

Characterizing the Role of Arts Education on the Physics Identity of Black Individuals

Tamia Williams

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Introduction: There is an underrepresentation of black people in the field of physics. There is an exclusive culture of physics that has marginalized black people into thinking that they do not fit the criteria of who a physicist is supposed to be [1]. There are studies that show that black people have made an effort to study physics, however those same individuals tend to leave soon after [2]. How one negotiates their physics identity is crucial to becoming and maintaining membership in the physics community [3]. Therefore in order to increase the presence of minorities, especially blacks, in the field of physics there must be a further examination of physicist identity.

Background: In this work, we hypothesize that the arts provide a way to escape the challenges that underrepresented students face in STEM environments. In order to understand racial and physics identity, we look to the work of Nasir [4] who developed a framework of racialized resources that can be available in learning environments. Nasir has three different categories that make up her framework: material, ideational and relational resources. Because racial identity precedes physics identity, we must foreground it in our framing of a racialized physics identity. The other work that we look to is Hazari, [5] who developed a framework for physics identity from the work of Carlone and Johnson [6]. This framework includes the constructs of interest, competence/performance, and recognition that Hazari draws on from Carlone's work. In prior studies, we operationalized these constructs in order to examine connections between physics and racial identity [7].

There is not much literature about how arts have played a role in individuals' physics abilities. Involving an artistic component to science culture, especially that of physics, can be a useful tool when learning science in an informal environment. The incorporation of arts can bridge science culture and identity with those of non-dominate students. In parallel, there are studies that show that the arts can act as an identity mediator or coping mechanism for underrepresented groups in STEM [8]. In this investigation, we add to a methodology developed in previous studies [7] to analyze interviews of black physicists and examine how arts have impacted the development of their physics identity. In this work when we say the "arts", we mean the performing arts, such as music, theatre, and dance. One particular reason to why we focus on performing arts rather than visual arts is because in visual arts, there is a media that can show a person's emotions or feelings, than compared to performing arts where the individual must express their emotions and feelings through their physical actions. Additionally, it is important to understand that when we talk about identity of black individuals to keep in mind that there are different types of black identity.

Objectives: The two goals of this work, are to (1) create new codes for analyzing the impact of performing art from the interview responses and (2) analyze interviews of black people from different nationalities and see if arts impacts these individuals differently (African American

born in the US vs a Caribbean or African). I use an existing data set of interviews of black physicists for my analysis. I am also conducting new interviews of physicists, who identify as being black, African American or part of the Caribbean and African diaspora. The information obtained has resulted in the creation of several central findings that span from one cultural perspective to another.

Methods: This project focuses on seven black physicists from different parts of the world. They identify as Black, African American, Caribbean and/or African. Each of these physicists have their own personal experiences of learning physics. We use the lens of narrative inquiry to privilege their stories and personal insights, and thus, we have developed an interview protocol that prompts interviewees to tell their experiences. Some questions that are included in the interview protocol are “Have you ever participated in any performance art in your past or currently?” and “How have they played a role in you becoming a physicist?”. We use these questions to point out unique experiences that these physicists have had with the performing arts. Once each interview is completed, it is transcribed and then analyzed. In total seven interviews were analyzed. The analysis consisted of several central finding that highlight the intersection of the interviewee’s physics identity and their artistic identity.

Findings: From the beginning of the analysis process we had some ideas that the role of arts in the field of physics would be a means to cope with the challenging field and also an identity mediator. Out of the seven individuals that were interviewed most participated in the arts in some form, with the exception of one. Four individuals found that arts did have a significant impact in their journey in physics while two said it did not. Table 1 shows the impact of the arts compared to the amount of individuals. The three central themes that arose in the analysis process of arts impact in physics: (1) increased physics abilities, (2) better social environment than physics, (3) arts as a coping mechanism. From these central themes we created five corresponding codes to categorize the impact of each interviewee’s participation in the arts that are described in Table 2.

