The Politics of Public Discourse: Discourse, Identity, and African-Americans in science education

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ABSTRACT

This review examines twenty years of research (1985 to 2005) on African-American students in science education. This analysis identified three types of research studies on African-Americans. First, a series of studies provided status reports of African-American students’ performance in science. Second, a series of studies highlighted cultural discontinuities that existed between African-American students and the culture of science classrooms. A third series of studies called for the identification of cultural continuities that exist between African-American students’ culture and science. The results of this review implicated scholars’ failure to thoroughly explore the relationship between students’ language, identity, and their influence on science learning. This review concludes with an analysis of how scholarship on African-Americans in science would benefit from incorporating a theoretical perspective that values the influence of African-American students’ language practices on science learning.
The Verbal Advantage

Amid the barrage of negative commentaries regarding the status of education, there is good news. The good news is that those without the verbal skills associated with educational achievement can purchase the verbal advantage needed to obtain intellectual privilege. This insight came in the form of a commercial from Verbal Advantage TM, a company that offers vocabulary training for those who have the desire to improve their verbal repertoire. They provide a not so subtle implication for language use, by suggesting that those who use more sophisticated words will eventually achieve an image of intelligence. Ultimately, they make the profound argument that acquiring an advanced use of words can change your image and thus, provide you a Verbal Advantage.

Can this be true? Can our intelligence and sophistication be measured through our vocabulary? If one can use the evidence of words to judge sophistication and intelligence, then could the use of particular words signal intelligence and sophistication? Could I engage in the game of attempting to appear less intelligent or less sophisticated by selecting the appropriate combination of words? Could I carefully use my words to sound like a particular type of person, simply by selecting the correct set of words? This idea is far from novel and exists at the very edge of our conscious awareness. However, I was impressed that a company would be savvy enough to market and provide consumers with the promise of sophistication and the appearance of intelligence by merely teaching them to use words in a skillful manner.

Challenged with these ideas, I felt compelled to visit their website where I encounter this statement:

It is our mission to make certain you have the very best tools available in this millennium of Internet communication and digital dialogue. We understand that no matter what the medium, the message always needs words; used correctly, and with clarity and style.

This excerpt from their mission statement struck a cord with me. I was particularly intrigued with the idea that language has two components that lead to the acquisition of a verbal advantage: clarity and style.

The notion that clarity is key to helping individuals achieve a communicative advantage is based on a theoretical assumption that the speaker and listener share a common understanding. Clarity is connected with two aspects of interpretation; First, the speaker selects signals that she assumes represent the idea. Second, the listener determines what the speaker intended to communicate. When both the speaker and the listener arrive at the same conceptual understanding, clarity is achieved.

The style aspect of the communication process extends the notion of clarity by suggesting that the speaker can choose from several ways to communicate the same idea. Baugh’s (2001) work on variation explores this phenomenon by noting how the selections of particular genres are more privileged than others. Ultimately, Verbal Advantage TM based its advertising on the notion that they have identified the privileged genre (style), and can teach the consumer to use this privileged discourse with clarity. Considering these issues

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1 Verbal Advantage maintains the trademark to its product title. This reference is for analysis purposes on and does not promote or critique the value of the product.

2 This quote is taken from the Verbal Advantage websites at: http://www.verbaladvantage.com/about/index.cfm
led me to consider how the notion of a verbal advantage could be applied to the rich discourse of science learning and its implications for African-American Students.

Clarity and Style in Learning Science

When considering the verbal advantage issue and the notions of style and clarity in the context of learning science, the style of communication in science becomes intriguing. Science educators have implicated the role of talking science as one of the keys to students' success (Brown, 2004; Fang, 2004; Lemke, 1990). In the broader education community the conflicts African-American students experience while using academic talk have been explored (Bergin & Cooks, 2002, Fordham, 1996), yet research on the role of discourse conflict and African-American students have limited in science education.

One of the many critiques of science involves its reliance on the notion of objectivity. The depersonalization of scientific text provides science with a way to construct the phenomenon or processes of science as unique entities (Fang, 2004; Halliday & Martin, 1994). Science has developed a way to convert complex processes that are generally described through clauses, into simple nouns that represent complex ideas in a concise manner (Fang, 2004; Halliday & Martin, 1994) Research has explored how processes like Photosynthesis and Glycolysis can be converted into tangible things by referring to them in noun form (Bazerman, 1986; Fang, 2004; Halliday & Martin, 1994). In fact, scholars of science have examined the rhetorical practices that allow scientists to change intricate biological processes (e.g. standing water, evaporating water vapor, and falling rain) into singular abstract phenomenon (e.g. The Water cycle) [Fang, 2004; Halliday, 1996; Halliday & Martin, 1994]. Once this rhetorical reconstruction has been accomplished, this style of scientific communication provides it users with a venue where complex ideas can be readily exchanged if users share the same interpretive framework. Rhetorical strategies like these provide users of science discourse resources for reducing complex processes into simple nouns or noun phrases (Halliday & Martin, 1994). This practice, along with other discursive practices, like removing the narrative and personal voice of writers, creates a discursive environment in which the language of science has evolved into a lexically dense, impersonal, fact-driven type of discourse.

