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Rap as a roadway: creating creolized forms of science in an era of cultural globalization

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Abstract Even during an era of cultural globalization where diversity, hybridity, and heterogeneity prevail, educational institutions remain unchanged and economically and racially marginalized students continue to experience a sense of exclusion in school. Whereas the science education community often addresses such exclusion in terms of the achievement gap or the lack of materials and qualified teachers in urban schools, there are also more subtle ways in which these students remain as outsiders to the culture of science. The study highlights how the acceptance and affordance of students' cultural capital can encourage a sense of belonging with school science. Specifically, this paper contributes to the literature by sharing longitudinal findings that reveal students' skills of orality, in the form of rap practices, can be rich resources for developing creolized forms of school science, and how rap creates entryways for students to form and reform hybridized identities in which canonical science discourse and lyrics about non-science subjects can begin to emerge in integrated, fluid and seamless manners.

Keywords Creolized science · Hybridized identities · Hip-hop

تبرز دراسة الراب كيف يمكن أن تكون غنية الموارد لتطوير أشكال العلوم بالكريولية. عن طريق تشجيع إدماج ممارسات الراب المتأصلة في ثقافة الهيب هوب في سياقات التعليم والعلوم ، وتظهر النتائج أن : (١) تعطي الطلاب فرصا لتطوير فئات جديدة من الهوية من جانب كل من الهيب هوب والعلوم والثقافات ؛ (٢) مدرسة العلوم يمكن أن تغير في أشكال مختلفة والذي سوف تقابل بالترحيب من جانب مجموعات متنوعة من الطلبة ؛ و (٣) قاعات دراسة العلم يمكن أن تصبح أماكن للطلاب المهمشة التي تساعدهم يشعرون بأنهم ينتمون إليها.

العولمة الثقافية توفر الأساس المنطقي للقول بأن العلم والمعلمين يجب عليهم توسيع مفاهيم ومناهج التربية والعلوم في الفصول الدراسية. وأشدد على الطرق التي الراب ، وإن كان منشؤها في الهيب هوب والثقافة ، هي أوسع بكثير من واحد معين الجماعية (أي الأمريكيون السود) ، والمربين وينبغي أن يكون قادرا على التفكير في التقنيات المختلفة لمساعدة الطلاب على فهم العلوم. إننا لن نشجع النجاح بالنسبة لغالبية الطلاب من خلال المحافظة على الوضع الراهن على حاله من خلال المناهج الدراسية والمناهج التقليدية النهج. من أجل زيادة عدد الطلاب الذين مع تحديد موضوع العلم ، الهياكل في الفصل الدراسي يجب أن تتحول للسماح للطلاب تجربة تشكيل هويات جديدة لأنها تقوم بإنتاج 'بالكريولية' أشكال العلم.

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> I would describe myself, talented, smart, hard working … I got talent in singin, rappin. I can do basically anything. … I started rapping personally at the age of 11 and I'm going on 15. … There's a lot of different artists out here that got their own style in rappin. I think. I think it is a talent that everybody like go after. It's just, I think like it ain't about color or nothin but I think that it's something that's in the world. That's in somebody—that's in everybody system. It is a big talent cuz I think it's like something that everybody dreams of being or dream of doin someday. Everything that's out here is a talent—just like playin basketball. Rappin, ya-mean,[1] drawin, it's all a talent. That's like a hobby or somethin that everybody would dream of becomin. (Ivory, research meeting, summer 01)

When I first arrived to the University of Pennsylvania and met Ivory, one of the Discovering Urban Science (DUS) high school student researchers hired under an NSF-funded study for improving science education in urban schools, she pulled the headphones off of her ears and gestured for me to come over and stand beside her. She handed me the headphones and waited as I placed them on my own head. As a steady stream of rap music flooded my ears, I focused upon the lyrics, yet I must admit that most of them eluded me. This interaction is memorable—even years later—as it was an initial induction into understanding the centrality of the hip-hop culture (and rap as a form of literary expression integrally associated with the hip-hop culture) among the urban African American youth who worked as co-researchers with me over the 3 year grant. I didn't realize, at the time, that Ivory was inviting me to take a glimpse into a culture within which she and her peers were deeply embedded. In fact, listening to, creating, and performing rap was so central in Ivory's lifeworld that she saw the ability to rap as a talent pervasive across all individuals. "It ain't about color or nothing," she proclaimed. It's a talent that "everybody go after," she further asserted. As I spent increasing amounts of time with Ivory and the other student researchers, I came to understand rap as a thread interwoven into almost everything that the youth did. Whether rapping along with Eminem[2] as they worked on their projects, freestyling out loud as they walked, or quickly scribbling down newly created lyrics during a free moment prior to our research meetings, they had a definite affinity for this style of expression. Moreover, listening, writing and performing rap was more than just a pastime activity; for Ivory, being a talented rapper represented a core and relatively stable dimension of her identity—of who she was for herself and who she was in relation to others.

Over a period of 3 years, I worked closely with Ivory and several additional high school student researchers who were hired to participate in a funded endeavor to develop understandings of how to improve the teaching and learning of science for students who (like themselves) were attending city schools in large urban centers where socially reproductive cycles of poverty prevail. Over the duration of the study as the student researchers acted within multiple roles such as ethnographers, interviewers, science curriculum developers, and science learners, rap practices surfaced and re-surfaced continually and consistently in oral, written and performance forms.

Initially, when rap practices were spontaneously integrated into our research context, there were not any overt connections to our focus on improving science teaching and learning. A student researcher would author some personally-relevant lyrics on a page of their researcher journal in between more traditional reflections, for example. Or, triggered

[1] "Ya-mean" stands for "You know what I mean".

[2] Popular White rapper.

by fingers lightly drumming our table top during a research-related discussion, several of the group would intuitively create a "beat" together with bare fists and a single quarter from someone's pocket. The youth also engaged with the artifacts of popular rappers. For example, on a daily basis, they seized any available moment to utilize the computers that were accessible to the research area to look up beats and/or listen to favorite raps. Moreover, initially, it was not uncommon to have to ask several times for a student researcher to slide off her/his headphones to join the group discussions. It soon became evident to me that the wide variety of emergent rap practices that arose time and time again, felt natural and appropriate for the youth. Certainly, when enacted in the moment and without being truncated by adult researchers like myself, their participation as "rappers" elicited strong positive emotions and a distinct sense of solidarity among the student researchers. For instance, in a spontaneous rap creation that is discussed in greater depth later in this article, Shakeem, Ivory, and Randy smiled, laughed and become increasingly entrained in each other's motions and lyrics as they freestyled (to the beat and rhyme of a popular rap that was playing on a computer in the room) about their shared experiences as high school students in their local neighborhood school (see Fig. 1).

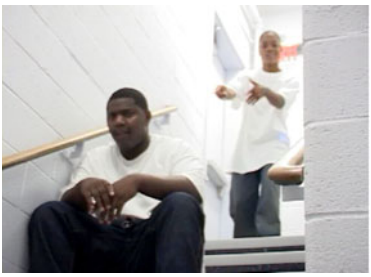
Although their emergent rap practices were *not* initially associated with the research on improving science teaching and learning, with time and through developing understandings of how to "be" with one another, conscious efforts began to be made on the part of the students and myself to incorporate and support rap in our daily research activities as a resource for our work (see Fig. 2). For instance, the DUS student researcher-created "Sound in the City" movie included an instructional performance segment where Shakeem rapped at three different speeds (from slow to super fast) to represent the variation of the speed of sound vibrations through gases, liquids, and solids, respectively. In the same science movie, Ivory and Shakeem danced to the beat of Randy's rapping to create an "intercession" segment that they then positioned in between instructional segments so as to provide entertainment to their anticipated audience of peers. Further, in developing their autobiographical video ethnographies consisting of self-selected, personally salient video

Fig. 1 Shakeem (*back left*), Ivory (*middle*), and Randy (*front right*) spontaneously break into synchronous freestyle rap about their shared experiences as high school students in their neighborhood school as Big Tymers Song, *No, No*, plays on the computer in front of Shakeem

Shakeem raps at three different speeds to represent the variation of the speed of sound vibrations through solids, liquids, and gases.

Ivory (front) and Shakeem (back left) dance to the beat of Randy's rapping (seated on the couch) to create an entertainment intercession for their instructional science movie.

Ivory and Shakeem perform a rap and dance for their autobiographical video ethnographies.



Shakeem and Ivory produce a rap that highlights their experiences with DUS and captures the hybridity of identities that were emerging.

