, “like what?” and the boy paused briefly and replied, “I don’t know, calling a girl dumb.”

Aside from students, even Sharon at the coed site endorsed gender stereotypes about math abilities. She explained, “Like I said [girls] are more focused. They’re more still for the lesson part of it—but I don’t know. The boys seem to be better thinkers.” Only in one interview did a coed boy state that an advantage of being coed is that he could ask the girls for help in math.

**Behavioral: Boys are too playful and girls gossip too much.** Behavioral stereotypes held at the single-sex site at the beginning of the school year were that the girls thought boys played around too much whereas the boys thought girls talked too much. At the coed site, the girls also thought that girls talked too much, and both sexes agreed that boys played around too much. Interestingly, excessive talking between girls was never observed; instead, lots of talking occurred in the boys’ classroom. For his all-boys classroom, David said, “A
couple of the boys have said they don’t like [coed] because the girls just talk too much. And I said to them, ‘guys, have you ever listened to yourselves?’”

A behavioral stereotype held by Sharon and Bill at the coed site was that the girls were “mellow,” and this might contribute to their lower rates of volunteering answers in class. Boys at both sites said that boys were competitive. A boy from the all-boys class said, “I’m thinking it is probably a good idea that we’re up in an all-boys class because sometimes boys do get competitive with girls and that starts a problem.” Similarly, during his interview, a boy from a coed classroom speculated, “I guess because we’re competitive and we try to get the best on our test.” Competition did not come up in any of the girls’ interviews. Finally, students and teachers at both sites felt that boys were more aggressive. A boy from the all-boys classroom said, “I’d have to say that we all kinda have the same thing in common. We’re all like aggressive, all like basketball.” Similarly, Bill at the coed site explained, “boys are more aggressive about presenting and participating in class discussion.”

**Research Question 2: Student Beliefs That Changed**

**Initial beliefs**

*All-girls classroom.* At the beginning of the school year, an overwhelming majority of the girls could think about potential benefits of their classroom. These included more opportunity to talk about girl problems, more encouragement and support from girls, more comfortable participating in class, more classwork being done, and less teasing due to the fact that boys were not around. For example, one student stated, “Well, being in an all-girls classroom, it’s like you’re not afraid to talk about like girl problems. And the boys won’t be around to start teasing you about it.”

A little more than half of the girls could not think of any disadvantages of being in a single-sex classroom. Of those who did, all responses were anticipated forms of relational issues. For example, one girl said, “more drama, sometimes teasing, and a lot of rumors.” A second girl indicated that you might not “... like the girls in your classroom”; and in a similar vein a third one said, “like some girls be thinking they’re better than everybody.” Interestingly, a fourth girl had only misgivings about an all-girls classroom. She explained that she was not looking forward to an all-girls classroom because most of the girls in her class were “girly girls.” She elaborated, “I don’t think there’s good things [about an all-girls’ classroom] because I want to be in an all-boys classroom ... I’m kinda of like a tomboy.”

*All-boys classroom.* At the beginning of the year, the boys said that the potential benefits of their classroom were that there were less opposite sex
Coed students’ beliefs. Coed students’ beliefs remained stable over time. Most of the coed girls thought that there would be less teasing or distractions in all-girls classrooms, but too much talking. Most girls explained that there would be less work completed in math because there would be too much talking or because there would be less help in math. One girl stated, “In the girls classroom we’ll talk a lot. So I just want to learn and don’t talk a lot.” A couple of girls also mentioned that if the boys were not there would be fewer opportunities to have boys as friends.

Similarly, the boys thought that the advantage of an all-boys classroom would be less opposite sex distractions and less fights between boys and girls. One boy stated, “Yeah I think the amount of teasing will change. Cuz boys, when boys get mad, they like take their anger out on the girls. . . . There would be, like, barely any teasing.” For potential disadvantages, they thought that there would be too much playing around or talking. The boys had mixed feelings as to how much work would get done in an all-boys classroom, with the majority saying either the same amount or more. For example, one coed boy thought that more work would get done. He explained, “Cuz sometimes like guys just, like they don’t really care, like, everybody in the class is just doing their work. When people are doing their work sometimes the girls distract them.” In contrast, two other coed boys had a different view about the presence of girls in the classroom. They thought girls, being more focused on their work, kept the boys on track and away from talking.

