

The salience of identity in the academic success of Black STEM students and professionals

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ABSTRACT

This paper contains some historical views and will demonstrate how issues related to identity impact the stigmatization and marginalizing that underlie the underrepresentation of Black people in the STEM fields. In this paper, identity is defined within the educational context and a framework is provided for exploring how STEM students and professionals author and perceive their own identities in relation to their educational and professional aspirations. This paper will also demonstrate how these authored identities are impacted by those with whom they share the STEM learning and work environments. The authors will present their own data to further demonstrate how a focus on STEM identity development results in significantly enhanced STEM academic outcomes for Black students.

KEYWORDS

STEM; identity; Black students; achievement

Defining identity in the education context

This paper offers an analysis on identity aimed at exploring how Black students and professionals author and perceive their own identities in relation to their educational experiences, particularly in the context of STEM education and work. Simultaneously, the paper also has a focus on how these identities are impacted by the people within the STEM learning and work environments. The paper will focus on Black STEM students and professionals, even when at times reference is made only to one group.

In the education context, identity has both an exclusive and inclusive component. Having an identity as belonging to a particular racial or ethnic group is exclusive as it without prejudice excludes those belonging to other such groups. It is also an identity that is relatively uncontested and uncomplicated and therefore rarely challenged. The relevance of this exclusive and uncontested identity is the empirical finding that when students have positive perceptions of their racial identity their chances of achieving academically are significantly enhanced (Oyserman, Elmore, & Smith, 2012; Wright, 2009)

The inclusive component of identity refers to the fact that all learners in a learning context need to be included and fully recognized as full members of the learning community (Pinder, 2020; Pinder, 2013; Pinder, 2008 A; Pinder, 2008 B; Pinder & Blackwell, 2013). This educationally vital inclusive identity can be denied to some students in many ways. It is well established that Black students and professionals are oftentimes denied this vital inclusive membership in STEM learning and professional communities. Within this framework of identity, 'stereotype threat' can be viewed as a mechanism to deny Black students and professionals inclusion into what their education and professional progress require (Apple, Weber, & Kronberger, 2015; Dewar, 2020; Johnson-Ahorlu, 2013; Kwak, 2021; McClain, 2016; Massey & Owens, 2014; Steele, 2018).

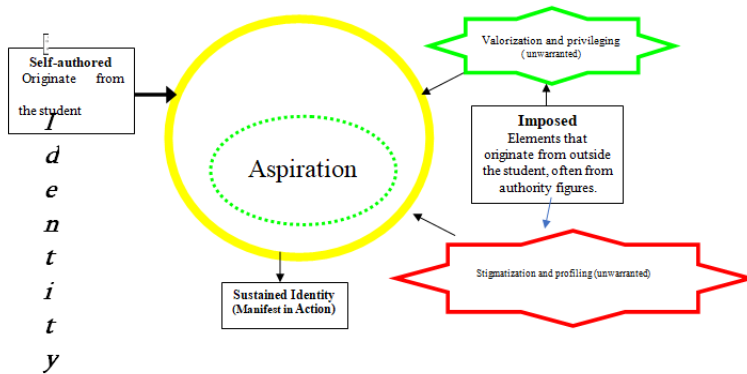
Many studies have linked student identity to school success (Elmore & Oyserman, 2012). A well-established insight from social psychology is that the cultivation of 'possible selves' (images of the selves one would like to attain) is critical for motivating action (Anderman, Anderman, & Griesinger, 1999; Maurice, 2018; Strahan & Wilson, 2006; Straumann & Higgins, 1988; Syed, Azmitia, & Cooper, 2011). These possible selves are constructs which can be viewed as aspects of identity formation and development. A number of studies have reported that adolescents with school-focused possible selves are at reduced risk of involvement in delinquent activities. Such adolescents also perform better at school, and feel more bonded to school (Oyserman, 1993; Oyserman & Harrison, 1998). The research program of which this study is part, has focused on how to develop school experiences and perceptions of African American students that are geared toward fostering the cultivation of exactly the types of racial self-concepts or 'possible selves' that have been identified as associated with high academic performance and engagement (Hock & Deshler, 2006; Oyserman, Terry, & Bybee, 2002).

The inclusive identity has a variety of components which may interact with each other in different ways. The perceptions and aspirations that a student or professional bring to the STEM learning or working context constitute a crucial aspect of their inclusive identity. Figure 1 is a diagrammatic representation of how the authors conceptualize the relationship among identity, aspirations, and perceptions. Identity is conceived as both authored by the individual and imposed by others. Authored identity is viewed as an individual's sense of who they are. Imposed identity would be the sense that others might have of an individual's identity.

