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Motivation to Pursue a PhD in Computing: Black Students in Historically Black Colleges and Universities

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ABSTRACT

This study investigates the motivation of African American master's degree students in computing to pursue a PhD in Computing. Specifically, we sought to understand the motivation of those students attending Historically Black Colleges and Universities (HBCUs) in the United States. Our framework was founded on the premise that an adequate theoretical rooting of broadening participation calls for reflections on the nature and practice of justice. Motivation, nonetheless, remained the core factor, albeit addressing it within a context of justice or lack thereof. The study shows that while most students seem intrinsically motivated by a desire to learn, leading to a likelihood to pursue a PhD, extrinsic factors such as funding and employability constitute the highest hindrance to such likelihood.

Keywords: Historically Black Colleges and Universities (HBCU), African-American students, computing, theory of justice, equity, access, intrinsic motivation, extrinsic motivation

INTRODUCTION

In the past years, the National Science Foundation (NSF) invested millions of dollars into its Broadening Participation in Computing (BPC) program, which aimed at increasing the number of graduates in computing disciplines from underrepresented communities of U.S. citizens and permanent residents (NSF, 2008). BPC projects focused on efforts to improve recruitment and retention and underwent formative and summative evaluations. We conducted a nation-wide study to assess the extent of impact that BPC projects have had at the time of conducting this study. This study is concerned with the motivation of African American master's degree students in computing to pursue a PhD in computing. Specifically, we sought to understand the motivation of students attending Historically Black Colleges and Universities (HBCUs). According to the Integrated Postsecondary Education Data System (IPEDS) of the National Center for Education Statistics (NCES), the numbers of graduates in Computer Science (CS) and Computer Systems Analysis (CSA) were very low. The IPEDS (U.S. Department of Education, NCES, IPEDS, n.d.) data showed that, for HBCU master's programs, there were 206, 181, and 155 total graduates in CIS for the corresponding years 2006-2007, 2007-2008, and 2008-2009; 79 and 75 blacks/African-Americans graduated in CIS in 2007-2008 and 2008-2009; and, in 2007-2008, only 34 blacks/African-Americans graduated in CS and three (3) blacks/African-Americans graduated in CSA. According to the IPEDS data and to what we later learned from our correspondence with department chairs and faculty in HBCUs, many computing programs did not have graduate students. Thus, our initially projected sample of 500 master's students was unobtainable.

Acknowledging that gauging motivation is a complex undertake, this study engaged perceptions from students about what factors into their motivation to pursue a PhD degree in computing and perceptions from faculty about their grasp, or speculations, of what factors into students' motivation to pursue a degree in computer science. Our goal was two-fold: to understand what motivates students in HBCU environments to pursue a PhD in computer science; and, to provide insight toward developing programs, curricula, pedagogy, and the organizational culture needed to accommodate these changes. Moreover, departing from an assumption that that there is a link between issues of justice and issues pertaining to educational equity, we frame this discussion within issues of justice and equity.

Amartya Sen (Sen, 2009) evokes a distinction between different concepts of justice in early Indian jurisprudence (i.e., *niti* and *nyaya*). He claims that "no matter how proper the established organizations might be, if a big fish could still devour a small fish at will then that must be a patent violation of human justice as *nyaya*" (p. 20-21). Sen advocates for a realization-focused perspective (i.e., nyaya), which is concerned with the actual realization of justice - the world that actually emerges, not just the institutions or rules concerned with organizational propriety and behavioral connectedness. In the light of Sen's argument, we can derive that a theory of justice ought to be founded on an idea of justice guided by an impetus to prevent manifest injustice rather than an impetus overwhelmed by perfection. Addressing manifest injustice is more urgent than awaiting a perfect justice verdict because, we argue, such is ultimately detrimental to those haunted by injustice now. For instance, the Civil Rights movement addressed manifest injustice rather than wait for adequately endowed institutions to do so in a time they thought appropriate. Even decades after such institutions were put in place, the spectrum of injustice remains almost unchanged as we continually unearth various layers of manifest injustice. However, we should not be conformed to this realization of not having to wait for perfect institutions; instead, we should continue to address the issues of justice and equity beyond the scope of modernity and its educational promise (e.g., the reliance on meritocracy and upward mobility), which continues to leave outside of its borders, those whom it considers "the other" (Cossa, 2020).

Given the colonial nature of modernity (Cossa, 2018), it is not surprising that what emerged as an institutional response to racial discrimination and the deprivation of blacks to pursue higher education, i.e., the HBCU, has become a justifiable instrument of present-day injustice as it continues to be seen as inadequate to produce quality graduates that fit the criteria of acceptable modernist knowledge. On paper, claims such as those held in some conformist circles that "HBCUs graduate more African-Americans in STEM" reflect an indulgence in the illusion of success. The recipe for minority success as prescribed by modernity and capitalism, presents a challenge in overcoming historically-rooted disparities in capabilities, economic access, freedom, and other areas. Moreover, and sadly so, it demands that minorities subscribe to assimilationism—the illusion of becoming an integral part of the white mainstream culture. Amidst the promise of inclusion into a modernity-centered system of education that is

colonial and exclusionary in its very core, we should continue to ask ourselves, "inclusion to what?"