In many ways the density, complexity, and functionality of science discourse can provide users with a verbal advantage. If we consider how the discourse of science provides learners with a verbal advantage, due to its detailed discursive style we must ask; what are the consequences of using science discourse in public arenas? Science educators, often assume the acquisition of this style of discourse is an unproblematic process because all students must learn to use the discourse of science (for exceptions see Brickhouse 1994; Brown 2004; & Rosebery, Warren, & Conant, 1992). The work of Stanley and Brickhouse (1994) suggests that the science community's reliance on the notion of objectivity shelters science from multicultural critiques. Ultimately, research on the discourse of science and African-American students suffers from the same oversight. Many scholars of science education assume that the discourse of science exists as an apolitical, objective language that is accessible to all.
positioning.

How is science discourse different? Seen from this perspective, this review of contemporary research on African-American students in science education argues that the symbolic meaning of using science discourse serves as a limiting factor for student achievement. More specifically, the work makes the assertion that scholars of African-American students in science education must begin to explore how issues of language, identity, and classroom learning are connected to the relationship between students’ identity as expressed through language as they attempt to appropriate scientific discourse.

If science teaching is seen through a lens that examines the sociocultural value of using science discourse, science teaching can be conceived as the process of assisting students in successfully engaging in science discourse. In light of this consideration, this review maintains two primary objectives. First, it seeks to review and expand the notions of cultural conflict and mismatch that pervade the body of existing research on African-American students in science. Secondly, this review will examine the cultural politics associated with using science as an academic discourse. Third, this review will examine the theoretical notion of a Discursive Identity as a framework for understanding African-American students' experiences with science learning. Fourth, this study will introduce potential research directions for studies of science discourse appropriation for African-American students.

**Studies of African Americans in Science Education**

Although this review takes a broad view of studies of African-American students in science education, to examine trends in science education published over the last 20 years, I chose to focus this assessment on three significant journals (International Journal of Science Education, and Journal of Research in Science Teaching, and Science Education). The use of these three leading science education research journals provided the opportunity to evaluate the trends in published research on African-Americans. In the initial attempt to collect a complete listing of articles published in the past 20 years, I conducted a computer-guided search using the Web of Science search engine. This allowed for the identification of articles examining African-American students in science education, while also providing an index of cross-referenced articles that were cited by the author(s). The key words for the primary searches were: African-American, Black, Minority, Negro, Urban, & inner city.

Contemporary studies of African-American students in science education have provided an overview of the experiences of African-American students in science education. Existing studies are of three sorts: First, a series of studies provided reports of
the status of African-Americans in science. Second, a series of studies offered a perspective that highlights the perceived cultural discontinuity that exists between African-American students and the culture of science classrooms. A third series of studies examined the cultural continuities that exist between student African-American culture and science. Many of these perspectives offered pedagogical interventions that were designed to promote improved performance of African-American students. Taken together, research on African-American students in science education makes a concerted effort to call attention to the contemporary role of science education in African-American communities.

Reports of Student Performance

One of the most prevalent areas of research on African-Americans involves examinations of the contemporary and historical performance of African Americans (Alick & Atwater; 1988; Campbell, Denes, & Morrison 2000; Lewis & Collins, 2001; Norman, 1998). A series of investigations called attention to the effects of our current failure to provide African-American students with equitable access to science careers. Tate’s (2001) investigation suggested that providing access for African-American students equated to an issue of civil rights. Tate states; “I argue that the opportunity-to-learn literature provides science educators with the theoretical perspective necessary for viewing school science as a social justice construct. An analysis of three opportunity-to-learn constructs will illustrate their potential as civil rights tools in science education (p. 1016).” Although housed in the broader argument for improving ‘urban education,’ this analysis uses the history of legislation for African-American students in education as a framework for implicating how failure to improve science education can ultimately be seen as an issue of civil rights. Norman (1998) posed the issue of civil rights and social justice by critiquing science as a marginalizing discourse. In an analysis of how pseudo-scientific practices like Phrenology and Craniometry were used to supported racist political ideologies, Norman examined the discourse of science as an issue of social justice. Norman explained:

The discourse on race and gender raise the question of scientific objectivity in very compelling ways. In the context of scientific literacy, it is absolutely crucial that the question of fraudulent science in the interest of political ideology be treated separately from the more fundamental question of how problematic it is to achieve complete objectivity in science. It would be a disservice to students to present the unsavory history of science in matters of race and gender as a simple case of science gone wrong owing to infection by cultural influences. (p.371)

Norman’s work essentially brought issues of scientific discourse into the body of work that explores science learning as an issue of social justice.