Mid-year

All-girls classroom. By mid-year, the reported benefits of an all-girls classroom had increased. Example of these were as follows: “I’m just not afraid now to raise my hand”; “if you were sitting by a boy and need his help, you wouldn’t feel comfortable asking him to help you. But if you were sitting by a girl, they’ll be more comfortable helping you”; and “You can ask questions and not be embarrassed. You can ask questions and not be embarrassed that someone will laugh at you.” For disadvantages, all of the girls listed “drama.” The girls defined drama as gossiping about people and arguing over boys. One girl explained, “Well people like to, in this classroom, like to pick
arguments and stuff.” When asked what the girls usually argued about, she promptly responded, “boys.”

**All-boys classroom.** By mid-year, the boys stated that the advantages of an all-boys classroom were the absence of opposite sex distractions, more opportunity to play boy games, more help from peers, and more opportunity to talk about boys stuff with each other without the girls telling on them. The disadvantages listed were that there were LOTS more fights, bullying, distracting laughter, too much talking, and that there were no girls around to tell on them when they clowned around. One boy stated, “I can’t get the work done because there’s steady talking and they don’t make good choices about who they sit by.” Another boy said,

> And then in the boys class, like if you don’t get to work and stuff like that, they won’t tell on you. So you’ll just gon be fooling around for the whole class and you won’t get no work done.

The boys were split regarding the amount of teasing and the amount of work getting done.

**End of year**

**All-girls classroom.** At the end of the school year, additional benefits of an all-girls classroom included “I can concentrate better” and “we listen more to the teacher.” Another girl said that as a whole, the class got more answers correct. She explained, “Most of the time their [girls] answers be coming out correct, and last year, there’d probably be all of them wrong.” Disadvantages listed were drama over boys and showing off in front of boys when they were around during community time.

Thus, overall, there were three major changes in beliefs that occurred in the girls over the school year. First, the list of advantages had almost doubled; second, they all articulated that drama was a problem, and third, there was no longer a general consensus that there was less teasing or they got more work done.

**All-boys classroom.** By the end of the school year, the advantages given were that there were fewer opposite sex distractions, better focus, and more opportunity for fun boys stuff. For disadvantages, the boys replied that “people like to act tough,” there was pressure to “act tough,” there was lots of picking on smaller boys, too much talking and noise, and that it was harder to concentrate. Finally, the majority of the boys thought that there were more teasing and more work getting done.
Thus, overall, the boys too experienced changes in beliefs about an all-boys classroom. At the beginning of the year, the boys thought that there would be fewer disruptions and less talking; however, by the end of the year, none listed this as an advantage. For initial disadvantages, the boys mostly discussed clowning around and fighting; however by the end of the school year, bullying and acting macho were added. Their perceptions of teasing and amount of work getting done fluctuated, but by the end of the year, more boys thought that there was not only more teasing but also more work getting done.

Another interesting finding at the end of the school year voiced by a minority of the boys was that the physical presence of girls actually added to their learning experience. One boy explained, “When we had [coed] classrooms, if you’re working, but not really working, you see the girls will tell you like “shut up and get to work” and then the teacher tells you to “get to work and stuff. . . . And then after that, you don’t want . . . them to tattle tale on you no more so you just get right back to work.” In addition, another boy believed that the presence of girls deterred fights. He explained, “Because like when we had girlfriends, and boys wanted to fight you, they [the girlfriend] would like tell for you.” In that way, boys avoided looking like “punks.”

Research Question 3: Pre-Test and Post-Test Scores (Single-Sex Site)

Math scores from district mandated tests (pre- and post-) were collected in the single-sex classrooms. Half of the items on these tests measured fifth-grade benchmarks and the remaining items measured sixth-grade benchmarks. The same test was administered at the beginning of sixth grade and at the end of sixth grade. Due to the nature of the items, the test allowed students to demonstrate learning from the previous year as well as the current academic year.

Preliminary analysis using a paired t test of pre- and post-test scores revealed that both classrooms made significant gains in test scores (Table 2).

Repeated-measures ANCOVA was then run to further explore the effect of time and sex, controlling for prior knowledge as measured by an averaged fourth- to fifth-grade math standardized percentile ranking. For the repeated-measures ANCOVA, time was the within-subject factor, sex was the between-subject factor, and an averaged fourth- to fifth-grade standardized percentile ranking was the covariate. The results of this test revealed that both time and the averaged fourth- to fifth-grade standardized percentile ranking were significant predictors of gain scores, $F(1, 23) = 23.5, p < .001$ and $F(1, 23) = 50.6, p < .001$, respectively, but sex was not, $F(1, 23) = .071, p = .792$. In
addition, the interaction between time and averaged fourth- to fifth-grade gain scores was significant, $F(1, 23) = 15.5$, $p = .001$. Conversely, the interaction between time and sex was not significant, $F(1, 23) = 1.52$, $p = .230$, further indicating that there was no difference in the overall scores between the sexes at any of the time points (see Table 3).