Fig. 2 Over 3 years, several of the DUS student researchers began to regularly incorporate rap practices as they participated in research activities and developed artifacts/representations associated with the research project

footage from the multiple fields, the youth included video of rap and dance segments from performances in various fields (e.g., home, neighborhood, work). An additional example from our final summer of work together was a production conducted by Shakeem and Ivory and presented through Final Cut Pro in which they wrote, performed, filmed, and edited a rap that highlighted their experiences with DUS. Their rap skillfully captured the hybridity of identities that were emerging amongst the youth researchers (e.g., one lyric of the rap stated: "the best science squad makes great researchers"). Thus, rap became a means for generating a DUS squad of intermixed, hybrid, bricolaged identities—that is, for example, the youth began to perceive themselves and be perceived by others as simultaneously enacting multiple identities (e.g., rapper | student researcher | scientist).

Utilizing the student researchers' voices, their actual practices (both individually and collectively enacted), and analyses of written artifacts from our work within summer research sessions, this study answers the following questions:

1. How do some African American students' perceive music, and particularly rap, in relation to science classroom teaching and learning?
2. How can the enactment of rap practices in science learning contexts, become an empowering experience, particularly for African American youth from marginalized backgrounds?
3. How does being a "rapper" in science learning contexts shape the hybridization process of youth identity in relation to school science?
4. How might rap practices in science learning contexts transform school science into creolized forms?

This research makes apparent the necessity for encouraging the incorporation of rap practices rooted in hip-hop culture into science learning contexts so that: (1) students have opportunities to develop new and hybrid categories of consciousness and identity as members of both hip-hop and science cultures; (2) school science can emerge into creole forms that are valued by diverse groups; and (3) science classrooms can become spaces that help to diminish marginalized students' feelings of diaspora or "finding oneself away from the familiar resources that characterize the home" (Roth 2008).

Globalization, hip-hop and science education

> Strangely, education systems, otherwise so responsive to certain economic imperatives of globalizations, have made little attempt to understand what contemporary globalizing forces mean for the construction of youthful identities and the implications of such constructions for education. Rather they have adopted a form of educational fundamentalism that shows an almost complete disregard for who the youth are and might become. (Kenway and Bullen 2005, p. 32)

An era of cultural globalization is upon us. Catalyzed and sustained through the advent of new technologies of information and communication (Nixon 2005), the world has become interconnected in new and complex ways. Through these venues, individuals have access to cross-cultural contacts, such that they can learn new symbols, practices, attitudes, and valued ways of being in manners that expand beyond their immediate resources within the physical localities of neighborhoods, schools, and homes. Thus, although shared experiences in those spaces expose youth to similar sets of material, symbolic and human structures, they also have in common their exposure to "consumer-media culture" (Kenway and Bullen 2005), which contributes in many ways to what the youth find pleasurable, believable, and desirable. Further, as cultural globalization offers new ways for belonging and identifying with others, and for potentially shifting existing power relationships, youth are developing new categories of consciousness and constantly forming and reforming hybrid identities. Since the 1980s, cultural globalization has shaped the ways in which hip-hop and rap (as the primary literary text associated with the hip-hop culture) has become more widespread across the globe. Different groups and individuals, often those whom are most marginalized from society, achievement and the institutions of education in their countries, allocate and modify rap practices in ways that feel appropriate (Emdin 2009a). Hip-hop has in fact "become all-encompassing, influential and global. It is the worldwide urban soundtrack; that is, rap emerges from New York to Nairobi and from the Rio *favelas* to the townships of South Africa" (Neate 2003, p. 6).

Despite this reality, Kenway and Bullen, in the above quote, point out that educational institutions remain relatively static—unable or unwilling to understand and accept the rich

resources students bring (i.e., rap practices, in the case of this study). This is particularly true within the discipline of science, as it has traditionally been positioned in a sterile, masculine, and objective manner far removed from the emotional, cultural or subjective (Roth and Barton 2004). Teachers are typically prepared to implement a homogeneous science curriculum utilizing a "one size fits all" methodology. With rigidly defined borders, there are definite perceptions of what does or does not constitute science. Rather than science morphing into creolized forms similar to the historical emergence of Creole languages, the impetus for change is placed upon the youth. Students are expected to discount ways of being that are perceived as "nonscientific" (i.e., rap practices) in order to experience success in science classrooms. A lack of tolerance for hybridity within science classrooms limits the manners by which a student can experience a sense of belonging, and she/he may struggle to be their "own person." As expressed by Shakeem, one of the African American student researchers involved in this study:

> I got so much stuff goin on outside of school that you have no idea about … teach me something—I'm gonna appreciate that. … Let this [school] be the place where I can do me…. I think that schools nowadays should tryda get the person who's actually being taught input because that's who it's about anyway, right? … I mean you're your own person. (Research meeting, 5/06)

Shakeem highlights the inherent flaws of the schooling institution in its "failure to take into account differing cultural orientations and unequal power relations among groups that share membership in a society" (Shujaa 1994, p. 14). His comments communicate his position in relation to a more powerful educational entity as well as his outright frustration with schools' lack of interest to learn about and draw upon students' lives outside of school. He views schools as places where students should be able to employ habitus (Bourdieu 1990) or dispositional ways of being that are deeply ingrained and often unconscious (e.g., "I can do me" and "you're your own person"). Shakeem's reflections become even more important upon considering what occurs within inner city schools where the majority of the students come from economically disadvantaged and culturally marginalized backgrounds. These schools, distinctly recognizable by their prison-like features, focus on establishing social control over students like Shakeem and Ivory through discipline and punishment and, more subtly, through disregarding who they *are*. There have been efforts to address this harsh reality, for example, through attempts to develop a culturally relevant pedagogy for science education. However, researchers like Tippins and Ritchie (2006) and Barton (2000) remind us that we have yet to establish viable and consistent images of a science classroom that affords marginalized students the opportunity to be—in Shakeem's words—one's "own person" while simultaneously participating in the science discipline. In fact, ideologies of the dominant race and class continue to govern what content is taught as well as the frameworks for pedagogical approaches to instruction.

In other studies (e.g., Seiler and Elmesky 2007), communal ways of being were found to afford greater participation in science classes from marginalized students who were typically labeled as unmotivated or resistant. For instance, many of the students grow up in neighborhoods and families where deeply bonded relationships are vital; youth are committed to having each other's back and families support members in multiple ways, both financially and in childrearing capacities. These collaborative and communal ways of being were found to arise in science classes where, in contrast, competition and individual achievement are stressed values. This article adds to the literature additional examples of how the inclusion of heterogeneous cultural ways of being, that would be typically

considered as unscientific, can in fact significantly enhance the manners by which some marginalized African American youth successfully participate in science learning contexts.

Creating culturally inclusive, global classrooms through music

> Like a lot of studying and stuff, people can't really relate because that way it's presented to em is like foreign. …I'm not sayin you have to make Barney songs out of the curriculum—or nothin like that, but like kids listen to music. Everybody—everybody (elevates voice) listens to music in one form or another!—Everybody listens to music. I don't care if you like country or rock or gospel type—whatever. You listen to some kind of music. So, it's just so much easier. It's catchy. It got pace, rhythm. You know what I mean? It ain't got to be about too much of nothing but as long as you can rock to it. Just a little (begins beating out a rhythm on the table—boom boom tap). You be like (continues beating while speaking—boom, boom tap, boom, boom tap). You could teach something to this. You know what I'm sayin? An that ain't nothing! but you could teach it … an it's like just that easy, just that simple—just a boom, boom tap. (Research seminar, 5/06)

This article is focused specifically on hip-hop rap music; yet, as Shakeem points out, human affinity towards music is universal, although diverse. Additionally, preferences for particular forms of music differ from country to country, from culture to culture, and amongst different groups of individuals living within similar city and neighborhood structures. Although hip-hop music did not emerge out of the dominating race and class in the United States, the cultural globalization movement has allowed it to develop into "an international phenomenon critically centered in youth popular culture" (Stovall 2006, p. 585). I argue, in agreement with Shakeem's above statements, that music, and particularly, rap can effectively act as a pedagogical tool for science curriculum implementation for today's globally acculturated students. Further, I maintain that the conscious and unconscious incorporation of rap music into science learning contexts is particularly essential for economically disadvantaged African American youth who experience schooling in oppressive, symbolically violent manners. As students draw upon aspects of rap in relation to science, hip-hip then becomes a powerful vehicle for agency and identity (re)formation and hybridization.