Special emphasis is placed on the identity that teachers and other authority figures impose on students. It is important that persons who wield power over the lives of students and professionals not use perceptions based on unwarranted stigmatization or unwarranted valorization to impose identities on their charges. There is also a need to further distinguish between authored identity and sustained identity. Sustained identity is manifested in

achievement commensurate with the authored identity. It is one thing for a student or professional to think of themselves as highly motivated and with high aspirations (authored identity) and quite another for that student to sustain the effort required to record the achievement expected from a highly motivated individual (sustained identity).

Figure 1
Model depicting the relationship between student aspirations, identity, and perceptions



Aspirations as part of authored identity serve as useful capital; in that, it helps the individual sustain goal setting and goal maintaining behaviors. An example of imposed identity is when a teacher regards a student as either having or lacking high educational aspirations. This imposed identity serves as useful capital for the student; in that, teachers are more likely to expend effort on students they perceive as motivated, than on those they perceive as unmotivated.

A teacher or supervisor’s belief that a Black student or insubordinate has a lower aspiration to succeed than white peers will negatively impact the interactions of the individuals involved. That negative impact is aptly described by Holland, Lachicotte, Skinner, and Cain (1998) as follows:

Even in situations where all students are admitted to the arena of learning, learning is likely to become unevenly distributed in its specifics. Teachers will take some students’ groping claims to knowledge seriously on the basis of certain signs of identity. These students they will encourage and give informative feedback. Others whom they regard as unlikely or even improper students of particular subjects... are unlikely to receive their serious responses. (p. 135)

Imposed and authored identity may interact in positive or negative ways. A student’s authored identity as a motivated individual can be undermined when a teacher or other authority figure imposes a negative identity on that student. The interaction between authored and imposed identity can be illustrated by media reports of a few years ago on the incident involving media personality Don Imus and the Rutgers University women’s basketball team (Hiachere, 2007). Commanding an audience of millions, radio personality

Don Imus imposed a negative identity on a team of predominantly Black athletes. The identity he imposed on these athletes was couched in racist and sexist stereotypes and additionally implied that these young women were thuggish ('hardcore'). When these young women went public in challenging Imus, it was clear that the identity that they had authored and sustained for themselves was that of motivated and accomplished selves. To the extent that their authored and sustained identity was demonstrably very unlike the identity that Imus had imposed on them, the imposed identity amounted to unwarranted stigmatization. It was also clear from their reported statements that the negative identity imposed on them by this powerful individual had a negative impact on them; in that, it reduced, if only temporarily, their ability to sustain a goal-directed focus.

As will be pointed out below, an analysis of the National Longitudinal Study of Youth data (NLSY, 1997), *Norman et al. (2006)* found that while the aspirations of Black students are not different from that of white students, Black students have more negative perceptions of their learning environments. The empirical evidence therefore is that the attitude of Blacks has both negative and positive aspects. The position advanced in this paper is that this ambivalence, which can be easily mistaken for a lack of commitment to education, should be seriously considered by educators at all levels. It is an ambivalence that can be seen as an existential echo of Du Bois' (1903) notion of the 'double consciousness' that characterizes Black life in America.

The ambivalence that Blacks might have regarding the promise of education may to a large degree be a reflection of the ambivalence that American society has always displayed toward Black advancement and inclusion. This ambivalence is discernible throughout the nation's history beginning with the uneasy tension that has always existed between the nation's enlightened democratic impulses of inclusion and equity and its benighted traditions of exclusion and marginalization. The tension was lurking right there from the country's inception in the contradiction of slave-owning founding fathers seriously committing themselves to establishing a republic based on the enlightened idea that all persons are born equal. Since then, American history has been an uneasy dance between its enlightened ideals and its less enlightened traditions and practices.

As early as the Reconstruction period, the Black philosopher Alain Locke described what he saw as the paradox between the rhetoric of democracy and its failure to deliver on the promise of freedom and equality for all. Locke, the son of a middle class northern Black family has emerged as a prominent educational philosopher of the late 19th and early 20th centuries (Cain, 2004). In his work entitled *Race Contacts and Interracial Relations*, Locke (1915/1992) analyzed race relations in American society and concluded that the path to improved race relations was through education. However, his own experiences of racism at Harvard and as a Rhodes Scholar at Oxford later tempered his optimism about the power of education to bring about meaningful equity in society.

