Reducing Stereotype Threat in the Science and Mathematics Classroom: An Overview of Research, Best Practices, and Intervention Strategies

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Abstract

Stereotype threat research is relatively new in the world of social psychology, yet since the mid-1990's thousands of studies have been generated to explore this social-psychological phenomenon. It is now known that it can change the thought processes and aspirations of African American students and either point them into or away from a career in mathematics and science. Stereotype threat research has taken a welcome direction in the last few years, much of it now focusing on classroom and institutional interventions that contribute to reducing the threat to students in classrooms across the United States. This practitioner-focused report highlights research that can be useful to classroom teachers, policymakers, and educators at all levels, especially in urban school districts, to help make decisions and develop training for classroom teachers. The report includes a list of books, websites, videos, and an extensive set of references to guide future research and implementation.

Keywords

stereotype threat, STEM, stereotype vulnerability, psychological interventions, African American

Introduction: What is stereotype threat?

Imagine a student starting the first day at a new school. She is an African American female whose mother had to transfer because of a new job. Her last school was 50% African American, 30% Hispanic, 20% white, and a mix of students from other countries. At her old school, she was near the top of her class and enrolled in Advanced Placement (AP) science and mathematics courses. As she walks into her AP Physics course, she is struck with the fact that, out of 18 students in the class, she is one of only five females and only the third African-American student. She is the only African American female. It does not take long for her to feel out of place, as though she does not belong. Her new school is a suburban school with 70% white, 15% Hispanic, 10% African American, and only a few other nationalities. She worries it is going to be a long year. She meets her teacher, a white male with many years of experience and he greets her with a smile. She has no idea what the year has in store.

African American students in this country continually fall behind their white peers in mathematics and science (Massey & Fischer, 2005). The reasons for this trend are numerous, but many researchers feel it is related to a psychological concept known as stereotype threat. C. M. Steele (1997, pp. 616-617) defined stereotype threat as follows:

> The event of a negative stereotype about a group to which one belongs becoming self-relevant, usually as a plausible interpretation for something one is doing, for an experience one is having, or for a situation one is in, that has relevance to one's self-definition.

In other words, some students have a fear of confirming a stereotype for a group to which they belong (e.g. race or gender), which has the potential to negatively impact their performance. Stereotyped messages are in the form of stereotypes that are brought forth by the media (Davies, Spencer, Quinn, & Gerhardstein, 2002), racial slurs and micro-aggressions, and even well-meaning individuals who are uninformed. But make no mistake, students take these messages to heart. In situations where they feel as though they are being compared to other groups (usually white or Asian students) or feel as though they must represent their own race and prove to the world that those stereotypes are untrue, stereotype threat can have serious effects on classroom performance. In the 1990's, Claude Steele and Joshua Aronson tested a number of situations in a laboratory setting where they gave tests to different groups of African American students. For one of the groups, they told them it was a test of intelligence. For the other group, they told them it was simply a test of comparison. Without the threat of believing that the test measured intelligence, the African American students scored nearly the same as their white student counterparts (Steele, Spencer, & Aronson, 2002).

C. M. Steele (1997) believes that stereotype threat may be one of the reasons for differences in SAT test scores, IQ tests, and other measures of aptitude in the United States. Other researchers, such as Aronson and Inzlicht (2004), conducted a longitudinal study of African American students and found that many of them were unable to assess and gauge their level of test performance (which they called inaccurate performance assessment), which could be a factor in their testing gap differences. Walton and Spencer (2009) conducted a meta-analysis of over 18,000 studies of stereotype threat from five countries and found that stereotype vulnerability, a precursor to stereotype threat, could account for almost 10% of the variation in grades between African American students and white students.

Although it is unlikely that every African American student is affected by this feeling of stereotype threat, many of them are vulnerable and it affects their everyday life in the science and mathematics classroom. Stereotype vulnerability, the tendency to be influenced by negative stereotypes about one's racial or social group, is prevalent in not just African American students, but also in other students of color, such as Asian (Whaley & Noel, 2013) and Latino (Gonzales, Blanton, & Williams, 2002) students. Even white female students may be vulnerable to stereotypes in the field of mathematics (Spencer, Steele, & Quinn, 1999). It is difficult to know which students are vulnerable to stereotype threat, so teachers must assume that all African American students feel the pressure to perform in even small amounts. Since research has shown that stereotype threat is pervasive for African American students in this country, it is reasonable to assume that we can put interventions in place to stop this from happening (Walton, Cohen, & Steele, 2012). However, the answers may be more complex and deeply ingrained in the students than educators have ever imagined.