The hip-hop culture: historical emergence, global spread

The hip-hop culture emerged in the post-civil rights era as Black urban populations were forced to confront and navigate cultural, social and economic challenges. Hip-hop became an expressive worldview "comprised of shared beliefs, practices, and language all tied together by the common appreciation for the urban aesthetic" (Ginwright 2004, p. 31). Recognized through clothing, music, art, poetry, and language, the hip-hop culture captured the Black urban experience, validating struggles that were often ignored by other parts of society and acknowledging a wide range of explicit experiences, from violence and disappointment to hope and love. Within the visually and aesthetically expressive culture of hip-hop, rap music emerged in the 1970s in the New York Bronx as one of the first forms of hip-hop expression. Capturing emotions associated with being located along the margins in society, rap music is a skillful literary technique of "expressive and innovative

syncopated rhythms, laced with poetry, and storytelling" (Ginwright 2004, p. 32). Rap gave and continues to give voice to people of color trapped within spaces satiated of inequities—political, economic and social.

> Lyrics to rap songs tell a tale of both the physical realities of life in the inner city and the emotional frustration that comes with being ostracized and silenced from mainstream culture. There is a deep relationship between rap and the lives of those oppressed in the inner city that those involved in Hip Hop deeply understand. In other words, the streets speak to the music and the music reports back what it hears from the streets (Emdin 2009b).

Since its emergence, hip-hop music has pervasively spread to groups across the world; from Iceland to Japan, youth relate and identify with this artifact of the hip-hop culture in different ways. As cultural boundaries are porous, hip-hop rap has creolized into different forms that integrate different ways of speaking, knowing and interacting. Even in the United States, rappers are diverse—from Muslim African American rappers like "Native Deen" rapping in a mixture of English and formal Arabic about challenges of being a Muslim in America to White rappers like Eminem rapping about subjects such as drugs and controversial 9/11 politics to hardcore, East Coast African American rappers like Nas rapping about the oppressive conditions and joyous moments in the inner city hood. Rap practices are a signature of the hip-hop culture; however, with a common attention to the struggles of the oppressed, rap links together individuals from all different backgrounds and life experiences. Interestingly, in the opening quote of the paper, Ivory emphasized that rapping is "something that's in the world. That's in somebody—that's in everybody system." Similarly, in his comments, Shakeem stressed three times that *everybody* can connect with music. Moreover, Shakeem went even farther to suggest that music can be a point of commonality from which teaching can depart. The strong convictions of the youth researchers regarding rap and music illustrate that within the collectives that they interact, these are salient and central manners by which to identify, relate and interact with others and hence potential resources for science teaching and learning. In addition, signaled by words like "everybody" and "the world," these youth situate rap practices as an attractive and valued way of being within a larger, global collective.

Learning from student researchers

I was afforded access to Shakeem and Ivory's perspectives on rap and the role of rap in science through their work as student researchers. Over the summer research sessions and during after school research activities, I (along with other adult researchers) worked with Ivory, Shakeem and additional student researchers within multiple roles. The research process involving the youth was recursive and constantly building in layers of complexity. For example, they collected data from their homes and neighborhoods which they then analyzed and re-presented in formats such as video clips, PowerPoint presentations, poems, and edited audio summaries of interviews that were conducted with family and/or friends Simultaneously, as the student researchers collected and analyzed data from other spaces, we audio and videotaped our daily research and science-related activities, researcher discussions, and formal presentations occurring within the university research setting. Footage from the science classrooms attended by the youth researchers was also regularly captured. Furthermore, in efforts to form deeper understandings of how to better engage

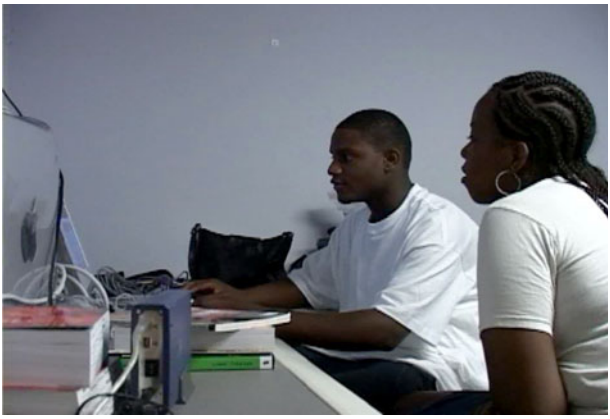


Fig. 3 May and Randy jointly edit several hours of video footage from multiple science classrooms/labs to develop a representative video clip that tells a story about the types of material and human resources that are accessible to students like themselves for learning high school science

marginalized African American youth in high school science curriculum, the research context sometimes became predominantly a science-learning context. The student researchers were asked to engage in simple science activities, more complex lab work, and independently-shaped curriculum projects that required them to build scientific understandings. In all cases, the employment of the student researchers continuously introduced additional layers of data that I could further analyze alone or together with the youth (see Fig. 3).

Through these multiple data sources and by being with the youth over a long period of time, rap became strongly associated with the work/learning environment and the centrality of rap as a tool of representation emerged. The student researchers utilized rap as a medium to organize data from outside of school fields and in their representations of science understandings during curriculum development roles. In addition, Shakeem spent time teaching me to recognize the descriptive, metaphoric merit of rap lyrics, and often, he asked me to listen to particular raps and compare his style and ability to that of a famous rapper of his choosing. In a similar manner, Ivory critiqued rap video clips in terms of style. Sitting with her, she took me to http://www.launch.com/ and showed me, for example, *Contagious* by the Isley Brothers, also featuring R. Kelly. She highly regarded the rap lyrics that were almost sung, suggesting that this was a unique approach within the rap industry. These conversations provided me with opportunities to recognize how the student researchers perceived themselves in relation to a larger collective of rappers, providing important insights into the ways they might identify with those groups.

Centrally salient to the findings provided here, I also drew upon data collected around the youth's science-related rap writing and performance practices to consider the role rap might play in how they perceive themselves as capable science learners and how others perceive them as being part of science communities. Additional data sources emerged 2 years following the end of the grant, when the six student researchers from different Philadelphia schools came together for a half-day research seminar where previously recorded video clips of science-related raps and poetry were shown and discussed (see Fig. 4).

Fig. 4 In order from the front left, Author, Ivory, Shakeem and May meet with other adult and student researchers at a day long seminar to discuss the role of rap and poetry in science teaching and learning

Rap practices in schools

Rap can be theoretically conceptualized as a form of orality or "a preference for oral modes of communication in which both speaking and listening are treated as performances and in which oral virtuosity—the ability to use alliterative, metaphorically colorful, graphic forms of spoken language—is emphasized and cultivated" (Boykin 1986, p. 61). Additionally, rap can be understood in terms of capital (Bourdieu 1986). As a form of embodied cultural capital—or cultural practices that are consciously and unconsciously enacted within multiple fields, rap practices can contribute to the development of social and symbolic capital (e.g., social networks and relationships and respect amongst peers). By understanding culture as loosely bounded systems of symbols, practices and their associated meanings (Sewell 1999), the rap culture, part of a larger hip-hop culture, is defined through language, dress, tone, pronunciation, hand movement and body rhythm. Although this article focuses upon African American youth in Philadelphia, it is important to acknowledge that these cultural resources develop to varying degrees in multiple racial and ethnic groups through family and community experiences as well as in relation to exposure to the consumer-media culture.

Schools are not ideologically open to the incorporation of rap into aspects of curriculum. Concerns around rap content (e.g., violence, misogyny, drugs) and language/word choice are the most typical criticisms that arise and limit the possibilities for considering creolized curricular approaches that would allow students to enact rap practices in the classroom in central ways. In the literature, when rap lyrics and music have been incorporated into the classroom, it has mostly occurred in English (e.g., Lee 2001) and social studies courses (e.g., Stovall 2006) and much less commonly in relation to school science (Elmesky 2005).

Rap lyrics have been utilized as "cultural data sets" to provide a starting point for students to move into analyses of canonical literature works (Lee 2004). During a three-year intervention with students who placed well below grade level in reading, familiar rap lyrics were elicited to encourage engagement in deeply meaningful literary interpretations. That is, rap was conceptualized as a tool for the access of "traditional" forms of literature.

Similarly, in another study, students were found to respond favorably to the incorporation of the rap songs, which were frequently played on the radio and authored by highly visible music artists, into the social studies curriculum (Stovall 2006). Rap was viewed as providing "the context for students to develop a critical lens in approaching subject matter and its relevance to their daily lives" and as a method to "promote critical understanding" (p. 589).