An adequate approach to student aspirations requires that aspirations be viewed separate from, albeit in the context of students' perceptions about the rewards and other pertinent aspects of education. Separating aspirations from perceptions is one way to avoid the confounding of causes and effects which O'Connor, Lewis, and Mueller (2007) ascribe to the under theorizing and inadequate conceptualization that has characterized some of the scholarship on Black education. Aspirations are driven by a quest for rewards, both tangible

and intangible, and are therefore responsive to perceptions about rewards. Ogbu and Simons' (1998) construct of 'effort optimism' captures this aspiration-perception nexus. The effort to maintain high aspirations may be easier to sustain when there are optimistic perceptions about the eventual rewards which drive the aspirations in the first place. It is therefore, at least in theory, conceivable that some members of groups that have experienced the inequitable distribution of the rewards of education may find it difficult to sustain their educational aspirations compared to members of groups with no such experiences. Using analyses similar to those in this paper, Buttaro, Battle, & Pastrana, (2010) also used the NLSY data set to explore the gap between the aspirational authored identity and sustained identity of Black students.

Researchers have always recognized the connection between student aspirations and students' academic achievement (Christofides, Hoy, Milla, & Stengos, 2012; Fox & Faber, 1981). Fox and Faber (1981) have also provided empirical evidence that for some students the level of aspiration is impacted significantly by their perceptions of the extent to which the structures and arrangements of society create jobs and other reward opportunities for them.

The analysis used in this paper is located within Critical Race Theory (CRT; Ladson-Billings & Tate, 1995) and more specifically in the Africana Studies Approach of CRT as described by Lynn and Bridges (2009). According to Lynn and Bridges (2009), the Africana Studies Approach of CRT view African diasporic cultures as sites for the development and construction of theories that will look beyond African people's marginalization to explore how they define, frame, and develop an emancipatory critical praxis in schools and society.

Empirical findings on student aspirations and perceptions

The conceptual and theoretical analysis advanced in this paper is informed not only by the empirical work of Fox and Faber (1981) and others (Christofides, Hoy, Milla, & Stengos, (2012), but also by an empirical analysis reported by the authors of this paper elsewhere (Norman et al., 2009; Norman et al., 2006; *Norman, 2013*). As part of exploring the nexus between aspirations and perceptions, this study set out to determine the responses of a large random sample of Black and white students to survey items that addressed their educational aspirations as well as their perceptions of their learning environments. The analysis was done on data from the NLSY (1997).

The NLSY 97 consists of a nationally representative sample of approximately 9,000 youths who were 12 to 16 years old as of December 31, 1996. The cohort continues to be surveyed annually or on a biennial basis. In addition to the Student t-test, the analysis also addressed the following two questions identified by Kirk (2001) as crucial in the analysis of mean differences: 1) How large is the effect? And 2) is the effect large enough to be considered useful? In order to answer these questions, the authors used Cohen's *d* (1988), the difference between the sample mean responses of the two groups divided by the approximate or estimated common standard deviation. As Table 1 shows, no significant difference was found between the expressed aspirations of white and Black adolescents. The only significant difference found was in the way these white and Black adolescents perceived their learning environments. Black students perceive their learning environments

significantly more negatively than their white peers. The complete analysis consisted of 41 aspiration and 32 perception items, but only the results of two of each construct are shown to illustrate the overall findings.

Table 1
Effect sizes (Cohen's d) and difference of means (t-test results) of selected student aspiration (As.) and perception (Pe.) items

Aspiration Items	Source	Cohen's d	t-test
As. 1. Percent chance you will graduate college by age 30 (2001 survey)	NLSY 97	0.03	AA < W NS
As. 2. Percent chance you will graduate college by age 30 (1997 survey)	NLSY 97	0.05	AA < W NS
Pe. 1. Are students graded fairly?	NLSY 97	0.27	AA > W**
Pe. 2. Are teachers good?	NLSY 97	0.23	AA > W**

Note: AA = African American subjects; W = White subjects, NS = non-significant, Df = 2, As = Student Aspiration Item, Pe = Student Perception Item
Significance is established at: * p < 0.05, ** p < 0.01, Weighted means were used.

The findings of this study are very similar to those of Carter (2003) who found that 84% of the Black students in her sample of 44 aspired to go to college, but only 64% expected to attend college because of financial constraints. According to Carter, the interviews with her subjects revealed 'no evidence that their preference for 'black' cultural capital lessened their desire for high academic and career aspirations' (p. 147).