Table 1: Arts Impact in Physics

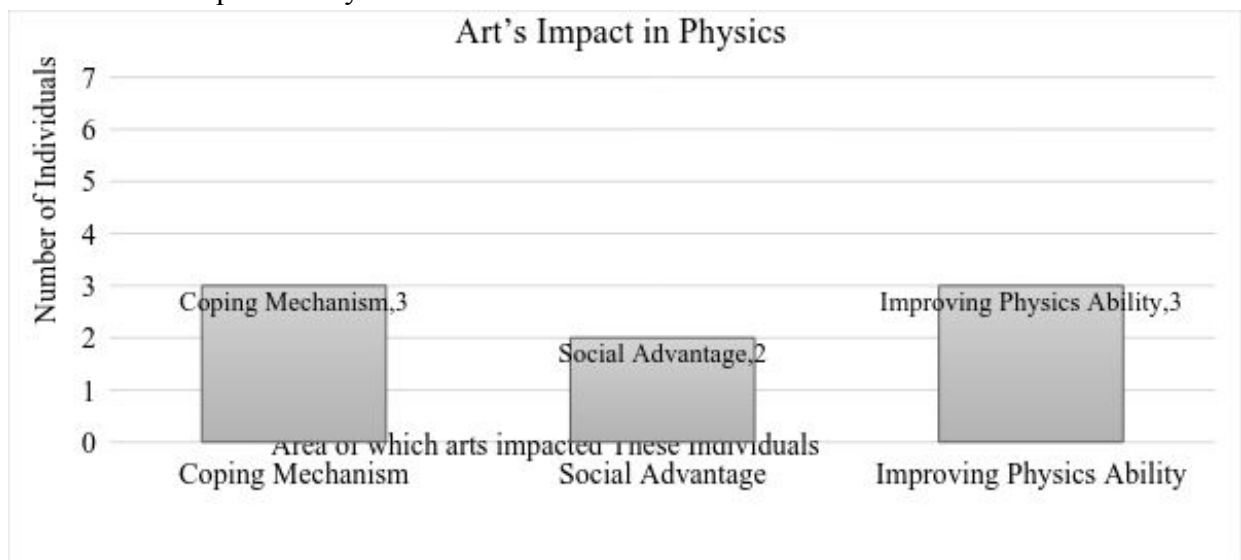
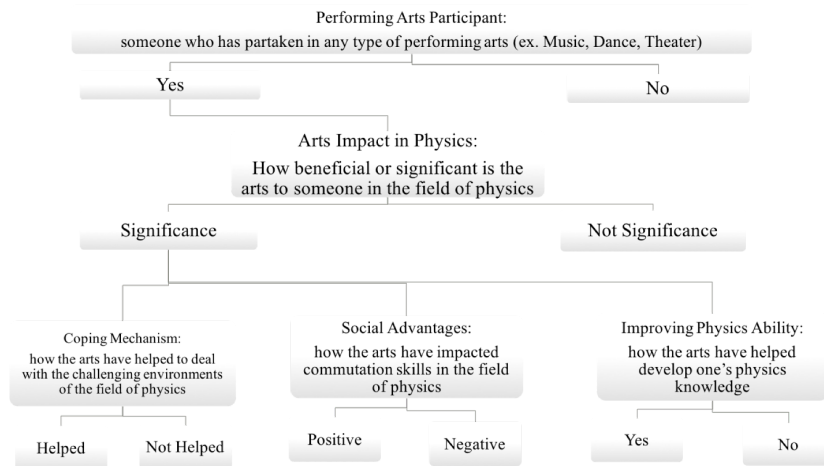


Table 2: Arts Codes



Another finding when looking at a black American physicist compared to an African physicist, the African physicist felt that arts had no influence in the way that she learned physics. In the future, there will be further investigation to see if individuals who identify as Caribbean or African, don't view performing arts as impactful or don't participate in the performing arts at all. When asked if she participated in the performing arts Molly stated,

"No. I think I'm very poor in any arts, so no..... I was an athlete at some point before I stopped. I don't think that counts as art.....".

compared to a statement by Janet,

"Yeah, so I've been playing the violin since like third grade. Or I'm sorry, the piano since like third grade, and I picked up the violin in sixth grade. And it's something I tried to continue in college..."

Many of the individuals who felt that the arts had significant impact in their time with physics gave several experiences that solidify the original hypothesis that arts do have an impact on black individuals. However some individuals who did say that they were performing arts participant did not find to be impactful in their physics education. Mike's response to when asked if he found arts playing a role in him becoming a physicist he responded,

"Probably not. Like... wow, probably... not for me. Not for me personally. Just because like for me I love, I loved music like since I was a little kid, and like doing music and podcasts and radio shows now it's like these separate worlds for me. Physics and music are two different worlds for me and it didn't influence the other one. Like me being in physics didn't influence me doing music more or getting into music more and vice versa."

No, it really didn't. Like I keep those two worlds kind of separate. Like for me personally I keep them separate because it's just, I don't bridge the gap between those because I think it's kind of cheesy when people blend like music and physics together, I think it's kind of cheesy. That's my personal take on it, I think it's kind of cheesy because like then you try to analyze the music too much and sometimes it's just like hey, enjoy it, like let it be what it is."

Jackie as a performing arts individuals and physicist gave examples of how the arts has helped increased her physics ability and a coping mechanism. Her improved physics ability has been impactful both in and out of an physics environment.

"But then there's the analytical skill as well. Like when I sit down and I'm talking with my brother about people or we've watched a video of some nature, I can analytically break things down or ask certain questions, like hey, we're not talking about what you think intuitively is happening but let's look analytically what's going on. So I think they both intertwine with one another. I don't know how to- I don't know how they- I don't know how one has helped me over the other, but I just feel like they're intertwined."

Jackie was also able to use the arts to cope with the challenges of physics. Here she explains the impact the arts have made her feel compared to physics.

"Yeah, I guess so. I guess so. I could see myself in physics even if I didn't do anything like that. But you know, it's- the arts are, for me, sometimes are liberating. It allows me to express myself a little more willingly, where physics is a lot more I don't want to say concrete, but it's just there's a structure within physics itself. But the arts it's a little more liberating. I don't think- I think I could still be a physicist and not have done that other stuff, those other- I'm sorry, learn those other skills, but I don't think I'd be the person I am without it."

Brittany is another black individual who felt that arts had an impact on her journey with physics. She believes that arts for her helped in social aspects.

"You have to be confident in the field of physics; getting up on stage performing for someone gives you a bit of confidence. So I think that people who probably do performance arts might be a little bit better in physics than people who don't because of that confidence and because of their ways of thinking. And at the end of the day you can have a great physics project but if you don't know how to present it and write it so that people actually understand what you're doing, what does it matter?"

Conclusion: Characterizing the role of arts education is very important when it comes to black individuals. The arts have an impactful role when it is intersected with physics. The performing arts help to create better social encounters, an increased physics ability and a coping mechanism when the field becomes too challenging. The performing arts as part of someone's identity can be a unique aspect that helps black people with the challenging spaces in physics. However, the

performing arts does not always have the same results on all individuals who identify as Black because there is no single identity when it comes to being black.

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