In contrast to these studies, this research does not focus upon the use of popular rap lyrics as resources for science teaching and learning; rather, the focus is upon the student researchers' creation of their own forms of rap as well as their actual rap performances within a collective of peers. I specifically focus upon how orality, in the form of rap, when enacted in interactions with others, promotes students' empowerment or agency as they build social and symbolic capital with each other and strong feelings of affiliation with multiple groups both associated and not associated with school. Furthermore, I show that when students are able to utilize rap in relation to science—either to build understandings or represent the concepts they have grasped, they introduce new forms of science—creolized forms and experience the hybridization of their identities. That is, they begin to perceive new possibilities of who they are and can be in relation to school science and simultaneously alter the possibilities for others' perceptions of them as science learners.

Orality as a gateway to scientific literacy

> So it's like it's no wrong way to eat a Reese's [peanut butter cup]—it's no wrong way to learn. It's mad ways to learn, you just gotta ask and observe and figure out which one is right for this particular group of kids or for that particular person. (Shakeem, research meeting, 2006)

Through this statement, Shakeem urges teachers to take a varied approach to their teaching, venturing that different styles will be "right" depending upon the individual's needs. Unfortunately, what may seem to be the "right" way to teach certain students may not be accepted as "right" within the culture of science. Students who learn better through music and rap may in fact find themselves on the margins of the science classroom. Roth and Barton (2004) challenge science educators to consider the ways margin and center spaces are created in classrooms. I argue that when the learning environment fails to capitalize on the use of rap as a pathway to science, schools serve to reinforce further displacement of students into the margins.

The discourse that unfolds within science classrooms between students and during their interactions with the teacher represents a central structure that often "makes" or "breaks" the quality of the learning environment (Tobin 2006). Affording expanded discourses in the science classroom through "ghetto analogies," for example, has been found to assist some African American students in making sense of science content, when these forms of orality are allowed to flourish (Seiler 2005). Rap is a form of discourse that represents another such roadway that can help marginalized students identify with the school science community. Interestingly, some secondary science teachers have begun to encourage or at least allow hybrid discourses to permeate the science classroom. Jen Beers, who worked as a teacher researcher under the NSF grant supporting this research, began to experiment with the use of rap in her classroom. As documented by a collaborating university researcher, LaVan (2004), student groups were given the option to utilize rap as a medium for demonstrating their understandings of a unit on plate tectonics. Video footage was captured of the rap performances that two student groups in Ms. Beers' class developed as

part of their final science unit presentation. In subsequent years, these video clips became an integral part of research meetings and served as a central focal point around which adult and student researchers could dialogue. For example, following her viewing of one of these video clips, one student researcher, May, shared her perspectives regarding some of the benefits of incorporating rap into science classrooms.

> I think the reason why the rap thing is better too because it puts things—like it bring it down to your level. Like you got teachers that went to college and they learned this stuff an it's so easy to them … the groups [of students] go up there [in front of class] an teach different forms of it in their language—like people we associate with every day. Like it's easier that way cause like it's different forms. I might understand one version of it an then somebody else understand a different version of it, an if you put it together, then other people will catch on faster. So I think it's easier that way.

The inclusion of students' oral practices or, as May describes, "their language" is one manner in which children can move into the center from the margins. In the process of bringing their ways of talking into the classroom, they introduce structures that resonate with their peers ("like people we associate with every day") and this helps scaffold the ways that they can access and appropriate the science material. That is, May essentially argues that agency or the power to act as a science learner is enhanced through the use of rap in science classrooms.

Rap as a resource for expanded agency and hybridized identities

> Most discussions in schools and universities uncouple cognitive issues (what is the curriculum to be like) from the emotional and motivational, as if students were computers in which to put information. Identity ought to be more central in considerations of knowing and learning—including emotion and motivation as core elements—without which cognition cannot be understood. (Roth 2006, p. 152)

Identity is a central construct shaping student performance in science classrooms. Roth writes about identity as a dialectical relationship between a more stable autobiographical storyline of self and a shifting narrative of the experience of self within a larger group of persons—self within the collective. Students determine early on whether they belong or fit within a community. That is, students come to school with conceptions and storylines of who they are. These perceptions are both how they see themselves and how others perceive them, and these storylines form and reform as they spend time in different spaces. A student may see him/herself as an avid rapper, a successful student, a scientist, a football player, and a big brother/sister; these storylines shift as an individual undergoes new experiences within multiple collectives, including science classroom communities. Hybridization of identity as a theoretical lens allows us to view identities as heterogeneous and integrated; a student would not be expected to consciously (or unconsciously) view her/himself as *either* a scientist/science learner *or* as someone who raps well. Identity is evident through practices, and hence an individual might draw upon ways of being that would simultaneously gain her/him access and acceptance in multiple collectives thus reinforcing particular identities concurrently. Considering that most of what we do is enacted in fluid, unconscious manners, hybridization of identity is often an unconscious process. The following section illuminates the ways in which one of the student researchers, Ivory, was found to experience the hybridization of her identities as rapper and science learner.

Ivory's rap on sound

In establishing a core part of one's identity, an individual often repeats a storyline that highlights the capital that identifies or dis-identifies her with specific groups (e.g., those who rap); this storyline shapes future interaction dynamics, which in turn further shapes the individual's personal narrative. As indicated earlier in her first person account opening the paper and in many places elsewhere, Ivory identified herself as smart, hard working, a singer and a rapper. Out of those characteristics of herself, she further elaborated on her cultural capital as a rapper that had begun to emerge several years prior ("I started rapping personally at the age of eleven and now I'm going on fifteen"). When she expanded upon this narrative, she described rap as both embodied capital ("in somebody") and outside of the individual, within a larger group of "the world."

For individuals like Ivory, rap practices are incredibly powerful. This cultural capital was often exchanged for social capital or networks of social relationships, symbolic capital in the form of respect, and contributed to the building of additional forms of cultural capital such as science knowledge. Ivory's awareness of her cultural capital as a rapper became evident during a research meeting, as she described the way that she recognized, approached and interacted with a famous rapper, Beannie Segal, in a neighborhood near her school and home. This experience was central to her identity as a rapper; she spontaneously related this story twice to two different audiences. The first time was in 2001 with the DUS group of researchers; she recounted the narrative again in 2006 at the research seminar where most of the DUS team was reunited and met with student researchers from another school.

> I saw him [Beannie Segal] on Lancaster Avenue. I was coming from school. Matter of fact, we was comin—it was like our second day of school, my first year in high school. … An we saw him an they didn't believe me. I told them that was *Beannie Segal*. It was like aright I went up to him. He had this other boy with him that freestyle with him… an I went in the sneaker store where Beannie was at and I had this notebook in my hand, an he signed it—the back. An then everybody was rackin lines and people was rappin for him. An I went to rap for him. He told me I was too little (playfully sniffs in mock sadness). … He say, "You too young." He say, "I would get you, but you too young." An I think he was lyin. (7/01)

The ways in which an individual interacts with others is interconnected with capital that she holds and the collectives with whom she identifies. Arguably, an individual who lacked an autobiographical narrative that included a core identification with "rappers" may not have approached and interacted with Beannie. Being a good rapper in the neighborhood and among peers is important for status and respect or symbolic capital, and as Ivory shares the above narrative, she is utilizing her knowledge of how to rap to emphasize her status. That is, even though Ivory was "too young," a famous rapper wanted her ("I would get you"). Understanding these aspects of Ivory's identification with rap outside of school, assists in recognizing how her identity of being a rapper hybridized as Ivory drew upon her ability to author and perform rap with relation to science (Fig. 5).

In all of her years of rapping, Ivory had never written or rapped about anything that was related to science prior to joining the DUS group. However, her fluidity in knowing how to compose and perform rap shaped the ways in which she was able to author a rap on sound for their student researcher-created movie entitled, "Sound in the City."