Scientific racism and the creation of stigmatized identities

Leading scientific bodies such as the US National Academy of Science (NAS) should be lauded for taking the lead in combating racism in STEM and advocating for more STEM participation by underrepresented groups. An example of these praiseworthy efforts would be publications of the NAS such as the 2004 book on measuring discrimination (Blank, Dabady, Citro, & NRC, 2004). But it must be pointed out that the persistence of the stigmatization of marginalized groups in STEM might very well be due to the fact that leading voices from within the US NAS once strongly advocated for the stigmatization of marginalized groups. One such prominent advocate of stigmatization was Harvard's geologist Louis Agassiz who was a founding member in 1863 of the US NAS and also served on the Board of Regents of the Smithsonian Institution. Note how Agassiz imposes inferior identities on Blacks and Mongolians while valorizing others:

The indomitable, courageous, proud Indian--in how very different a light he stands by the side of the submissive, obsequious, imitative Negro, or by the side of the tricky, cunning, and cowardly Mongolian! Are not these facts indication that the different races do not rank upon one level in nature (Agassiz, 1850, p. 144)

Agassiz is only one of many prominent scientists of his era who used the imprimatur of science to stigmatize Blacks and other as inferior to whites. *Norman (1993)* dealt with how members of stigmatized groups arose to oppose the racism, sexism, and classism espoused and advocated by mainstream science from its institutionalization until the first half of the 20th century. Because science played a major role in advancing the marginalization and stigmatization of groups still underrepresented in STEM, the scientific enterprise must embrace its responsibility to take an equally prominent and vocal role in the eradication of that marginalization and stigmatization. It is open to question whether the National Academy of Science is adequately embracing that responsibility.

Stereotype threat as a stigmatizing assault on identity

The leading theorists on minority education such as John Ogbu, Aaron Steele, and others have posited valuable theoretical constructs for framing the issues germane to the performance patterns of minority students. The conceptual and theoretical analyses in this paper attempt to provide the calibration needful for a more nuanced understanding of the construct of ‘oppositionality’ (see Akom, 2003, and Carter, 2005, for additional accounts on ‘oppositionality’). The conceptual analysis suggested in this paper is that the ‘oppositionality’ of Black students, to the extent that it does exist, may not manifest itself as diminished educational aspirations as Ogbu and Davis (2003) imply, but rather as an increased negative perception about school and schooling. Ogbu and Simons (1998) observed a diminished ‘effort optimism’ and a heightened ‘oppositionality’ among Black students. According to Ogbu and Simmons (1998), the daily experiences of Blacks signal to them that they should expect fewer rewards for their efforts, hence their decreased level of effort optimism. These same signals also engender a heightened sense of ‘oppositionality’ or resistance which in adolescents may manifest itself as a counter-productive disengagement from academic studies (Ogbu & Simons, 1998). Steele (1992, 1997) explored a related question concerning the type of experiences that Blacks have and which might undermine their identification with all or certain aspects of school achievement. Some of these factors have been identified as: disadvantaged socioeconomic backgrounds, a history of oppression, inadequate school resources and perceived stereotype threats. These factors may cause Black students to have an ambivalent attitude toward education. Ogbu’s earlier work had a decidedly structuralist streak. He pointed out that the manner of a group’s incorporation into a society (voluntary or forced immigration) and other structural features of societies impacted the school performance of students from various groups. However, Ogbu’s (2003) last work was widely criticized for making the decidedly culturalist argument that the low performance of Black students was caused by their failure to value education.

Underlying the 'stereotype threat' described by Steele and others is the stigmatizing of students as either genetically or culturally deficient. Steele and Aronson (1995) advanced the idea that competitive learning environments may engender 'stereotype threats,' which may compromise the test performance of African American and other minority college students who suspect that they are perceived as intellectually inferior. Stereotype threat is the apprehension felt by members of stigmatized groups that they are at risk of confirming a negative stereotype of their group. According to Steele, "for too many Black students, school is simply the place where more concertedly, persistently, and authoritatively than anywhere else in society, they learn how little valued they are" (Steele & Aronson, 1995, p.11; see also Aronson, 2004). Steele cites these negative school experiences as an important source of the 'disidentification' of some Black students with learning.