The Problem with Stereotype Threat

Stereotype threat interferes with learning in mathematics and science in a number of different ways. Students under threat mistrust their internal performance feedback mechanisms and develop inaccurate academic self-concepts, especially in domains in which they are deeply invested or identified (Aronson & Inzlicht, 2004). If those domains include mathematics and science, students may start to feel as though they are not as capable in those subjects and that mathematics and science are not for them. If the student is highly identified in these subjects, he or she may withdraw and weaken his or her identity as a good mathematics and science student, which will lead many students not to consider

these fields as college majors or future career choices. This process is called *disidentification* (Schmader & Beilock, 2012). In a longitudinal study, Fischer (2010) found that breaking identification with any academic domain could make students underperform in that discipline.

A number of studies have looked at the question of whether stereotype threat causes students to underperform in academic domains. The added stress of stereotype threat could interfere with attentional resources, specifically working memory (Schmader & Johns, 2003). Think of it this way. When students are taking a test, they have a number of issues on their minds, as though they are juggling three balls. Most talented jugglers can handle three balls when they can concentrate. Every time another ball is added, it increases the difficulty for the juggler, thus increasing the need for concentration. African American students taking a test have a number of issues on their minds, but the threat of disproving stereotypes about themselves and their race is like another ball to juggle. It robs them of the attentional resources they need to concentrate and do well. Most white students in the same situation do not feel the weight and distraction of that burden.

A study by Taylor and Walton (2011) showed that stereotype threat may not only attack memory, but could be implicated in deficits in both learning and performance. Students studying in a condition in which they were told they were taking a test of intellectual ability had lower recall performance skills than white students in the same threatened environment. Studies by Schmader and Beilock (2002) proposed that African American students' working memory was taxed when primed with a stereotype condition. They are unable to give the test their full attention because of competing thoughts, emotions, and anxieties (Schmader & Croft, 2011). This process is referred to as rumination, and it could affect African American students' standardized test scores and even their interaction with other races (Steele, 2011).

Most white students, with the exception of white females in a mathematics classroom, do not experience the pressure of stereotype threat. In fact, their knowledge of stereotypes may even give them a boost in confidence and push them to an even higher achievement level. Walton and Cohen (2003) discovered instances of stereotype lift, where white or Asian students receive a boost in confidence by having derogatory thoughts about the intellectual ability of minority groups, women, or even poor people. It could be said that, for white students, *stereotype lift* works exactly opposite of stereotype threat and gives them a boost to achieve even more. If you pair this with the negative consequences of stereotype threat for African American students in regards to testing and achievement, it becomes painfully obvious how the gap in mathematics and science achievement continues to widen.

When Does Stereotype Threat Begin?

Research suggests that one's awareness of their ethnicity and associated stereotypes begins at quite a young age. Some studies have found that students as young as ages 4 to 6 are already familiar with ethnic stereotypes (McKown & Weinstein, 2003), although students as young as 3 to 5 years of age can recognize a person's ethnicity (Ambady, Shih, Kim, & Pittinsky, 2001). Studies have also found that students are aware of other types of stigma, particularly socio-economic status (SES). According to Ambady et al., (2001), students in the first grade may already believe boys are better than girls in mathematics. First graders may also express the belief that mathematics is more relevant to boys' self-concepts than girls. They also found that students around the age of 10 are already aware of stereotypes related to gender and mathematics. Although the students would explicitly tell you that boys are no better at mathematics than girls, implicit stereotype-awareness tasks revealed that students believed those who were good at mathematics were more likely to be male and Asian (Ambady et al., 2001). Although it is slightly disconcerting to realize that students are already forming impressions of ethnic and gender stereotypes at such a young age, the study results also point to the fact that these students are still impressionable and can unlearn these stereotypes with effective intervention.