Other studies investigated how the systemic problems of teaching African-American students, including problems of teachers lacking science knowledge, poorly
trained teachers, and poor expectations continue to exist and can be seen as a social inequity for African-American learners (Atwater, 2000).

In a report of the historical conditions that are thought to have created the achievement gap between African-American students and their White counterparts, Norman, Ault, Bentz, & Meskimen (2001) called attention to the sociocultural factors that lead to marginalization. Their research lobbied for the use of Ogbu’s (1978) model of cultural conflict as a framework for understanding the achievement gap. Normal et al. (2001) suggested “a functional approach to the culture of schooling also provides a useful contextual framework for the exploration of student ‘oppositionality’ and ‘resistance’ (Ogbu & Simmons, 1998) as secondary cultural characteristics exhibited by certain minority students in response to their societal marginalization (p. 1103).” Their work concludes by suggesting understanding African-American students’ underperformance requires researchers to engage in sociohistorical analysis of African-American students’ experiences with school and society as a whole.

Other studies that provide reports of the status of science education for African-American students analyze the potential risks associated with high stakes testing and standards (Kahle, Meece, & Scantlebury, 2000; Seiler, 2001). This area of research has provided reports that challenge the reform movement while in contrast affirming its effectiveness. Kahle, Meece, & Scantlebury’s (2000) study suggested that teachers who actively applied standards-based instruction positively affected African-American students’ attitudes and beliefs about science. A striking component of their research involved their suggestions that these findings were most notably significant for African-American male students. In contrast to the work of Kahle et al. (2000), Seiler (2001) challenged educators to reconsider the standards push. In a study calling for more critical research on student culture, Seiler suggested that the imposition of external standards has done little to eliminate the performance gap in science because of a failure to adequately address the role of cultural influences that affect science learning. Collectively, these studies of the role of standards and reform in science represent conflicting perspectives presented by scholars of science learning for African-Americans.

A third type of report-based research provides informative analyses of students’ performance in classrooms and their subsequent career choices (Alick & Atwater, 1988; Lewis & Collins, 2001). Alick & Atwater (1988) conducted an analysis of African-American students’ success in college chemistry. Their findings examined the study of Stoichiometry by identifying how successful students employed three primary strategies for achieving success. Those strategies included using deductive and inductive reasoning, rereading the chemistry problems several times, and relating the ideas to other contexts to promote understanding.

Lewis & Collins (2001) examined how African-American students decided to pursue advanced degrees in science. They interviewed students as they made career decisions and discovered students’ science related career choices were directly related to the degree to which they perceived a career in science
would be supportive of their life goals and their views of the nature of science. Students who held strong beliefs about the nature of science and maintained goals for science careers were more likely to matriculate towards a career in science.

Studies of Cultural Discontinuity and Science Learning

A second body of research explored African-American students' experiences in science learning through a lens that highlighted cultural discontinuities that exist between the cultural of African-American students and the culture of science (Gilbert & Yerrick, 2001; Parsons, 1997; Wanderese & Griffard, 1999; Yerrick, 2000). Some studies examined the role of cultural conflict in learning (Gilbert & Yerrick, 2001; Wanderese & Griffard, 1999), while others examined the attitudes of teachers and students (Atwater, 1995; Parsons, 1997). Research from this mode sought to identify the sources that promote the continuing achievement gap that exists in science education.

The first series of studies of this type illuminated the role of cultural conflict in learning for African-American students. Wanderese & Griffard (1999) engaged in an analysis that implicated a series of cultural barriers that ultimately lead to underperformance of African-American females. They noted how students became disengaged with the science learning due to the prevalence of a series of emergent cultural factors. They identified how students' attention to behavior over learning, confidence without academic competence, and cognitive passivity created cultural conflicts that limited students' science learning. In line with Wanderese & Griffard's work, Gilbert & Yerrick (2001) engaged in an extended ethnography of a southern high school which implicated the role of cultural conflict in science learning. Gilbert and Yerrick claimed students were confronted with the challenge of balancing dueling cultural influences. They described these two cultures as the “Marginalized Sub-Culture” and the “Dominant School Culture” (p.584). If students were a part of the Marginalized Sub-Culture they resisted school success and alienated themselves from mainstream cultural endeavors, which included success in science. Those who chose to participate in the Dominant School Culture characteristically lost membership in the Marginalized Sub-Culture and were often accused of “trying to be of another race” (p. 584). The contrast they identified in their work exemplified the body of research that identifies the conflicts of culture and science achievement.