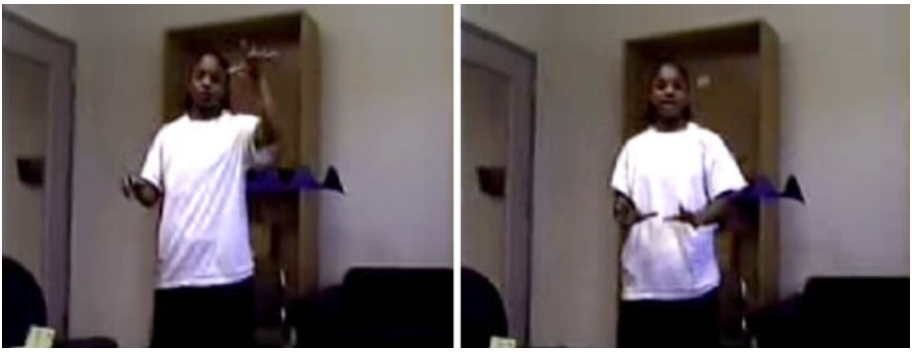


Fig. 5 Ivory performs her science rap for the "Sound in the City" movie

I'm gonna step up to the DUS and spit what I heard
Harm to the ear from cities to suburbs
The rapists and jailbirds
Vibration and singing birds
You see my style is better than Hanks
and any character that step in his lank.
Discovering Urban Science is the DUS do mad flow
we that squad not just filming on tapes
not just snapping pictures not just dissecting apes
That Bill Nye the science guy couldn't even
mess wit [with] dis [this] tape
You talk about me bein a young buck but I live a pro life
You mess with me you crazy you betta get ya fro right
cuz any problems with ya ears you betta get ya dough right
and that's that, that's a fact.

Ivory's performance of this rap was recorded and included in the student researcher produced movie and represents an example of how Ivory's identity as a rapper began to shift and (re)form to include science. By rapping about an atypical topic (sound), Ivory exercised expanded agency. Individuals' power to act expands as she/he accesses and appropriates new resources or existing resources in new ways. Specifically, Ivory accessed and appropriated multiple forms of existing cultural capital—her knowledge of rhyme and meter for rap, slang expressions and words as well as newly acquired canonical discourse and concepts about sound. For example, in her rap, she used language that would resonate with other students by using words like "spit," "mad," "fro," "young buck," and "dough." Simultaneously Ivory captured some of her understandings about "sound" that she had constructed while working in the role of curriculum developer. For instance, she included a rap lyric that referred to the way in which sound travels ("vibrations"). Additionally, drawing upon internet-based research, she wrote a lyric communicating the long-term impact of loud sounds upon human hearing, and her recognition that such damage ("harm to the ears") could affect any range of individuals ("from cities to suburbs").

Mainstream science teachers might argue that raps like Ivory's do not really address the science material deeply, and perhaps that is a viable perception. However, Shakeem challenges such conclusions by asking, "Now if they say they can't see the science in it,

then how come I could? … Maybe *you're* not thinkin wide enough. You know what I'm sayin? It's not *the way* [emphasis added] of learnin so it's like it's something new." As Shakeem points out, utilizing rap in science is not "the way" that students are expected to learn or teachers are expected to teach. However, the student researchers help point out that students learn in different ways and, accordingly, it should be expected that science will also take on different forms.

> Whatever amount of science that you put into that rap was for you or for the people that needed that part. It's different parts … that people don't get … but the part that's hard—make up a rap for it an [and] make it easier for you. Don't worry about the hard part. So who are they to say there's not enough science? There's no such thing as not enough science. It's what level you on. (5/06)

In taking on these new or creolized forms, school science becomes more accessible to a larger audience of youth; that is, as this student researcher describes, "the part that's hard" becomes "easier" through the medium of rap. Through this integration, learning science becomes more personalized and catered to the individual—the creolized science is "for you" or for other students whom may similarly benefit from fusing the mediums of rap and science.

The power of Ivory's rap is situated additionally in understanding the ways in which her rap (with science connections and presented within a student-created science movie) helped her to achieve outcomes of respect or symbolic capital just as her traditional rap practices similarly afforded in fields outside of school such as the home or neighboorhood. When another class in Ivory's Small Learning Community (SLC) watched the sound movie featuring Ivory's rap, similar interests and awe ensued with such excitement that many of the students worked to create their own mini movies on science topics. Her science rap had resonated with many of the students; there was a strong resemblance of her science rap lyrics to the style and tone of raps that are typically created among peers. For instance, in the rap, Ivory challenged and asserted her status or position through articulate and clever word choice (e.g., "you see my style is better than Hanks" and "That Bill Nye the science guy couldn't even mess wit [with] dis [this] tape"). Hanks is an African American scientist who had appeared locally on a local television station to try to make science accessible to students and Bill Nye the Science Guy is a nationally known figure associated with science. Through her rap, Ivory challenged and warned others of the powerful group of youth scientists—Discovering Urban Science—with whom she was affiliated. Ivory's cultural capital as a rapper and specifically being able to rap about an unexpected area (science) allowed her to garner respect; she was able to gain recognition and status from her school peers. Ivory's science rap is indicative of the ways in which rap practices—if they seep into science curricular representations—can allow students to begin to garner similar forms of capital that they might visualize as only developing within non-academically oriented fields.

The ripple effect: expanded agency for Ivory to expanded agency of others

Ivory was agentic in her creation and performance of her rap, and in doing so, she created additional structures that could be accessed and appropriated by others within our larger research group consisting of teacher and student researcher groups across four schools. In showing how rap practices could contextualize science within student experiences and ways of being, Ivory generated new schema or frameworks for what constituted authentic forms of representation in the science classroom. Adult co-researchers, including teacher

researchers, observed Ivory's rap, thus it served as a model and encouragement for possible connections between rap and the culture of science. In some cases, as described earlier in relation to Ms. Beers, teaching and learning practices began to shift (LaVan 2004). Through cogenerative dialogue (a method that can be used to identify tensions and develop collaborative resolutions through a model of shared responsibility in classroom settings), Beers, LaVan and a student teacher became aware of students' concerns that their assignments in science did not "fit." In response to a student question: "Can't we do projects and assignments that we like to do, and fit us better?" (p. 109), Beers both adjusted the assignment she had given to the class as well as authored and personally performed a rap to model the ways in which students might connect science and rap.

> Jen [Beers] told the students that she too had created a rap … that she would perform with Mr. Chang and me… Intermittently throughout the presentation, audience members laughed and shouted. By the end of the rap, many students were repeating the refrain ('move this way, slide this way') and enacting the corresponding hand movements. (p. 111)

When rap and science mix to create emergent creolized forms of science, in the process, identities of students and even their teachers can hybridize and afford further opportunities for expanded agency. Beers had previously been wary of allowing students' dispositions towards movement expressiveness to appear in the classroom (Elmesky and Seiler 2007). However, as Beers observed students successfully experiment with creating creole forms of representation for scientific concepts, the schema shaping her teaching practices underwent some changes. Beers explained this to me through email correspondence.

> I think that my experiences with Ivory, at City High and with DUS all influenced my choice to rap and [to use] other forms of oral expression as a means of assessing student understanding. I think Ivory's use of rap allowed me to see how it could be used in science class and that, given the right structure, could allow students to explain something that they otherwise may have had difficulty explaining. (3/07)

Beers' practices and documented reflections upon her decision to incorporate rap into her classroom are not to be lightly dismissed. Ivory's ingenuity in creating new ways for talking about a scientific topic—sound—represents student movement towards the discipline of science, and it is not unusual that the impetus for change would be placed upon the student. Less common and rarely expected, however, is the movement of teachers towards youth culture. By exercising practices that resonated with the youth in her classroom, Jen developed creolized science teaching practices; importantly, this provokes researchers and practitioners to consider what can happen when a teacher occupies a dynamic rather than static position in the science classroom.

Poetry: as a form of rap

> Yeah, I think rap is nothing but poems. Cuz like, you can write a poem, that's how I started rappin an I didn't even know how to write poems. It was raps and it was poems an when it was poems, it was raps. Basically I say it's all the same. An the poem don't really have to rhyme, it's just that the way you pronounce it—the way you say it.

As Ivory points out in this quote, many youth see poetry and rap to be interconnected. Within the student researcher group, May was one of the youth who often talked about how

much she valued poetry. She had been writing poetry since she was very young, and during our time working together, May consistently enacted poetry-writing practices. Her dispositions to this medium of expression were clearly well developed and afforded her the exchange of and building of social and symbolic capital, although in a different manner from Ivory. When May read her self-authored poems aloud to peer researchers, they were congratulatory and supportive of her talent and creativity. They also recognized that May's poetry was similar in rhythm and structure to the raps that some of the other student researchers were authoring. Thus, year after year, they would urge May to put her poems to a beat and to rap with them. May, although an avid listener of rap music, always refused, choosing to express her orality through the medium of poetry. The following represents one of her 'science' poems that, like Ivory's rap, focused upon the concept of "sound."