The significance and uniqueness of Steele and Aronson's work is that it sheds light on a putative mechanism for the test score gap. Teachers' negative perceptions about the ability of Black students, in turn, elicit negative student perceptions that manifest themselves as 'oppositonality' and /or stereotype threat. Both manifestations seriously undermine students' motivation and ability to perform optimally on academic tasks. According to Steele (1997), stigmatizing is at the root of the stereotype threat that undermines student performance on academic tasks. The analysis presented in this paper suggests that one way in which stereotype threat may be evoked is by way of an unwarranted stigmatization or the imposition of an unearned negative identity. Steele's basic idea is that negative stereotyping induces a 'stereotype threat' that inhibits optimal performance in those who are negatively stigmatized. It may be that by the same token a positive stereotyping of a group in a particular domain may induce a 'stereotype affirmation' that gives members of the positively stereotyped group a competitive edge in that domain. There are anecdotes of Asian students reporting that their stereotyping as academically talented does give them confidence to push themselves to higher levels of academic performance. This persistence in the face of the inevitable obstacles encountered in learning, is crucial to academic success. It is open to question whether the same principle of 'stereotype affirmation' gives Black athletes a competitive advantage.

Carter (2003; 2005) has shown that students from different cultural backgrounds bring different kinds of cultural capital to the learning context (Yosso, 2005). However, the cultural capital of students from minority cultures is often not valued as much as the cultural capital of students from the dominant group. In an analysis of data from the NLSY (97), the authors of this study found that at least with regard to the extent to which they value education, both Black and white students bring the same capital to the classrooms (Norman et al., 2009; Norman et al., 2006; Norman et al., 2001). This raises the question: Why does the same capital not have the same 'purchasing power' for the two groups in the learning environment? This differential acknowledgement and validation of the same capital is structural; in that, it exemplifies society's social structure of inequality (Loury, 2002).

How an intervention based on countering stigmatized identities has shown promise of improving student STEM performance

In the foregoing paragraphs, the aim was to demonstrate how issues of identity play into the stigmatization and marginalizing that underlie the STEM underrepresentation of Blacks and other communities. This study now addresses the possibility that confronting and countering the marginalization and stigmatization of individuals can form the basis of effective teaching interventions aimed at improving academic outcomes for Black students. Given the entrenched and pervasive nature of the debilitating stigmatization described so far, it is highly unlikely that interventions that ignore the issues of identity stigmatization can be effective in helping Black students thrive academically and Black STEM professionals access and remain in STEM careers. There is a strong suggestion in the literature that when teachers use hands on and inquiry-based approaches advocated in the standards-based reform movement, all students benefit, but minority students benefit the most (see Schoenfeld, 2002). Inquiry based approaches impact student identity; in that, the levels of intrinsic interest in STEM inculcated can lead to the students more closely identifying with the STEM domain. This domain identity or fealty has been associated with improved STEM learning as well as persistence in STEM careers,

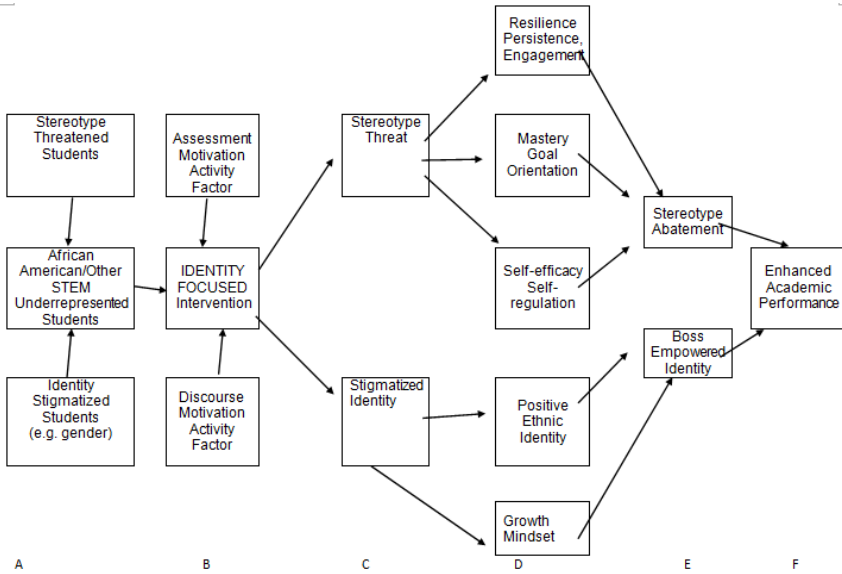
The National Research Council of the NAS has called on the education research community to develop effective empirically validated STEM teaching interventions that can be used effectively by STEM teachers. In response to this call, the lead author of this study has developed an intervention that is focused on student identity. The rationale for the intervention and its components have been described in Norman (2013a&b, 2014). In this study, the only aspects of the intervention highlighted are the results obtained in the pilot of the intervention and how the issues of identity are addressed in the intervention.