Another body of research within the group of studies that examined the role of cultural conflicts detailed the role of student and teacher attitudes (Atwater, 1995; Parsons, 1997; Griffard & Wandersee, 1999; Sorge & Newsome, 2001). These studies are dynamic due to their examination of two sides of the learning process. Some studies explored how the attitudes of African-American students affect their science learning, while other studies explored how teachers' attitudes about African-American students affected students' science learning (Brickhouse, Lowery, & Schultz, 2000; Brand & Glasson, 2004; Yerrick & Hoving, 2003).

Atwater (1995) explored student performance through a lens that promoted multicultural education. The findings suggested African-American students’ performance was closely connected to a complex set of attitudes. These attitudes included students’ attitudes towards science, their friends’ attitudes toward science, and their attitude towards their science teachers. Griffard & Wandersee (1999) examined of African-American females science experiences and implicated cultural disengagement as a resource for promoting cognitive passivity, and generic motivation. Sorge & Newsome (2001) continued this line of research as they
suggested African-American boys’ beliefs about becoming professional athletes impeded their attitudes towards science. They suggested that using activities that addressed the probability of becoming a professional athlete could positively affect student learning and their perception of science. Parsons (1997) offered another analysis of the role of attitudes as she investigated African-American females’ perspective towards scientists. The results of this study indicated that their views of scientists differed as the gender and race of the scientists differed. Ultimately, Parson’s found students’ attitudes towards the dominant culture and African-American culture prevailed over images of scientists. The prevalence of these perspectives served to racialize their perceptions of scientists. A common thread connects each of these studies. Each study identifies how attitudes embedded in African-American youth culture affected students’ attitudes towards science.

Another set of studies regarding attitudes involves research of teacher attitudes in dealing with African-American students (Brand & Glasson, 2004; Yerrick & Hoving, 2003). Yerrick & Hoving (2003) investigated pre-service teachers who worked with African-American students. They identified two categories of prevailing attitudes that influenced teacher performance. First, they identified a group of teachers who demonstrated a willingness to change their attitudes in response to their professional experiences. In contrast, another group resisted changes in their beliefs in an effort to reproduce their own educational experience.

Brand & Glasson (2004) continued this line of research as they engaged in an extended ethnography of teachers developing belief systems. Their study suggested that teachers’ attitudes were influenced by their early life experiences and that these attitudes affected their pedagogy. In addition, they noted that the teachers’ racial and ethnic identities affected their pedagogy and philosophy of teaching regarding diversity. Their experiences during the pre-service program either confirmed or challenged their existing belief systems. These studies share a common premise, which is to explicitly address teacher’s beliefs regarding teaching African-American students due to the influence of images and expectations regarding race, identity, and academic performance.

**Studies of Cultural Continuity and Intervention**

Another body of research on African-American students in science education seeks to promote the continuity that exists between the culture of science and the culture of African-American students. These studies contrast scholarly perspectives that operate on a theoretical model of cultural conflict, by suggesting that educators must identify ways we can improve science education for African-American students by identifying the cultural resources they bring to the classroom. These studies fall into three categories: (a) research on the construction of collaborative learning environments that serves as a cultural resource, (b) research that investigates pedagogical interventions for African-American students, and (c) studies that identify cultural literacy resources.

The first of these three classes of research involved using collaborative learning environments to promote learning for African-American students (Rahm, 2002; Tobin, Roth, & Zimmerman, 2001). Rahm (2002) offered an analysis of informal learning environments that suggested that a primary outcome of learning
environments might be the construction of learning communities that will promote science learning. The study suggested that informal programs may not explicitly improve science learning, but the development of learning communities could provide a space for integrating science and community into the learning environment. Tobin, Roth, & Zimmerman (2001) implicate the role of co-teaching programs for pre-service teachers as a way to develop a culturally relevant pedagogy for African-American students.

Another set of studies detailed examinations of pedagogical interventions that promote achievement for African-American science students (Hrabowski & Maton, 1995; Jones 1997; Seiler, Tobin & Sokolic, 2001; Tobin, Smith, & Mackenzie, 1999). These interventions are proposed for multiple contexts, including teaching students as well as teaching pre-service teachers. Tobin, Smith, & Mackenzie (1999) presented an analysis of pre-service teacher's training that advocated co-teaching as a means to support pre-service teacher's teaching African-American students in urban communities. Jones (1997) engaged in an examination of The Young Scholars Program at The Ohio State University. Jones presented findings that implicate an informal approach to teaching agriculture. The study suggested that the combined effects of taking an informal approach, using nontraditional scientists and taking an approach that focused on the relevance of agricultural study addressed the disinterest found in African-American participants.