People depend on sound
to get us around almost everyday
we sometimes hate it but then
we love it especially when we play
even the blind it helps them to find a
way to see in mind
sound makes vibrations which makes equations so
take advantage of this information

Although usage of canonical science discourse is minimal within both Ivory and May's writing, May's poem, similar to Ivory's rap, represents a creolized form of science understandings. They have taken small steps upon a journey to acquire different ways of talk (canonical science discourse) through using their own ways of talk. May communicates that sound travels through "vibrations." Additionally, she recognized that concepts/phenomenon can be symbolically represented through an accepted system of symbols ("equations"). Furthermore, May recognizes that there is value in gaining scientific knowledge—urging others to "take advantage of this information." May's poetry illuminates the expansive nature of orality as a motivator for producing creolized forms of science as students seek out and make connections between science and experiences that are familiar. Moreover, I include this section on poetry to emphasize that the skills of verbal expression and lyrical intelligence emerge in other forms besides rap and to highlight the heterogeneity that existed amongst the youth researchers.

Freestyling and scientific fluency

Thus far, in discussing orality as a resource for science teaching and learning, I have focused upon the conscious authoring of rap—in other words, the creation process of rap where lyrics are written down on paper so they may be revised or edited. However, there is also the spontaneous development of rap or *freestyling* where rap is "written" in the moment of performance. While freestyling, an individual improvises and creates uncut, unedited, uncensored lyrics that relate directly to the immediate circumstances and/or surroundings in which the rapper is situated. Freestyle rap allows a rapper to demonstrate talent and fluidity in creating lyrics that are appropriate in rhythm and meter as well as in contextual subject matter.[3] Often, rappers engage in freestyling battles to prove their

[3] Most of my understandings about freestyling emerged from my time spent with the student researchers. Some supplemental understandings were attained from reading http://en.wikipedia.org/wiki/Freestyle_rap.

Fig. 6 Young boy in the neighborhood strengthening rapper identity by performing a rap "on stage"

rapping skills or simply as a means of "settling" a disagreement with or putdown from another individual or group. Such a battle can emerge at any time—for example, Ivory recounted how she successfully waged and won a freestyle battle against a student at another high school during a field trip. Students like Shakeem and Ivory became skilled in freestyling in neighborhood and home fields where deep social bonds and important symbolic capital are built through such practices. The centrality of rap as a means for capital development and exchange was evident in Shakeem's video ethnography of his neighborhood, for instance; it revealed the induction of young children into a rap culture that included learning how to perform (in the moment) in front of others (see Fig. 6). These dispositions also seeped into our research setting at the university and were sometimes captured on videotape. This was the case on one day in the summer of 2001, at the end of our mid morning break. An analysis of this vignette follows.

Ivory, Shakeem and Randy were seated around the computer where Shakeem was on the Internet looking for different songs and raps. When he played Big Tymers Song, *No, No*, Ivory and Shakeem began to freestyle to the beat of this common rap that they both knew—they rapped about their ninth grade experiences in the neighborhood school that they both attended. By microanalyzing video footage of the youth freestyling, it became evident that the students could enact rap practices fluidly, in anticipatory manners with each other. Their rhymes identically mimicked those of the Big Tymers in meter and rhythm yet differed in wording. They took turns verbally to make a series of statements that ended with the refrain "No, n–no, n–no; No, n–no, n–no; No, n–no, n–no. Uh-no he/she/we didn't." Although they each freestyled their stanza alone, they sometimes joined in together to rap the refrain. Frame-by-frame analysis reveals that Ivory and Shakeem's patterned overlapping verbal utterances contributed to their entrainment and to the emergence of synchronous gestures in conjunction with the refrain. In Figure 7 below, I captured eight frames of their consecutive movements; noteworthy is the manner in which they moved their right hands in rhythm with one another as they rap the refrain in synchrony. In the first frame, Shakeem took the lead with movement of his right hand. Ivory joined in and extended her right hand (2nd frame). Then Shakeem and Ivory pulsed their hands in time with each other (frames 3–8). As they rapped, these youth were vibrant,

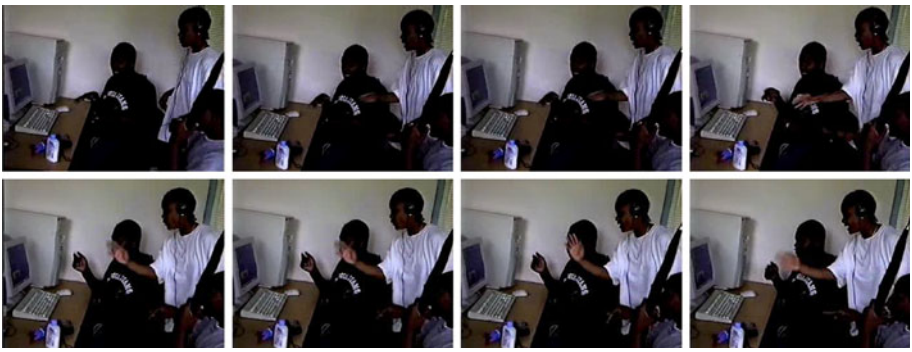


Fig. 7 Shakeem (*sitting in front of computer*) and Ivory (*standing*) are mutually entrained as they engage in synchronous freestyle rap

rhythmic, energetic and clearly enjoying their spontaneous activity. They were building solidarity, or social connections with each other as well mediating symbolic capital with the other researchers.

Although it is a cultural practice predominantly utilized and valued in contexts outside of school, freestyling has great potential to act as a resource for science learning. As students are actively engaged in the doing of science, it is useful to consider how freestyling about the science activities might assist first in enhancing their engagement and secondly in enhancing their ability to reflect on what they have completed and the concepts that have been introduced. Thus, just as freestyling indicates a level of rap fluency, this form of orality can assist students in establishing a certain amount of fluency in accessing and appropriating science canon within a mixture of other ways of talking. In the process, bonds of solidarity can emerge between students and with the teacher, and dynamics of respect can be built, maintained and/or strengthened. Additionally, one would anticipate that symbols associated with the culture of science (equations, vocabulary, textbooks, lab equipment, etc.) would also become invested with positive emotion such that future encounters with the same symbols in science learning environments invokes a positive response.

Freestyling about Newton's laws

During the first summer of my work with student researchers, after observing spontaneous interactions like the one described in the preceding vignette, I began to ask Ivory and Shakeem to attempt to freestyle about the science activities in which they were taking part. In retrospect, I did not fully realize the power of freestyle, yet it seemed clear that it was a form of highly valued cultural capital that both Shakeem and Ivory held. I thought that perhaps the conscious and direct integration of freestyle with science topics could then serve as a means for generating more interest around science activities. The following vignette occurred on a day when the youth researchers were working in the capacities of science learners/curriculum developers. Analyses illustrate that freestyling practices do more than generate interest and positive emotion; they provide resources for the development of creole discourses that potentially advance the youth's cognitive understanding of particular science concepts.

Ivory, Shakeem and I engaged in a short activity involving a "wind-up" car, water, and oil. The goal was for us to manipulate these simple objects as a catalyst for discussions around velocity, acceleration and frictional force. Below, parts of our discussion are transcribed, followed by two freestyle rap stanzas performed by Shakeem and Ivory.

Row: Let me write that word—velocity (*I write the word on the board*). That's just another way of saying speed. So speed is about how fast you're going—the distance that you're going per time and then it's also about the direction that you're going. …

Keem: Hold, look at this. Catch it. You ready? (He winds up the car slightly and lets it go.) Hold up. (He winds up the car again and lets it loose. It travels across to the other side of the table.)

Ivory: You Lose!!!

Row: At the very beginning, it accelerates though—cuz you have it wound up so at the very beginning its going to go a little faster.

Keem: Cuz it's a stick [shift], man. (Winds it up again and lets it go.)

Row: So why is it going to slow down eventually? (As it comes to a stop, I ask) What is it that keeps it from going on forever? …

Ivory: The brake.

Row: Well, there's no brakes on it. I mean I'm not pressing any brakes so there's natural brakes on it. Ummm, it has to do with the tires.

Ivory: Rubber.

…

Row: Now if you put down water, how do you think it's going to affect it?

Ivory: Its going to be stiffer and slide cuz look at the—(Shakeem pours out a small puddle of water onto the table. He places the already-wound car inside the water. The car wheels spin—unwinding with hardly any forward movement.) That was like cool. That's why when it rains its like hard to pump your brakes, and you can't get to the house. (Shakeem pours down oil onto the tabletop, and smears it so that it fills the pathway of the car.) Oh my lord, this is oil–it might work.

Keem: Yeah we bout to take it to the house.

Ivory: But its gonna make all types of U turns to get out the oil. If the water made it hardly go then that's gonna try to like turn and stuff.