Identity-Safe Classrooms

If minority and female students are to find success in mathematics and science fields and subsequently choose to enter those fields as a college major and potential career choice, they must be taught in an environment where they feel safe in honoring their ethnicity and feeling the security of an effective classroom teacher. Dorothy Steele (2012) defines an *identity-safe classroom* as one that validates "students' experiences, backgrounds, and identities to promote academic and social success for all students" (p. 1125). She believes these classrooms should not associate a student's race, gender, or religion with academic performance in any way. Identity-safe classrooms should emphasize student belonging, focus on cooperation as opposed to competition, and use challenging curriculum and learning tasks that focus on student interests (D. M. Steele, 2012). This child-centered pedagogy focuses on listening to the student and allowing minorities to share their thoughts and interests in a non-threatening environment, which can help them gain a sense of belonging and purpose.

Similar to regular classrooms, identity-safe classrooms require a classroom management plan, yet focus more on training self-discipline within the student. This self-discipline training requires that a teacher have firm and consistent expectations of the students, provide emotional support to them as they learn how to effectively manage themselves, and give students adequate time to learn about and practice pro-social behaviors, such as being responsible and respectful. Identity-safe classroom teachers have a rigorous curriculum and high academic expectations of their students. The majority of the time in class is focused on stimulating activities and intellectual discussions. The curriculum is rigorous and gives the students adequate time to think, reflect, and practice. D. M. Steele (2012) suggests including the following in identity-safe classrooms: (1) students placed in diverse working groups, (2) examples of books, music, and art from different backgrounds within the classroom, (3) posters with examples of important minority figures, (4) multiple languages in the classroom or providing examples of them, and (5) asking students to infuse their own histories and experiences within class assignments (p. 1127).

What Works to Reduce Stereotype Threat?

Thousands of studies have been conducted since C. M. Steele and Aronson (1995) first coined the term "stereotype threat". Since that time, the momentum and direction of the research has slowly turned from the laboratory to the field. As social psychologist Toni Schmader says in a recent *Scientific America* article (Yong, 2013), "I see three waves of research. The first was identifying the *extent of the* phenomenon. The second was looking at who experiences the effect and its mechanisms. The third wave is now to translate these results into interventions" (p. 78-79). Most of the data from interventions have come from 2010-2014, so the intervention phase of stereotype threat research has just begun. Table 1 summarizes a number of the remedies compiled by Walton, Cohen, and Steele (2012), which have been divided into classroom interventions and institutional interventions. The proceeding discussion will focus on classroom interventions, since the majority of the changes that are desperately needed are in the science and mathematics classrooms and depend on the instructors for effective implementation. Institutional involvement is highly important (Walton et al., 2013), but it is not the focus of this review.

Before discussing these interventions, it is important to note that stereotype threat is individualistic, in that it affects students as individuals and not as groups. Some students are vulnerable to stereotype threat and the deficiencies it causes, but many are not. It might be more accurate to say that some have developed personal coping mechanisms to be successful. McGee and Martin (2011), in a comprehensive qualitative study, found that students can overcome the negative effects of stereotype threat through a process called *stereotype management*. Although it is believed that stereotype threat is common and pervasive for students of color, especially African American students in the areas of Science, Mathematics,

Engineering, and Technology (STEM), many students use the occasion of stereotype threat as an incentive to push themselves to perform and succeed. In a study by Alter, Aronson, Darley, Rodriguez, and Ruble (2010), the researchers reframed a test as a challenge instead of focusing on related stereotypes and found that the African American students used the challenge as motivation to succeed.

The strategies in this paper are focused on the role of the teacher of minority students in the mathematics and science classroom and how they can decrease the likelihood of stereotype activation in their students. Although there are many positive ways to overcome stereotype threat, there a few that are not successful, such as withdrawal of effort, engaging in less practice or study time to provide an explanation for poor performance, and denial (Rivardo, Rhodes, & Klein, 2008). The intervention strategies will be discussed, with appropriate references, including a brief explanation of important best practices.