Hrabowski & Maton’s (1995) work also implicated the role of alternative programs as a means to promote science achievement. They examined 69 students enrolled in The Meyerhoff Program and discovered that their participation led to significantly higher grade point averages for African-American students. Seiler, Tobin, & Sokolic (2001) presented a study that suggested that teaching science through the use of activities based on technology and design could improve student performance and discourse appropriation. They found that students engaged in progressive scaffolding demonstrated an ability to engage in science discourse for diverse outcomes. The findings of their study called for the detailed examination of how the culture of African-American student could provide knowledge that could improve classroom instruction. Seiler et al. explain this position as they stated:

They have tremendous resources and capabilities, but these are not the traditionally valued resources that typically serve students well in school science. As educators, we must find ways to tap into cultural funds of knowledge (Lee, 1999) that students possess that are already science-like. This type of progressive scaffolding and modeling has been effectively used in changing literacy practices of similar students but has not been reported in science classes. (p. 761)

Their analysis of the need to build learning environments that access student culture strongly aligned with other studies that suggested that scientific literacy could be achieved through the identification of cultural continuities (Lee & Fradd, 1998; Warren, Ballenger, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001; Varelas, Becker, Luster, & Wenzel, 2002). These studies strongly align with the new literacy studies that exist in the educational community at large (Gee, 1996; Gutierrez, Baquedano Lopez, & Turner, 1999; Hull & Schultz, 2001; Street, 1993). Despite the prevalence of these studies, there are few studies in science education that explore the relationship between African-American students’ literacy and science learning (for exceptions see Varelas, Becker, Luster, & Wenzel, 2002).
New Literacy Studies in Science Education

Varelas, Becker; Luster; Wenzel (2002) offer one of few studies on African-American students that seeks to highlight the continuities between African-American students’ literacy practices and their science literacy development. Their study investigated African-American students’ literate practices in the forms of plays and hip-hop lyrics. They discovered how students’ experience with classroom science that involved numerous genres altered the learning environment. The three competing genres were the youth genre, the favored classroom genre, and the favored science classroom genre. They suggested “that a major task of science teachers today is to develop spaces where students’ propensity for social interaction and affective reaction are brought into play to foster engagement with science and their construction of scientific understandings (p. 583).” In their examination of the relationship between African-American students’ literacy practices they identified the challenges in building bridges to promote scientific literacy through the use of culturally relevant modes of discourse. Varelas et al. (2002) describe the challenge of appropriating the discourse of science as they stated:

In her science class, Barbara pursued this approach partly by encouraging her students to express and work out their scientific understandings in forms that are nontraditional in the science classroom, such as rap songs and plays. In this way, she both offered opportunity for students’ youth genres to enter the science classroom and disrupted the hegemonic practice of students who do not want to ‘act white’ (Fordham, 1996) to construct effective science genres. (p.583)

Their study calls attention to the relationship between African-American student identity, science discourse and classroom learning. Their study offers conceptual depth to contemporary studies of science education by identifying the hegemonic nature of science discourse and African-American students’ conflict in using science discourse.

New Directions for Research on African-Americans in Science

These perspectives often use African-American as an analogous term for urban, poverty, and under represented without considering the limitations of applying monolithic perspectives of race and culture. Said differently, several of these studies fail to explore the variety of the African-American Diaspora, which includes numerous socioeconomic levels, various cultural backgrounds, and different discursive practices. These perspectives would benefit from examining how individuals develop identities that construct the cultural identity of being an African-American learning science. In this way, by examining how students construct ethnic identities and examining how language plays a
role in this process, educators will be better able to construct learning practices that support African-American students’ development of discourse practices that promote science learning.

The Politics of Public Discourse

The idea of promoting scientific literacy for African-American students stands as a goal for several science educators (Brown, 2004; Varelas et al., 2002). Despite a diversity of understandings for what counts as scientific literacy, the theoretical notion of literacy for all serves as a rallying point for science educators.

The common goal of improving literate practices includes a concerted effort to include African-Americans in the body of scientifically literate citizens. Although few would dispute this as a goal, researchers do not pay close attention to the potential identity conflict that arises as many African-American students use science discourse.