In the above transcript, it is apparent that Shakeem and Ivory were actively involved in the activity, and willing to engage in a discussion centered on the car's motion on different surfaces. What emerged was a mixture of discourse. We talked about the procedures of what is being done (e.g., "now if you put down water" or "this is oil"), the actual observed movements of the car (e.g., "its going to be stiffer and slide"), and, acting in the role of teacher, I attempted to introduce various canon (e.g., "velocity," "accelerates," or "What is it that keeps it from going on forever?"). Additionally, the youth utilized everyday expressions (e.g., "we bout to take it to the house"). Following this discussion, I asked Ivory and Shakeem to create a spontaneous freestyle rap on the activity in which they had just participated. Upon making the request, they took turns rapping; the first portions of their raps are presented below.

Shakeem: Watch this. Check it, Ivory. Watch this. Yo. We put the S-2000 on the table, greased 'im up an see if he could beast 'em up. Uh. Ate all the cars up and it crashed because the friction in the table was not even there. You got gravity pulling 'im down. And you skate past the niggas cuz they thought they was clowns, uh. The grease on the

tire, made them slippery, they slip an they slide like the slip, the S&S crew. Oh no, you know I come through. I wish I was in the car, but then again I don't. You see it went off the table. There should have been a bridge in real life, even if real trite.

Ivory: Yo yo. This is how DUS is—I'mana spit for you a little slowly—make sure you can hear me clearly. As I tell you about the project we did today, it was a little somethin with the car—a bad boy's play. Uh, what had happened was we went from the table to grease an water an see what the stable and then after, uh, we made sure it was hot and then after that it was cliff on the spot.

Although I was also present in the room as Shakeem began to freestyle, he rapped to Ivory, further indicating that shared understandings exist around rap practices and that capital can be gained from interacting and drawing the attention of peers ("Watch it. Check it, Ivory. Watch this.") Both Shakeem and Ivory created lyrics that are basically descriptive of the activity they just engaged in together (Ivory: "What had happened was we went from the table to grease an' water" and Shakeem: "We put the S-2000 on the table, greased 'im up an see if he could beast 'em up"). Yet, in contrast to Ivory, Shakeem proceeded to create lyrics that were explanatory of friction and gravity in relation to his observations of the car's motion. Specifically, he made connections between the grease on the tires, the slippery motion of the car and the friction that was "not even there." Shakeem also added in a component of gravity as another force acting on the car in addition to friction ("You got gravity pulling 'im down"). Shakeem's freestyle rap, although preliminary and emergent in the moment, presented promising movements towards conceptual understandings of Newton's laws. Importantly, it seemed that Shakeem had begun to fluently interweave his immediate experiences in science activities into other narratives arising from other lifeworld experiences. He situated his rap about this activity within a larger context—mentioning a particular sports car (S2000), a car race and a crash. Shakeem's family circumstances surface as well—they did not own a car; his descriptions of narratives around this car were outside of his personal experiences ("I wish I was in the car…").

I share the above vignette because it represented the first time that I attempted to *consciously* shift the structures in the research environment to encourage the youth to combine freestyle rap with science topics. However, this example also highlights the ways in which our interaction must be understood within a larger context/history/chain of interactions that had been shaped by the ideological, human, material and symbolic structures that were continuously accessed and appropriated in unconscious manners in the research setting. Up until that point in the summer, many different instances had emerged that 1) communicated to the youth that the adult researchers valued rap as an acceptable medium for the space, and 2) revealed that there was a strong affinity towards rap and freestyling by the youth researchers. For example, Ivory and May wrote rap/poems about sound and received recognition from their peers and the adults in the research setting, and when the spontaneous freestyling incident occurred in conjunction with Big Tymers Song, *No, No,* the youth were not shut down. On a more subtle basis, I showed interest when Ivory wanted me to hear her favorite raps and listened when Shakeem practiced his lyrics. These, and other uncountable everyday events that occurred in relation to rap, contribute to understanding why I was able to ask Shakeem and Ivory to try their hand at freestyling about science concepts and sheds light upon why they even agreed to give it a try.

Interestingly, the freestyling attempt by Shakeem and Ivory around the car activity introduced expanded structures into the setting. That is, ideologically, freestyle as a genre of discourse then came to include "science talk," and as science-related practices were

enacted in relation to a particular science activity, those practices could be accessed and utilized as resources by the youth to meet varying goals. In fact, later during the same week, Ivory again attempted to generate in the moment rap lyrics as she observed and reflected upon Randy's (another student researcher) struggles to have his air-powered, self-designed vehicle roll smoothly on the floor (see Fig. 8). Specifically, Randy, like the other student researchers, had been working with life savers, paper, straws, tape and balloons to create a vehicle that could move forward when provided with a force from air (arising from deflating balloons). The following freestyle rap was created in the moment by Ivory after Randy was unsuccessful in having his vehicle move upon the carpeted floor.

Yo, Randy, his science ain't gettin through
because he just didn't know what to do.
He was puttin stuff together with the balloons too.
With the tape, putting them in the wrong places …
For one thing, it's a rug on the floor
an you got candy wheels thinkin it's really gonna move somewhere,
with that clay stickin on the straw.

In contrast to Ivory's first try at freestyling around science activities (with the car, water and oil), in this instance she had become more adept at making up spontaneous lyrics that fit the rhythm and rhyme of rap as well as captured her thoughts around a scientific design activity. As she rapped, Ivory gestured, in time, with her hands—similarly to how she pulsated in conjunction with the Big Tymers' beat while freestyling with Shakeem on non-science topics. She made connections between the rug on the floor and frictional force, understanding that candy wheels may encounter resistance in moving forward on carpet. She also emphasized that the vehicle's resistance to movement arose due to the clay that Randy had used between his straw axles to hold together the frame of his car. The wheel movement of his vehicle was inhibited by the clay pieces that were so large they dragged along the ground. Thus, although she did not use canonical terminology, Ivory had identified two sources of frictional resistance that Randy encountered as the air was propelled out of two balloons. In addition to providing a means for integrating canonical language with other forms of talking, freestyle rap is a place where youth can begin to make sense of their participation in the culture of science—from a comfortable location and within familiar ways of being. By continuing to engage freestyling as a means for reflection upon science related practices, Ivory expanded the possibilities for her future interactions within multiple collectives—with her peers both in the research setting and in the neighborhood and with her future science teachers. This vignette captured the third instance within a period of a few weeks where Ivory was actively merging her identity of rapper with the discipline of science. Hence, as she reinforced the stability of the storyline she had developed as rapper, her identity was simultaneously hybridizing to include a dimension associated with science. Access to supportive collectives of peers and adults in the research setting was central to her repeated attempts to "spit" science lyrics—central to her process of identity (re)formation into hybrid forms of a freestyle *science* rapper.

If we understand an individual's ability to freestyle as the enactment of rap practices on an unconscious level, then the ability to freestyle about science activities, concepts and processes would represent movement towards fluid ways of talking about, doing and understanding science culture. The analyses presented with regard to Ivory and May's written forms of oral practices illustrate the importance of providing students with space to consciously learn how to apply rap skills to science learning contexts. Moreover, the

	
Randy tries out his balloon-powered vehicle; there is no movement forward	Ivory freestyles about the Randy's vehicle design; putting forth theories for the lack of motion.

Fig. 8 Creolized rap, creolized science, and the hybridization of Ivory's rapper and science learner identities

analyses presented with regard to freestyling about Newton's laws illustrate that unconscious enactment of rap can afford fluent representations of creolized forms of science. I assert that, with time, similar to Ivory's case, freestyling opportunities in science learning environments may support the hybridization of some students' identities to include both rapper and science learner.

Rap as an instructional tool

As I continued to work with the youth during that first summer of research, I became increasingly encouraged to embrace rap as a cultural strategy that could aid the science learning process. However, as time progressed, the youth often challenged me regarding why I asked them to try new (hybrid) practices and did not do so myself. This challenge took me off guard; I was surprised that they directly demanded an equivalent participation mode from me. At first, I protested by pointing out that the student researchers were much better than me in enacting rap related practices. However, seeing that we were co-researchers, it only made good sense that there should be give and take in our interactions. Ivory explained that participation in a rap could take on many different forms—even nodding one's head to the beat or tapping a foot would communicate a form of solidarity with the rapper(s). In retrospect, it is interesting to consciously contemplate why I did not intuitively enact practices in conjunction with the youth around rap. This is especially interesting since, as a teenager, I had enjoyed the genre of rap and spent some amount of free time with peers memorizing rap lyrics, and occasionally "performed" in a peer group setting or with siblings. I had also been, since very early in grade school, an avid poetry writer. Although I found both mediums to be useful forms of expression, stability in terms of my own identity was moreso connected with being a "poet" than with being a "rapper." I often took risks in writing poetry, and this part of my identity was continually reinforced as I received positive feedback on my authored pieces throughout my school years. With encouragement from the DUS collective, I attempted to incorporate rap as a specific instructional tool. Rather than placing the impetus upon the student researchers alone, as we continued to learn about Newton's laws, I authored a rap in

written (not spontaneous) format to help emphasize the difference between speed and velocity. My plan was to write some of the lyrics and then elicit Ivory's help with writing the rest; however Ivory encouraged me to try rapping what I had already written. I did so, and received a variety of responses from the student researchers. The rap went as follows.