1. Teach science and mathematics students that abilities can be improved and intelligence can be expanded (Aronson et al., 2002; Blackwell et al., 2007; Dweck, 2007). Emphasize an incremental (malleable or changeable) view of intelligence as opposed to an entity (fixed or rigid) view of intelligence

Carol Dweck and other researchers at Stanford University discovered a relationship between implicit theories of intelligence and academic performance (Dweck, 1999). Individuals who follow entity theories believe that intellectual abilities are innate and immutable (unchanging), whereas individuals who follow incremental theories believe intelligence is malleable and can be developed. Research has found that entity students are more likely than are incremental students to dis-identify with their academic studies following negative feedback (Dweck, 1999). Entity students are more vulnerable to negative stereotypes because they do not believe their intellectual abilities can change (Dweck, 1999). Although many studies have treated these theories of intelligence as individual personality variables and as unchangeable,

Classroom Interventions	Institutional Interventions
• Remove Cues That Trigger Worries About Stereotypes	• Remove Cues That Trigger Worries About Stereotypes
• Convey That Diversity is Valued	• Convey That Diversity is Valued
• Create Fair Tests, Present Them as Fair and as Serving a Learning Purpose	• Create a critical mass of minority students
• Value Students' Individuality	• Create Fair Tests, Present Them as Fair and as Serving a Learning Purpose
• Improve Cross-Group Interactions	• Present and Recruit Positive Role Models from Diverse Groups
• Present and Recruit Positive Role Models from Diverse Groups	• Support Students' Sense of Belonging
• Help Students Manage Feelings of Stress and Threat	
• Support Students' Sense of Belonging	
• Promote a Growth Mindset About Intelligence	
• Value-Affirmations to Reduce Stress and Threat	

Derived from Empirically validated strategies to reduce stereotype threat by Walton, Cohen, & C. M Steele (2012). Used by permission.

Table 1 Classroom vs. Institutionally Focused Stereotype Threat Interventions

studies have shown that these beliefs can be altered (at least on a short-term basis) by modifying how abilities are described and the specific nature of praise (e.g., by praising effort rather than ability). Incremental students tend to be more focused on *improving* rather than *proving* ability to themselves or others (Dweck & Leggett, 1988; Dweck & Sorich, 1999; Mueller & Dweck 1998).

Aronson, Fried, and Good (2002) had undergraduates write a letter of encouragement to a younger student who was experiencing academic struggles. Black students who were encouraged to view intelligence as malleable, "like a muscle" that can grow with work and effort, were more likely to indicate greater enjoyment and valuing of education, and they received higher grades that semester. Good, Aronson, and Inzlicht (2003) showed similar effects with 7th grade students who received mentoring from college students. Mentoring emphasizing expandable intelligence and external attributions for difficulty produced higher reading scores and eliminated gender differences in mathematics performance. Learning in an incremental manner involves emphasizing the importance of effort and motivation in performance and de-emphasizing inherent *talent* or *genius*. Individuals who are encouraged to think in incremental terms will tend to react more effectively to challenge and are less likely to fear confirming negative stereotypes of their group. Creating a malleable (incremental) view of intelligence has also been shown to improve grades in all students, not only minorities and females (Blackwell, Trzesniewski, & Dweck, 2007).

2. Encourage values affirmation and affirmation of self (Miyake et al., 2010)

It is important for students to affirm themselves through writing about their characteristics, skills, values, and roles that they view as important (Frantz, Cuddy, Burnett, Ray, & Hart, 2004). Self-affirmation has been shown to be important for women to overcome threats to their mathematical skills in the lab (Martens, Johns, Greenberg, & Schimel, 2006) and for overcoming stereotype threat in a group of minority 7th graders (Cohen, Garcia, Apfel, & Master, 2006). Other researchers have achieved particularly impressive results by asking people to consider what is important to them, be it popularity or musical ability, and write about why it matters. The quick exercise acts like a drug that boosts students' self-confidence, helping them combat stereotype threat (Walton & Cohen, 2011; Cohen at al., 2009). Aguilar, Walton, and Wieman (2014) call this writing technique *saying-is-believing*, and found that it make the students feel as though they are a valued part of the classroom. To alleviate the effects of stereotype threat on stigmatized groups, Martens, Johns, Greenberg, and Schimel (2006) also encouraged students to think about what they value most before an exam. They also suggested that self-affirmation might serve as a buffer against stigmatization and its threatening effects. Schmader, Forbes, Zhang, and Mendes (2009) found that priming students before a test with self-confidence as opposed to doubt, known as positive reappraisal, not only reduced the effects of threat, but also increased performance. This finding was true for both minority and majority students.