All people develop everyday or vernacular ways of communicating with others (Gee, 1996; 1999; Labov, 1972). These everyday ways of communicating are complex and can range from general public ways of using discourse (e.g. talking to strangers) to specific ways of using discourse for special purposes (e.g. talking with teammates or club members). Labov (1972) familiarized the research community with this idea as he defined vernacular language as the everyday, native language that is publicly obtained through cultural interaction. In contrast, Labov described how the more context-specific ‘non-vernacular’ discourse serves more specialized purposes. Everyday, or vernacular ways of communicating are used according to the speaker’s understanding of the intended audience. For example, a football coach may use detailed language to explain a play to his players. He might state: “In our 4-3 hot package, Rick and Liz will fire, but Mike is man-up on the Z.” In making such a statement, the coach must assume that the listeners share the same non-vernacular understanding that will enable them to correctly interpret the complex discourse involved in this type of communication. The clarity of his statement is closely connected to the listener sharing a similar understanding of this style of discourse or share a common non-vernacular discourse. If our fictitious coach was to provide the same explanation to another audience, who he assumes is less familiar with the discourse of football, he may state, “when we blitz using our four linemen and three linebacker alignment, the left and right side linebackers will blitz the quarterback, but the middle linebacker will be in man to man coverage with the tight end.” Although this type of discourse is less dense and does not apply the same amount of football jargon, it also requires the speaker and listener to share a common set of understandings. Table 1 demonstrates how the variation in these statements offers the same message through different modes of talk. In these explanations, the speaker must select modes of talk that will provide the listener with the best opportunity for understanding. In the non-vernacular context, the same message can be communicated through the use of 17 words, while the non-vernacular mode requires 36 words.

Ultimately there are three emergent issues. The first issue involves the assumption that each mode of discourse requires the speaker and the listener to share contextual understanding, therefore both the vernacular
<table>
<thead>
<tr>
<th>NON-VERNACULAR</th>
<th>DEFINITION</th>
<th>VERNACULAR</th>
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<tbody>
<tr>
<td>4-3</td>
<td>A defensive package that uses for defensive linemen and three linebackers.</td>
<td>Four linemen and three linebackers</td>
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<tr>
<td>Hot Package</td>
<td>These are plays where individuals will pursue the quarterback instead of attempting to cover receivers</td>
<td>Blitz</td>
</tr>
<tr>
<td>Rick</td>
<td>The right side linebacker. The ‘R’ in the name signifies that Rick is the code name for the right side linebacker</td>
<td>Linebacker on the right</td>
</tr>
<tr>
<td>Liz</td>
<td>This is the left side linebacker. The ‘L’ in the name signifies that Liz is the code name for the left side linebacker</td>
<td>The Linebacker on the Left</td>
</tr>
<tr>
<td>Mike</td>
<td>Mike is the middle linebacker; The ‘M’ in the name signifies that Mike is the code name for the middle linebacker.</td>
<td>The Middle Line backer</td>
</tr>
<tr>
<td>Man up</td>
<td>This refers to they type of wide receiver coverage that the “Mike” linebacker is assigned. This coverage requires Mike to follow the Tight End wherever he goes.</td>
<td>Man to Man coverage</td>
</tr>
<tr>
<td>Z</td>
<td>This is the symbol designated for the Tight End.</td>
<td>The Tight end</td>
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both the vernacular and non-vernacular modes require a version of ‘non-vernacular’ understanding. Even in the vernacular example terms and ideas like ‘blitz’, ‘tight end’, and ‘linemen’ require a great deal of conceptual understanding. Although the ‘non-vernacular’ position is less complicated it also requires contextual knowledge. Essentially, both modes of talk require what Hymes (1971; 1974a) called a communicative competence. Hymes (1971) described how becoming a member of a speech community required an understanding of the words, but also required an understanding of what it means to use those words in particular contexts. Considering examples of this nature challenges us to consider why students easily appropriate these types of complex discourses, but struggle to appropriate the discourse of science.

A second emergent issue involves the results of using different non-vernacular modes of talk. The ‘non-vernacular’ mode of talk could position the speaker as one who takes on a football coach’s identity. Its technical nature makes it accessible to a smaller affinity group who must share similar knowledge regarding football. Through this process some people can become conceptual insiders, while a large number of people will lack the contextual knowledge and communicative competency to understand. While the ‘vernacular’ example requires less specific contextual knowledge and is less associated with the identity of football. Ultimately, use of the more technical discourse could allow the speaker to be seen as one who appropriates an identity commensurate with that of a football coach or player. Seen this way, using the detailed talk provides the speaker with an efficient mode of communication, but also strongly aligns them with an affinity group who shares a similar technical understanding. If we apply this analysis to the issue of African-American students’ becoming literate in the complex discourse of science, we could apply two contrasting theoretical considerations. First, could the ease of taking on an identity commensurate with ‘football’ provide athletes with a framework for learning to appropriate the discourse of football? In contrast, could the sociopolitical implications of taking on an identity commensurate with ‘science’ make the appropriation of science discourse difficult?