Speed, it means something different on the street
In here we move to a much different beat
Traveling a distance in a period of time
Hey sit back and relax, I ain't givin' you a dime
Speed
Speed it's the same thing as velocity
Except you add direction, hey that ain't an atrocity
Direction: north, south, east or west
Hey DUS on the set, we ain't nothing but the best
Direction, up down, left or right
I told you sit back and relax, you be lookin all uptight. (7/26/01)

Although the reactions ranged from "I'm sorry, but that sucked!" to "That was decent!" this experience seemed to help me build social capital and solidarity with the group. The youth were intrigued that I was attempting to enact practices that they valued. Whereas developing lyrics to capture the science concepts was not difficult for me, I struggled in utilizing language, rhythm and rhyme that would make my rap authentic. I used wording such as "ain't" and "be lookin," and I attempted to place myself and DUS above others ("Hey DUS on the set, we ain't nothing but the best"), as Ivory had done in her rap on sound (e.g., "You mess with me you crazy you betta get ya fro right").

By writing and performing this rap, I had created new ways of interacting with the youth and through that experience I expanded the range of possibilities for how they would perceive me in relation to the collectives to which they were connected. My identity as a science educator and researcher was hybridizing and the development of creolized forms of science further emerged within our group. With regard to science understandings, the implications of my rap for the student researchers' learning could be questionable. Yet, later that same afternoon, I had an opportunity to gauge the possibilities of rap as a resource for learning science when I engaged Shakeem in a conversation about velocity. We used a basketball game he was playing on the computer as a context for the discussion.

Row: Now what's the difference between speed and velocity?
Keem: There's no difference it's the same thing,
Row: It's the same thing.
Keem: 'Cept that velocity is in a diff—wait speed is veloci—Damn! Wait. Velocity is speed in a certain direction.
Row: How did you know that?
Keem: Cuz I heard you this morning.

By rapping, I had generated symbolic capital with the youth, yet, in Shakeem's case, that respect had become exchangeable for the generation of new science cultural capital (i.e., understanding the conceptual difference between velocity and speed.) This vignette is *not* meant to insinuate that all science teachers have to learn how to rap so that their students will learn science. Rather, I highlight this an additional example to Beers' classroom practices discussed earlier in order to illuminate the ways in which shifting the rules and the unspoken expectations/norms of science learning environments can assist in the development of new sets of practices both in the cases of the students and the teacher.

These new practices allow for the mergence of multiple ways of being, such that both rap and science cultures creolize. This also allows for expanded possibilities for the science classroom community and the ways in which students and teacher can identity with the creolized collective that has both familiar and unfamiliar aspects. The possibilities for students' agency as science learners expands as they are able to draw upon a repertoire of resources that previously sat in a reservoir to be utilized "appropriately" *away* from science—on the neighborhood streets or in homes among family and friends.

Connecting back to globalism

> The relationship between globalisation and science education … forces us to ask some hard questions of the science education reforms. …It also forces us to confront again what type of science education we wish to work toward. This remains an intensely difficult and enduring dilemma. Personally, I want to work toward developing science education that values noncommodified forms of knowledge, relationships, activities, and aspects of life, and that includes sustainability science, cultural recognition, and social redistribution in its agenda. Although the form this may take is yet to be configured, an important part of its development is elaborating the relationship between globalisation and science education. (Carter 2005, p. 575)

In her article, *Globalisation and Science Education: Rethinking Science Education Reforms*, Carter (2005) challenges the science education community to consider the relationship between globalization and science education. In particular, evident in the above quote, Carter suggests that establishing such understandings around globalization will assist in developing a more socially just field of science education that values hybridity and creole forms of science.

In situating rap practices within a framework of cultural globalization, I emphasize the ways in which rap, although originating in hip-hop culture, is much broader than one particular collective (i.e., Black Americans). I view cultural globalization as providing motivation and rationale for arguing that science educators must broaden our notions of pedagogy and curriculum in science classrooms.

> Who says that teachin on the board or readin from the book is the best way to get the finished goal? Like, it's not the road you take to get there—as long as you get there. Now when, if you get a flat tire along the way, then you're gonna have to figure out a way to fix your tire an keep it movin. So like if the rap thing in the classroom isn't workin, somethin like that, an you have to have a quiet settin—maybe that ain't workin neither. Maybe poetry might work. It's not exactly rap with a beat but I know if you wrote a poem about a couple of different things, you can learn it rather than like hearin DMX hollerin an screamin in your ear. … It all depends on the type of person that you got, an if you listen to him, an like ask questions … Now like people older than us or maybe even younger than us or the same age but from different neighborhoods or somethin might not listen to the same types of music we listen to or anything. But it really don't matter. … As long as you learn somethin by the end of the day, that's what's important—not pretty much how you do it. It's too many different ways to say that's the right way. You know what I mean? (Shakeem, 5/06)

In an increasingly global community, Shakeem's comments resonate with Roth's (2008) call for viewing the world through a framework of difference rather than sameness. In this manner, hybridity is the norm and educators should be receptive to thinking about the many diverse roadways for building science understandings. Orality in the form of rap represents one such roadway, although as Shakeem reminds us, students appreciate multiple approaches to teaching. One learning environment might better suit the inclusion of rap; another might flourish with poetry. Regardless, it is important for teachers and students to maintain open channels of communication. There are many ways for teachers to communicate a valuing of students' dispositions; flexibility, openness, and knowledge of students are important methods for demonstrating that caring. The student researchers explained the importance of having teachers who "can relate to the kid" and who "know what gets them to learn what they're [the teacher] teachin." Moreover, they expressed a dislike for "teachers that teach one way an don't know how to teach another."

Even if rap practices are not incorporated into the classroom through instruction, the students can be allowed to draw upon each other's dispositions as resources during science activities, particularly those requiring representations of their understandings. In addition, knowledge of the role that rap can play in making sense of the curriculum is useful so that teachers can encourage students to draw upon this capital at home as well. Many students have already learned to utilize rap as a memorization technique. For instance, individuals might use background music to remember material.

> It's the [music] beats for me. When I study, I listen to music because certain songs make me remember certain words that I just wrote. An then like in class when I see a question like that has to do with something I just like studied, that song come up in my head. So the song lyrics help me with the thing I just studied. You use that to make you—to remind you about the things that you need to know. Even if you never say nothing about it [science] in the rap. If it reminds you of what you need to know… what's this? You're passin the test!

Comments such as these indicate the ways in which students already draw upon rap music outside of school and bring those strategies into science class in unconscious ways ("that song come up in my head"). Other individuals who, like Ivory, don't listen to rap music while studying and instead prefer the quiet, might write rap lyrics as a study strategy (e.g., "It could be the dumbest sentence. I probably make a little rap line out of it."). Certainly, as these youth researchers point out, individuals are different, and there are multiple and different preferences for teaching and learning and this view is consistent with recognizing an increasingly diversified population that is more and more connected through media technology.

For too long, the preferred and accepted modes for teaching science are ones that do not resonate with the diverse populations in America's schools, making it difficult for students like Ivory and Shakeem to experience the hybridization of their identities in ways that allow them to feel connected to a school science community. Coming to identify oneself as a "scientist" or as someone who is "successful in science class" is shaped by your experiences within that community. As interactions fail or succeed, a student generates perceptions about how he/she can participate in science; additionally, others in that community form perceptions about a student's capabilities. In order to increase the number of students whom perceive themselves as being able to identify with school science, classroom structures must transform and shift so as to embrace and afford students' hybridization of their identities as they create creolized forms of science. Coming to understand how cultural globalization shapes the practices of youth is a essential step in

generating the evidence for insisting that science classrooms must change—maintaining status quo through a static, unchanging curriculum and traditional curricular approaches will not encourage success for the majority of the students.

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