To determine the degree to which boys and girls compared on fifth-grade knowledge at the beginning of sixth grade, comparative analyses using independent-samples $t$ tests were also done to examine students’ scores on prior year concepts versus new concepts. That is, these analyses made distinctions between test items that measured the previous years’ learning versus test items that measured the present years’ learning by performing independent-samples $t$ tests on fifth-grade benchmark items and sixth-grade benchmark items separately. At pre-test, the girls tended to perform lower than the boys on the fifth-grade benchmarks, $t(27) = −1.95$, $p = .06$, though note that this difference only approached statistical significance. In contrast, both girls and boys performed more similarly on the sixth-grade concepts, $t(27) = .013$, $p = .99$, demonstrating that at the beginning of the school year they were at the same level in terms of knowledge for sixth-grade benchmarks. By the end of the school year, there was no difference between girls and boys in prior, $t(29) = −.239$, $p = .81$, or new concepts, $t(29) = .828$, $p = .41$.

### Table 2. Overall Paired $t$-Test Scores for Single-Sex Site.

<table>
<thead>
<tr>
<th>Type of classroom</th>
<th>Pre-test ($M, SD$)</th>
<th>Post-test ($M, SD$)</th>
<th>Paired gain score</th>
</tr>
</thead>
<tbody>
<tr>
<td>All-girls</td>
<td>$(8.75, 5.61)$ $n = 20$</td>
<td>$(32.0, 14.1)$ $n = 19$</td>
<td>$(24.0, 11.6)$ *** $n = 19$</td>
</tr>
<tr>
<td>All-boys</td>
<td>$(11.3, 6.98)$ $n = 9$</td>
<td>$(30.4, 12.4)$ $n = 12$</td>
<td>$(20.8, 8.67)$ *** $n = 9$</td>
</tr>
</tbody>
</table>

Note. Paired gain scores were significant for both groups. ***Means $p < .001$.

### Table 3. Repeated-Measures ANCOVA Results for Single-Sex Site.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$df$</th>
<th>$F$ value</th>
<th>$p$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Within-subject</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>1,23</td>
<td>23.5</td>
<td>.000***</td>
</tr>
<tr>
<td>Time $\times$ Percentile ranking</td>
<td>1,23</td>
<td>15.5</td>
<td>.001**</td>
</tr>
<tr>
<td>Time $\times$ Sex</td>
<td>1,23</td>
<td>1.52</td>
<td>.230</td>
</tr>
<tr>
<td><strong>Between-subject</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td>1,23</td>
<td>0.071</td>
<td>.792</td>
</tr>
<tr>
<td>Percentile ranking</td>
<td>1,23</td>
<td>50.6</td>
<td>.000***</td>
</tr>
</tbody>
</table>

**$p < .01$. ***$p < .001$.**
**Discussion and Implications**

*Issues With Public Single-Sex Education as Reform*

There is a growing advocacy for public single-sex education in urban schools, with particularly strong presences in cities such as New York and Chicago (e.g., the Eagle Academies in New York and Urban Prep Academies in Chicago). In accordance with Title IX amendment, public single-sex education is often marketed as a school of choice that would improve the achievement gap for disadvantaged minority youth. Whether it actually does provide more equitable education is questionable (Goodkind, 2013). Furthermore, it appears to be marketed more toward boys because all-boys schools seem to receive more media spotlight (e.g., Sweet, 2010). It remains to be determined though whether single-sex education has the same benefits for both sexes and whether the benefits observed in the private sector would hold true for disadvantaged minority students attending public urban schools.

Warren (2011) contended that issues with many urban education reforms are that they are at times sporadic, not well thought out, fail to include key stakeholders, and lack political collaboration among others. Consistent with the notion of being *not well thought out*, to date there is no comprehensive theory of change delineating the inputs, outputs, processes, and outcomes that might make single-sex education a promising intervention in urban public K-12 schools (Halpern et al., 2011). Findings of this study support this notion. For example, one principal called for teacher professional training for the success of single-sex classrooms whereas the other principal did not. Similarly, the teachers of the single-sex site emphasized different reasons why single-sex classrooms were effective. It is important to test these assumptions as we move toward delineating a theory of change for single-sex education.