The intervention pilot was conducted at an HBCU in the US mid-Atlantic region. In a final department wide Biology examination, the students in the intervention sections obtained an average score of 72%. That was the highest score of all eight other sections that took the same examination. The intervention students outperformed the students in the non-intervention sections by more than 20% as the average score of the non-intervention sections was 50%.

The intervention's approach to identity is depicted in Figure 2 and the accompanying explanatory notes on the elements of the teaching and assessment intervention.

Figure 2

The identity focused intervention that resulted in significant improvement in the STEM performance of African American students at a Historically Black College and University (HBCU)



Discussion and implications for future research, practice and policy

The main policy and practice implication of this study is the need to find ways of countering the debilitating effects of stigmatization on student self-concept. It is important to consider that stigmatization may not only undermine student performance by engendering stereotype threat. Stigmatization may also undermine student academic engagement by compromising the development of the type of student self-concept that social psychologists have identified as associated with high academic achievement. Oyserman, Terry, and Bybee (2002) have identified the two types of racial self-concepts that are compatible with high levels of academic engagement and performance for African American students. If schools are to seriously take on the task of eliminating the achievement gap, schools must create learning environments that promote the development of the productive kind of racial self-concepts among African American adolescents (Norman, 2013b). The study results on student perceptions seem to suggest that schools may not be meeting this goal. The results suggest strongly that African American students have more negative experiences at school and that this may lead them to have more negative perceptions of school than their white counterparts.

If educators hold on to the unwarranted belief that Black adolescents do not value education as much as their white peers, they are contributing to the debilitating stigmatizing of Black students that has the potential to exacerbate the test score gap. Corrective policy

and practice responses can be directed to the areas that are identified in the study as potential causes for the more negative perceptions about school held by Black students. The analysis presented here suggests that Black students find schools less nurturing, equitable, and welcoming than their white counterparts. The policy, teacher education and STEM workplace implications of these findings are that steps should be taken to ensure that STEM learning and work sites become more equitable and welcoming for members of hitherto underrepresented communities (Barton, Tan, & Greenburg, 2016; Godley, Sweatland, Wheeler, Minnici & Carpenter, 2005).

The results presented in this study show that Black students do not believe that the teachers at their schools are as good as white students believe their teachers are. It is a well-known fact that schools serving large minority student populations have on average teachers who are less qualified than teachers at schools serving predominantly white students. Policy makers should ensure the provision of highly qualified teachers as well as adequate or at least equitable resources to schools serving large minority student populations. This should be part of a policy reappraisal that situates the 'achievement gap' in the larger context of a 'resource gap' in education (Anyon, 1997, 2005; Jimenez-Castellanos, 2010; Ladson-Billings, 2006). This resonates with Ladson-Billings' (2004, 2006) notion of viewing the achievement gap as a 'national deficit' for which solutions should be sought mainly in structural adjustments, in resource expenditure, and resource allocation.

Teachers and others working with minority students should recognize the need to have a solid empirical basis for perceptions about students in order to avoid unwarranted stigmatization of students. Teachers should actively and continuously look for instructional approaches that students find engaging and not alienating. Concern about all students' educational aspirations is always justified (Irvin, Byun, Meece, Reed, Farmer, 2016; Sax, 2007). Given the structural societal inequities, minority students are also more likely to pay a higher price for their lack of adequate commitment to education, even if that lack is no worse than that of their white peers. This realization should lead to redoubled efforts to ensure that minority students maintain a high level of commitment to education. What is never justified is the unwarranted stigmatizing of minority students as less committed to education than their white peers. The analysis presented shows that this stigmatizing of Black students is unwarranted and without empirical basis.

The conceptual framework (Figure 1) presented in this paper provides a basis for framing research questions on student aspirations and perceptions. How can a student's self-authored identity as 'motivated' be harnessed to help the student sustain that motivation in demonstrated increased effort and commitment to academic pursuits? This question is of particular importance for African American students. Research suggest that for African American students there is a disconnect between their expressed levels of motivation and their level of sustained motivation (Buttaro et. al., 2010). The reasons why teachers stigmatize certain students and valorize others is an area for research as well as professional development aimed at curtailing such unwarranted stigmatization and valorization.

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