The third emergent issue allows us to return to our exploration of African-American students’ experiences in science education. The third emergent issue involves the notion that no language or genre exists as a context free, apolitical mode of communication. As seen in the example above, both modes of discourse require contextual knowledge. Along with this contextual knowledge, it can be assumed that using the technically dense discourse or the less technical discourse will allow the speaker to acquire different types of identities. Said differently, one who uses the technical discourse regularly may be seen as a member of the ‘football’ community, while those who use the less technical approach may not be so strongly aligned.

This analogy can be used to symbolize the contextual nature of using science discourse. Although the discourse of science provides it users with rhetorical resources, research must consider how the use of science discourse positions the speaker as a particular type of person. Thus, the use of all discourses (including the discourse of science) can be seen as a political act, as people interpret who an individual is seen to be, based upon their public displays of discourse.”
an individual is seen to be, based upon on their public displays of discourse.

The issue of the political nature of a discourse was explored through the work of Russian scholar Mikhail Bakhtin. Bakhtin states:

Discourse lives, as it were, beyond itself, in a living impulse toward the object; if we detach ourselves completely from this impulse all we have left is the naked corpse of the word, from which we can learn nothing at all about the social situation or the fate of a give word in life. To study the word as such, ignoring the impulse that reaches out beyond it, is just as senseless as to study psychological experience outside the context of that real life toward which it was directed and by which it is determined (p. 292)

Bakthin's analysis of the living and dynamic nature of discourse is an invaluable way to examine African-American students' use of science discourse. The idea of studying words without studying their social implications will leave contemporary research on African-Americans in science education without access to the dynamic relationship between language, identity, and classroom learning. Science educators are confronted with the challenge of promoting African-American students' use of science discourse, but must examine how the use of science discourse affects student learning.

Few studies in science education have examined why African-American students would choose to engage in or choose to avoid learning the discursive practices of science (for exceptions see Brickhouse, 1994; Brown, 2004). If the issue of using and understanding science discourse is connected to understanding why African-American students choose to engage in scientific discourse, science educators can begin to uncover why large numbers of African-American students demonstrate the ability to master complex discourses (e.g. athletic discourses, musical discourses, & social discourses), but opt out of full participation in the culture of science. From this standpoint, understanding scientific literacy development as a sociocultural process requires a detailed examination of the social significance of using scientific discourse in interpersonal and intrapersonal contexts. Thus, I argue that contemporary research on African-American students can be informed by incorporating the notion of Discursive Identity as an analytic tool for understanding African-Americans' under achievement in science education.

Scientific Literacy, African-American Students and Discursive Identity

In order to state why scientific literacy must be understood by incorporating the notion of Discursive Identity, I need first to offer a more detailed set of assumptions than communicated above. These assumptions incorporate the work of linguists (Agar, 1994; Chomsky, 1986; Hymes, 1971; 1974b), educational theorists (Labov, 1972; Gee, 1996; 1999), and science educators (Brown, 2004; Warren, Ballenger, C., Ogonowski, Rosebery, & Hudicourt-Barnes). These assumptions are of three sorts: First, learning language has biological and sociological components. Thus, the learner must possess basic biological and sociological competencies in order to fully acquire the use of a new literate practice (Chomsky, 1986; Halliday & Martin, 1994; Hymes, 1971; 1997). Second, all language is contextualized and requires the development of communicative competencies in order to develop a full understanding of a discourse (Gee, 1999). Third, use of discourses (e.g. science discourse) can conflict with students' use of everyday ways of describing phenomena and experiences if they are foreign to student culture. Collectively, each of these theoretical assumptions requires
educators to examine the specific relationship between student languages, their emergent identity, and the learning of science.

Given these assumptions, a Discursive Identity is the understanding that speakers and listeners use to interpret who an individual is as communicated through the use of their language (Brown, 2004). Another way to describe a Discursive Identity is to suggest that a Discursive identity is how we choose to sound like a particular type person. This concept works two ways because it reflects who we perceive people to be based on their use of discourse. If we enter this theoretical perspective into the conversation of African-American students’ scientific literacy development, we must ask the question: Do African-American students experience feelings of conflict when they use science language? Does reading text that is rich in science discourse cause feelings of identity conflict, marginalization, or promote notions of inferiority for African-American students? These rhetorical questions are designed to highlight the dynamic cultural interaction that comes into play when we consider how the language of science has the potential to affect African-American Students’ sense of self.