3. Teach students about stereotype threat (Johns, Schmader, & Martens, 2005), allow them to discuss social class differences and deemphasize threatened social identities (Stricker & Ward, 2004)

An open dialogue about the threat that female students experience in mathematics courses is a valuable way to begin a new course. In raising the topic with students, teachers should consider asking the students to write down their thoughts about girls, boys, and mathematics and then talk about what they wrote. Teachers should feel free to ask students about the stereotypes that exist about girls' mathematics abilities and assess the degree to which the students believe these stereotypes (Johns, Schmader, & Martens, 2005). It is important to discuss stereotypes and how they are incorrect assumptions. However, do not focus too much on the stereotypes themselves to avoid making minority students feel uncomfortable, thus causing them stand out. This includes interventions in testing situations, such as asking them their ethnicity or sex at the end of a test instead of at the beginning, to reduce their salience, or self-awareness, as a minority (Stricker & Ward, 2004).

Interventions that encouraged individuals to consider themselves as complex and multifaceted (Gresky, Ten Eyck, Lord & McIntyre, 2005) and unique (Ambady, Paik, Steele, Owen-Smith & Mitchell, 2004) have been shown to alleviate stereotype threat. In some cases, it is important to highlight social identities that are not linked to underperformance (McGlone & Aronson, 2006), such as their accomplishments in school or out of school. There is much variance in the African American population as it relates to stereotype threat. Interestingly, one study showed that students who are biracial are less likely to experience stereotype threat (Shih, Bonam, Sanchez, & Peck, 2007) because they believe that race is socially constructed instead of internal. Although some well-meaning teachers make the statement, "I am colorblind; I see all students the same way," that is an inaccurate statement. African American students and other minorities want to know that their race and culture are respected. Colorblind sentiments should be avoided at all costs (Derks, VanLaar, & Ellemers, 2007; Purdie-Vaughs et al., 2008). African American students can be successful even in a predominantly white environment with proper support and encouragement (Sparks, 2013).

4. The teacher should give feedback that is mindful of stereotype threat, emphasize high standards and assure the students that they have the capabilities to meet those standards (Cohen, Steele, & Ross, 1999; Yeager et al., 2014)

Constructive feedback appears most effective when it communicates high standards for performance but also assures the student that he or she is capable of meeting those high standards (Cohen, Steele, & Ross, 1999). Such feedback reduces perceived evaluator bias, increases motivation, and preserves domain-identification, in this case the domains of mathematics and science. However, trust is something that must be earned. If a minority student does not trust the teacher's feedback, feeling it to be cold, biased, or indifferent, it could be dismissed (Yeager et al., 2013). Yeager et al. (2013) calls this feedback, which allows the student to trust the teacher and not feel judged or stereotyped, wise feedback. Wise *feedback* communicates to the student that the teacher has high standards but feels the student is more than capable of reaching those standards.

Teachers should avoid: (1) overpraising mediocre work, or (2) withholding criticism to not damage a student's self-esteem. Both are ineffective, especially for minority students (Yeager et al., 2013). Overpraising students with too many phrases like "What a smart comment" can have a negative effects as well. These convey a fixed intelligence mindset and should be avoided. It is also important that teachers pair critical feedback with excellent teaching strategies and do not simply rely on praise to help the students succeed. Students still need effective instruction, scaffolding, and extra practice to learn effectively (Aguilar et al., 2014). Students who continue to struggle while being continually praised will receive mixed messages and think the praise is not important or helpful. Aguilar et al. (2014) also found that warning students the first day of class that many of them will fail is ineffective and counterproductive; it is especially not motivational to African American students.