There are three common beliefs in the sparse literature involving public single-sex education in urban schools. They are that it eliminates opposite sex distractions, protects girls from harassment, and allows teachers to better adjust to the learning styles of students (Goodkind, 2013). This study provides additional components to be tested as a step toward delineating a theory of change. The findings suggest teacher buy-in, student perceptions about their learning environments, the roles teachers play in fostering positive math identities, and exacerbated social stereotypes are possible important contextual factors to be further examined. Below, we briefly discuss our findings regarding math learning in single-sex environments and how these achievement outcomes compare with the literature. We then place a more focused attention onto contextual factors in single-sex learning environments that ought to be further examined for delineating a theory of change.
Math Learning

This study’s quantitative findings support the literature of single-sex education being particularly advantageous for girls’ (but not boys) math achievement (e.g., Spielhofer, Benton, & Schagen, 2004). The independent $t$-test scores suggested that the girls had a tendency to lag behind the boys in fifth-grade content knowledge at the beginning of the sixth-grade school year but caught up by the end of the year. Although there might be some differences in elementary African American boys’ versus girls’ experiences with teacher expectations, attitudes, and academic identities (Davis, 2003), there currently appears no difference in their math achievement (McGraw, Lubienski, & Strutchens, 2006; McMillian, Frierson, & Campbell, 2011). Therefore, the tendency of these elementary girls to lag behind their male counterparts at the beginning of the school year might just be an idiosyncrasy of this sample. To arrive at more conclusive answers regarding math achievement gains in single-sex versus coed urban elementary schools, methods such as propensity score matching (when randomized field trials are not possible) can be conducted to make more valid comparisons.

Context-Specific Factors to be Tested

Teacher buy-in. Principal and teacher interview data revealed that teacher buy-in is critical to the effectiveness of single-sex classrooms. The principal and teachers at the single-sex site agreed that single-sex classrooms removed opposite sex distractions, made students feel more comfortable participating in the lessons, and gave students more opportunities to share and discuss personal topics that were gender-specific. These findings are all consistent with other non-U.S. findings (e.g., Brutsaert & Van Houtte, 2004; Salminen-Karlsson, 2007). In contrast, only Ernest at the coed site had a favorable disposition toward single-sex classrooms whereas the coed teachers were hesitant. Teacher beliefs and attitudes toward single-sex education should be examined before and after its implementation.

Students’ perceptions about their learning environments. A second factor to consider is students’ perception about their experience. Previous research demonstrates that African American students’ dispositions toward their learning contexts are critical to their learning process (e.g., Okwumabua, Walker, Hu, & Watson, 2011) and that their attitudes toward school are shaped at the elementary level (e.g., Tyson, 2002). Findings demonstrate that at the beginning of the year, students in both classrooms at the single-sex site were optimistic about advantages their classrooms would offer; however, by the end of the school year, the number of advantages expressed by the girls had almost
doubled whereas for the boys the list had decreased. Given this finding, the “catching up” of the all-girls classroom makes sense. Thus, congruency in expectations among members of the classroom is another factor to be tested.

Also with regard to perceptions, our findings differed from Hoffman et al. (2008) who found that urban high school students did not perceive any benefits of single-sex classrooms. Thus, grade level might be another important variable to examine.

**Teachers’ role in fostering positive academic identities.** Teachers at the single-sex site intentionally promoted mathematical identities for girls and maintained positive ones for boys whereas those at the coed site inadvertently opposed positive math identities for girls but fostered them for boys. This is consistent with the findings of Tiedemann (2000) whose work demonstrated that teachers of coed classrooms might have different beliefs about the math ability of girls versus boys. It is possible then that the gender composition of the classroom might actually moderate teacher expression of stereotypical beliefs about the math ability of girls. Future studies that include multiple single-sex and coed sites can test the extent to which teachers make such comparisons.