Without an ideology that carefully examines the relationship between language, identity, and students’ learning, scholars make the erroneous assumption that participation in science occurs free from cultural implications.

Brown (2004) examined the process of discourse appropriation in an urban classroom and implicated the role of science discourse as a primary source of conflict. In this study African-American students engaged in science discourse, but avoided the continued use of discourse or engaged in code switching as a means to maintain their ethnic identities. In a subsequent study, Brown (in press) interviewed students regarding their experiences in their first high school science classes. This study revealed students perceptions that the discourse of science serves a source of conflict. Students suggested that the discourse of science was specialized and did not allow them to maintain their cultural identity.

This emergent area of research began to examine the role of science language and African-American students’ performance in science classrooms. Studies of African-Americans in science education would benefit from considering the work of linguists who examine the interplay between language, learning, and cultural identity (Agar, 1994; Fishman, 1989). For example, Agar (1994) introduced the valuable notion of Rich Points. Rich Points are language interactions in culture that make cultural differences evident. Agar describes how these rich points are made manifest in the culture of language use:

Because of your languaculture bent, you’ll see the rich points as signals of frame differences that you don’t know about yet, differences that’ll teach you about frames that you’ve never been conscious of, as well as frames you’ll build that you’d never imagined existed. (p.256)

Agar’s insightful analysis suggests that there are places in culture where the frames of reference that guide our cultural practice are made evident. It is my assertion that for African-American students, the discourse of science classrooms often provides a rich point from which the conflict between the culture of science discourse and the culture of African-American discourse is made evident. Agar (1997) suggested that becoming bilingual requires the speakers to become bicultural as well. Students may not be aware that they are uncomfortable with the dense technical talk of
science until they experience science discourse through classroom talk and interaction with text. Ultimately, science educators must become aware of how these cultural rich points affect learning for African-American students. Ultimately, educators must uphold the responsibility of creating learning environments where the rich points experienced in science classrooms are indicative of cultural continuities as opposed to cultural conflicts (Lee & Fradd, 1998).

**Future Directions for Research**

Completion of this analysis of contemporary research on African-American students in science education leads to the consideration of future directions for research. One avenue of potential research involves a need to examine the relationship between the language of science, student identity, and classroom learning. A second direction involves the application of theoretical perspectives that exist outside of science education.

As noted above, contemporary research on African-American students may be informed by incorporating the notion of Discursive identity as a means to fleshing out the relationship between language, identity, and classroom learning. The existing body of research on language and the appropriation of science does an excellent job of identifying how language can be used to promote learning and how it affects students’ performance (Lee & Fradd, 1998; Rosebery, Warren, & Conant, 1992; Warren, Ogonowski, Rosebery, & Hudicourt-Barnes, 2001). To support these studies, research must explicitly explore African-American students’ use of discourse as an artifact of their identity. Scholars have yet to clearly articulate why African-American students who are fluent in English and numerous other non-vernacular discourses struggle to appropriate science discourse. In many research investigations, studies of African-Americans are naively grouped with studies second of language learners, urban schooling, and the broad category of minority students. The sociopolitical issues that guide African-American students’ conflicts with science language are unique and complex, thus scholars must explicitly explore the political issues associated with their use of science discourse.

A second direction for research is closely aligned with the first. Essentially, theorists in sociology, linguistics, and the educational community at large have built a substantial body of literature that explores the role of language, identity, and learning. Science educators have been slow to incorporate these perspectives in their research on African-American science students. It is my assertion that the science community’s reliance on the notion of cultural objectivity in science has prevented critical studies of how African-American students’ conflicts with science discourse are a product of broader cultural issues. Said differently, because we assume all students must learn the discourse of science, we then assume the use of science discourse is the same for all students. This issue must be explored in greater detail if African-American students are to acquire the verbal advantage that is inherently a part of using scientific discourse.

Reflecting upon the existing body of research on African-American students in science, one must look towards issues of language as a means to access student culture. Many African-American youth consider themselves members of the Hip-Hop community. By its very definition, the hip-hop community is an oral cultural that develops and sustains its own discourse practices through music, poetry, and daily talk. If the ideas of acquiring a verbal advantage by using science discourse hold true, they must be balanced by examining how the verbal games associated with culture affect student performance. If clarity can be achieved when the speaker and listener share a
common understanding, scholars of science education must develop insights into how the culture of language affects students’ developing clarity. More specifically, the style of science discourse must be examined in contrast to the politically rich style of African-American discourse if our African-American youth are to acquire the Verbal Advantage.
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