5. Expose students to positive role models who debunk negative stereotypes (Blanton, Crocker, & Miller, 2000; Marx & Goff, 2005). Although it is not always possible, having more minority teachers would be beneficial (Dee, 2004; Massey &Fischer, 2005)

Role models that are the same sex and ethnicity can help relieve students fears, increase performance, and reduce threat (Blanton, Crocker, & Miller, 2000). Studies by McIntyre, Lord, Gresky, Ten Eyck, Frye, & Bond Jr., (2005) and McIntyre, Paulson, & Lord (2003) showed that even reading essays about successful women can alleviate performance deficits under stereotype threat. Invite female guest speakers in mathematics fields to class. Consider a team-teaching approach with a female colleague. Include famous women in mathematics-related fields (mathematics, science, architecture, engineering, etc.) in the curriculum (Marx, 2002; McIntyre, Paulson, & Lord, 2003).

Studies find that having older (e.g., high school or college) students mentor younger (e.g., middle or high school) students eliminated gender differences in mathematics scores for the younger students (Good, Aronson, & Inzlicht, 2003). A female mentor who is relatively close to the younger student's age may be more likely to garner the younger student's attention and respect, therefore having a substantial effect on the student's learning, values, and habits. Students not only find out about role models, but they become the role model to a younger student. A teacher should also decorate their room with examples of minority scientists and doctors and show the students that science and mathematics is not an exclusively White male endeavor.

6. Reframe tasks to make them less threatening (McGlone & Aronson, 2006) and provide external attributions for difficult tasks, especially during testing (Johns, Inzlicht, & Schmader, 2008)

It is important to be honest with African American students and share with them that it is perfectly natural to be anxious before a test. Teachers do not have to go into specifics about stereotype threat or focus on the importance of the test. They should merely stress that all students have anxiety before a test and that it is a natural reaction. It is also important to assure females that the test is gender fair (Quinn & Spencer, 2001) and address the specter of gender-based performance differences within the context of the examination (Good, Aronson, & Harder, 2008). McGlone and Aronson (2006) found that priming students with positive aspects of their social identity (e.g., being enrolled in a private school or university or being a member of elite organization) can have positive benefits for overall test performance. Shih, Pittinsky, and Ho (2012) found that positive stereotypes presented to African American students could limit the effects of stereotype threat and even enhance performance through a process called stereotype boost.

Good, Aronson, and Inzlicht (2003) had mentors emphasize to young students that the transition to middle school is often quite difficult and that challenges can typically be overcome with time. Encouraging students to attribute struggle to an external, temporary cause also eliminated typical gender differences in mathematics performance. Johns, Inzlicht, and Schmader (2008) showed that telling individuals under stereotype threat that their performance will not be hindered and might even be improved by the anxious feelings they might be experiencing eliminated the performance decrements associated with stereotype threat. These studies indicate that providing individuals with effective strategies for regulating anxiety and arousal can disarm stereotype threat. Although it sounds counter-intuitive, you can even attribute a student's text anxiety to another source, such as an inaudible noise (Ben-Zeev, Fein, & Inzlicht, 2005), or an equipment failure (Brown & Josephs, 1999). The process of shifting blame and anxiety to an external attribute rather than the negative stereotype can ease anxiety and lead to better performance.

It is also important to provide students with positive stereotypes that counter commonly held negative stereotypes about their race or gender. Research has shown that providing girls with positive stereotypes about their mathematics performance effectively offsets the negative effects of stereotype threat (McGlone & Aronson, 2007). Every female student should know that, contrary to the stereotyped view that boys are more academically talented than girls, girls get better grades than boys as a group (Buchmann & DiPrete, 2006). Girls educated in all-girls mathematics courses have higher levels of mathematics achievement than girls in co-educational mathematics courses (Shapka & Keating, 2003). Research also demonstrates that stereotype threat is heightened for girls taking tests in rooms in which there are more boys than girls (Inzlicht & Ben-Zeev, 2003; Sekaquaptewa & Thompson, 2003), so they should be evenly distributed if possible during testing situations.