The students at both sites also demonstrated awareness of gender-stereotypical beliefs regarding the academic ability of girls, which is in line with the finding of Cvencek et al. (2011). An interesting difference in girls’ responses was that those at the single-sex site expressed academic stereotypes as what boys *thought* but emphasized that these were not necessarily *true*. In contrast, at the coed site, girls were also aware of academic stereotypes but they did not express disbelief of them. Thus, student beliefs appear congruent with teacher beliefs at their respective sites. It is important to test then whether single-sex education leads to more positive academic identities due to the absence of gender stereotype threat, or if in fact teachers need to intentionally combat negative stereotypes and foster positive academic identities as these findings suggest. Both factors may be influential, but one might be more influential than the other.

**Exacerbated social identities.** Single-sex learning environments might also exacerbate negative gender stereotypes regarding the social behavior of boys and girls. The girls at the single-sex site said that the all-girls classroom had too much *drama*. These girls described drama as gossiping about people and fighting over boys. According to Waldron (2011), gossiping and fighting over boys are both forms of relational aggression. Furthermore, her findings support the notion that the girl *drama queen* is a gendered stereotype of adolescent females. Thus, it is possible that the gender composition of the classroom influenced the students to endorse and enact the stereotype more heavily.
Although relational aggression is thought to be more characteristic of girls, members of the all-boys classroom also perceived heightened levels of relational aggression in the forms of showboating, bullying, acting tough, and perceiving pressure to act tough. Taken together, these findings suggest that the single-sex classroom might have higher levels of relational aggression, regardless of sex. This is especially problematic because relational aggression tends to be more covert compared with physical aggression. Exacerbated social identity is the final component that ought to be examined in these environments.

Summary

Overall, single-sex education might be especially advantageous for the mathematical identities of urban elementary African American girls. Although there was no evidence supporting or refuting positive outcomes for African American boys, there at least appeared no deleterious effect. Findings from this study suggest that teacher buy-in, congruency in students’ perceptions about their learning environment, teacher’s role in fostering positive academic identities, and exacerbated social identities are important contextual factors within these environments that go beyond the mere separation of the sexes. The further exploration and testing of these factors are steps toward determining whether single-sex education is indeed achieving equity for urban elementary minority students.

Appendix

Interview Questions

Principal.

1. What are your feelings about the sixth grade being single sex?
2. What benefits do you think single-sex classrooms offer?
3. What obstacles do you anticipate or are already aware of for implementing a single-sex class?
4. What do you sense is the general feeling among your staff toward the sixth grade being single sex?
5. What do you sense is the general feeling among your parents/guardians toward the sixth grade being single sex?
6. Do you think a single-sex class has an effect on student achievement? If so, describe it.
7. Do you think a single-sex class has an effect on student social interaction? If so, describe it.
8. Is there anything else you would like to add about your beliefs regarding single-sex classrooms?

Teachers.

1. Describe your teaching experience. How long have you been teaching? What grades have you taught, and in what type of school setting have you taught in?
2. Have you ever taught in a single-sex classroom? If so, what grade(s) and for how long?
3. What are your feelings about the sixth grade being single sex?
4. What are some classroom dynamics you think are specifically due to your all-girls (or boys) setting?
5. What do you perceive is the general attitude of students toward being in a single-sex classroom at the beginning, middle, and end of the school year?
6. What benefits do you think a single-sex classroom offers?
7. Is there anything you think might be easier to accomplish in a single-sex classroom?
8. What are some obstacles you anticipate or have already encountered teaching in a single-sex class?
9. Do you think a single-sex class has an effect on student achievement? If so, describe it.
10. Is there anything else you would like to add about your beliefs regarding single-sex classrooms?

Students.

1a. What do you think being in an all-girls (boys) math class will be like?
1b. In what ways do you think it would be the same to a regular classroom?
2. In what ways do you think it would be different?
3a. What are some good things about being in a boys/girls-only math class?
3b. What are some bad things about being in a boys/girls-only class?
4a. How comfortable do you feel participating and answering questions out loud in a regular math classroom?
4b. Compare this with an all-girls (boys) classroom. How comfortable are you participating and answering questions in an all-girls (boys)
classroom? (For students in a regular classroom, ask them to imagine how comfortable they think they will feel in an all-girls (boys) classroom.)

5. How do you think the other girls (boys) in your class feel about being in an all-girls (boys) math class?

6. Think about the amount of teasing that goes on in a regular math classroom.
   a. What are people usually teased about?
   b. Who does the teasing?
   c. Who is usually teased?
   d. Do you think the amount of teasing is more, less, or the same in an all-girls (boys) classroom?

7. Think about the amount of classwork students complete in a regular math classroom. Do you think this amount will be more, less, or the same in an all-girls (boys) math classroom?

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