Intersections of Race and Gender

Studies have shown that female students in STEM fields are more likely to experience stereotype threat (C. M. Steele, 1997) and have higher rates of attrition (Brand, Glasson, & Green, 2006; Massey & Fischer, 2005) than their white peers. Female students of color

(e.g., African American, Asian American, and Hispanic) must negotiate both their status as a minority and as a female in the STEM world. Their *double negative* or *double bind* (McGee & Martin, 2011) status may contribute to lower numbers of female students of color entering and staying in STEM fields. Understanding this *intersectionality*, including how the individual chooses which identity to focus on in which situation, is a field of study in its infancy (Purdie-Vaughns & Eibach, 2008). Although some studies have looked at this intersectionality in Latinos (Gonzales, Blanton, & Williams, 2002) and Asians (Whaley & Noel, 2013), only a few studies were found that connected it to Black STEM students (Massey & Fischer, 2005) or Black students in general (Settles, 2006).

In the science or mathematics classroom, African American females, like the one mentioned in the fictional story at the beginning of this report, have twice as many hurdles to jump. Teachers must recognize that these students face the stereotype threat of being a female and a minority. One could even say that they face a third threat, or *triple jeopardy*, if they express interest in a STEM field where they are both small in number and have few examples of black female role models that they can follow. It is important they are not singled out and made to be the representative for *all* African American females. They must be nurtured and valued for their diversity and made to feel a part of the community of the classroom. It is even more important for them that they are exposed to African American female engineers, computer specialists, astronauts, doctors, and scientists through posters, reports, videos, or guest speakers to validate their interests and future presence in STEM fields (Farinde & Lewis, 2012). While the number of African American females in STEM majors is low, research has found that their potential is unmistakable. Riegle-Crumb and King (2010) found that African American females were more likely than were White females to declare a STEM major when academic preparation in high school was held constant. They were also more likely to succeed when given adequate support. Due to cultural beliefs regarding womanhood and family structure, African American women in particular should be ideal candidates for survival in STEM programs (Hanson, 2004). Specifically in the African American community, gender is constructed somewhat differently from that of the white (non-Hispanic) community. Many characteristics that are considered appropriate for African American females (e.g., high self-esteem, independence, assertiveness, and high educational and occupation expectations) are consistent with characteristics that contribute to success in science and mathematics (Hanson, 2004).

Conclusions and Cautions

The psychological interventions mentioned in this report are exciting in their implications for the classroom and for the future of mathematics and science. If implemented slowly and cautiously, they can make a big difference in the life of individual African American students. The interventions should be taught to classroom teachers, given to them as tools to effectively guide and mentor students of color. However, there are a few cautions to consider when implementing these techniques in the classroom. First, the methods will seem counterintuitive. In other words, it may seem natural to single out minority students for afternoon tutor sessions, or tell the students that a certain number of them may fail if they do not work hard, or give feedback that includes "You are so smart." However, the research has shown that these practices are exactly the opposite of what teachers should do (Aguilar et al., 2013). Minority students do not like to be singled out, told they will fail, or given praise that promotes a static view of intelligence (e.g. you are either smart or you are not). It is not the fault of teachers for ineffective classroom practices that have been passed down from generations, but there is a better way to interact with African American students, and the research conducted in the last twenty years is revealing that better path.

A second concern of teachers is that these techniques will take away precious instructional time and get in the way of their required curriculum. Yeager and Walton (2011, p. 293) ease those fears:

> Social-psychological interventions complement—and do not replace—traditional education reforms. They do not teach students academic content or skills, restructure schools, or improve teacher training. Instead, they allow students to take better advantage of learning opportunities that are present in schools and tap into existing recursive processes to generate long-lasting effects.

By recursive processes, they mean to say that these effects are long-lasting and cumulative. These interventions will hopefully increase the confidence of students, which could encourage them to take more advanced mathematics and science courses, which in turn could push them to consider mathematics and science as future career choices. In a sense, these stealthy interventions (quiet, not forced, easily implemented) calmly affirm students' value, push them to higher standards, and encourage them to belong in a diverse group of students. The most exciting possibility is that these interventions, combined in multiple administrations and implemented easily within day-to-day classroom interactions, could have a cumulative effect on raising African American student performance (Yeager & Walton, 2011).

The greatest cautions are believing that these interventions are a "magic bullet" or that they can easily be scaled to a school, district, or state level. They do not erase poverty, bad teachers, sloppily designed curricula, or change the socioeconomic situation of the students. However, they do give the student more confidence in the face of those hardships (Cohen, Garcia, & Jabr, 2013; Walton et al., 2013). It is also important that these strategies are implemented at crucial educational junctures to have the best chance of success. These include the beginning of the school year, during an important transition such as when a student enters a new school, when students are tracked into upper level mathematics or science courses, and before high-stakes exams.

The second caution is never to scale up these interventions to a larger level without considering the specific culture, population, and politics of the local school. The interventions need to be discussed by a group of teachers, counselors, and school administration. Simply sending this information to the teachers in a memo and telling them they must implement it is ineffective. These strategies should not be introduced without proper training. Schools may wonder if there is a problem with stereotype threat and if these interventions are needed, which in many cases is hard to determine. Three indicators that these interventions are needed include if African American students are (1) struggling in mathematics and science courses and standardized test scores, (2) having an unusually disproportionate number of discipline issues, and (3) being underrepresented in Advanced Placement mathematics and science programs (Walton et al., 2013).

In the big picture of social and psychological interventions, research on stereotype threat and its effects on students of color is scarcely twenty years old. Much has been learned, but there is still much to know. The psychological intervention strategies mentioned in this report, compiled from the recommendations of leading experts in the field, are a great place to start. Institutional practices were barely mentioned because the research on them is particularly sparse. The starting point for *all* significant progress in the field of stereotype threat is the classroom teacher. They are the gatekeepers. They hold the keys to making students of color feel welcome, accepted, and capable in the fields of mathematics and science. Combining these strategies with effective teaching methods and caring teachers who are well-prepared in mathematics and science instruction, has the potential to revolutionize the education of African American students in this country. Our future as an innovative nation and leader in mathematics and science depends on a diverse set of future workers, confident and inspired by the realization that they have much more value than the stereotypes they hear and receive from society. A classroom safe from these negative identities is a wonderful place for them to start.

Recommended Reading (Books):

1. *Whistling Vivaldi: How Stereotypes Affect us and What We Can Do* by Claude M. Steele
2. *We Can't Teach What We Don't Know: White Teachers, Multiracial Schools* by Gary R. Howard
3. *Identity Safe Classrooms: Places to Belong and Learn*, by Dorothy M. Steele
4. *Why are All the Black Kids Sitting Together in the Cafeteria and Other Conversations about Race* by Beverly Daniel Tatum
5. *Stereotype Threat: Theory, Process, and Application*, by M. Inzlicht and T. Schmader (Eds.)

Recommended Reading (Blogs/Websites):

1. Shielding Students from Stereotype Threat: A Guide for Teachers by Lisa Damour and Larry Goodman Fall 2009, National Association of Independent Schools, http://www.nais.org/Magazines-Newsletters/ISMagazine/Pages/Shielding-Students-from-Stereotype-Threat.aspx
2. What Can Be Done to Reduce Stereotype Threat? on www.reducingstereotypethreat.org/reduce.html
3. Countering Stereotype Threat on Dynamic Ecology Blog by Meghan Duffy on http://dynamicecology.wordpress.com/2014/04/29/countering-stereotype-threat/
4. Stereotype Threat www.stereotypethreat.org
5. How to Expel Hurtful Stereotypes from Classrooms Across the Country in *Scientific America* http://www.scientificamerican.com/article/stereotype-interventions-expel-from-classrooms-across-country/

Recommended Watching (Videos):

1. Stereotype Threat: Social Psychology in Action http://www.youtube.com/watch?v=nGEUVM6QuMg
2. An Interview with Claude Steele http://www.youtube.com/watch?v=failylROnrY
3. Stereotypes: Stossel in the Classroom http://www.youtube.com/watch?v=ASDzcvyatgw
4. The Anti-Racism Experiment That Transformed an Oprah Show Audience | Where Are They Now? | OWN https://www.youtube.com/watch?v=5NHeFgaVWs8

Intervention Example:

PERTS https://p3.perts.net/about#team

Table 2 Resources for Stereotype Threat Reduced Classroom

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