Most studies concerned with BPC, while lacking a clear articulation of a theory of justice, approach the issue from an organizational change perspective, which best links with an assumption that the practice of justice springs from putting in place institutions and policies that promote justice. We suspect that part of this absence of a theory of justice in BPC studies may be due to an emphasis on data over conceptual and theoretical frameworks on which the data categorization and interpretation ought to be based. This unfortunate emphasis, perhaps also as a result of pressure from funders, turns those concerned with minority participation into data-driven methodologists with little, if any, considerations to theory and concepts; thus, rendering BPC efforts into a series of trial-and-error intervention-driven projects. While this may satisfy the funding community (along with advancing the agendas of modernity and capitalism), it is detrimental to the very minorities we intend to serve; even more so, if the demand is for numerical-driven accountability over quality-driven accountability.

For this study, specifically concerned with motivation to pursue a PhD, it would seem logical for us to employ only, or primarily, theories of motivation; however, to talk about broadening participation presupposes addressing equality of access, equity of participation, and ultimately the issue of justice within which equality and equity find meaning (Coleman, 1966). Motivation, nonetheless, remains a key factor in this study, but we address motivation within the aforementioned framework. Our framework is founded on the premise that an adequate theoretical rooting of BPC calls for reflections over the nature and practice of justice. This justice-founded framework ought to surpass a theory of justice that is merely based on capabilities (Sen, 2009), since such delimitation confines the pursuit of justice to a functionalist conception of justice (a modernity brainchild) as the mere provision of tools to function according to the rules of the dominant culture. Pettit (1974) argues that, "the theory of justice is the means by which we explicate and examine our sense of justice, it is not a means of providing it with metaphysical foundations." For instance, the argument advanced by Pettit (Sen, 2009) favoring a republican or neo-Roman theory of freedom, over that of freedom as capability, partly accommodates the argument about a sense of entrapment in attempting to broaden participation of minorities under a premise of assimilation into a dominant culture—recall our question, "inclusion to what?" Some of the students we interviewed manifested this sense of entrapment in that their disposition to choose (e.g., to pursue a PhD or career in computing) is "content-independently decisive, but their enjoyment of such decisive preference depends on the goodwill of those around..." (p. 305).

According to Pettit, in a republican or neo-roman theoretical conception of freedom,

> liberty is defined not just in terms of what a person is able to do in a certain sphere, but also includes the demand that others could not have eliminated that ability of this person even if they wanted to do so. In this view, a person's liberty may be compromised even in the absence of any interference, simply by the existence of the arbitrary power of another which could hinder the freedom of the person to act as they like, even if that intervening power is not actually exercised. (p. 305)

Following Pettit's logic and making a case for the difference between the capabilities-based theory and the republican theory, we concur that the ultimate state of freedom would be attained by a motivation resting on the intention to pursue a PhD regardless of capabilities (e.g., GPA, fulfilling the dominant criteria of "intelligence," or personal finances) or any form of external support (e.g., funding, mentoring, family, etc.).

Education plays a key role in shaping cognition and behavior, thus constitutes a challenge to liberty or freedom. Feinberg and Soltis (1998) argue that compulsory education assures a replacement of older, dysfunctional habits, attitudes, and loyalties by newer, more functional ones. We argue that such education is an attempt to guarantee that individuals are transformed into "functional" entities that have internalized the values, attitudes, and beliefs of the society imposing them. While access is important to functionalists, it is selective access that dominates their conceptualization, since society only functions well if there are differences in rewards (i.e., based on merit); thus, the differences in our rewarding of the work done by various groups of people (e.g., janitors, carpenters, and scientists) on the basis of the quality of contribution that such professions make to society. This is critical for our discussions of equity and access, since groups of people are slotted into different pathways of the functionalist machine in order to perpetuate the ongoing differentiation, in the name of complementarity, which is believed to bring about "progress" in a given society.

One of the problems with the functionalist assertion is that the differentiation is tied to historically established role-differentiations that are exploitative in nature - i.e., stated covertly or overtly, certain people are designed to undertake certain professions, be it on the basis of their gender, intellectual ability, race (skin color), ethnicity, religion, physical ability, or any other categorization that relegates them to a position of being perceived as distinctly inferior to the mainstream group. This is an indispensable frame

for understanding the institutional resilience of HBCUs amidst their struggles to compete with privileged white institutions of higher education and for understanding the cultural resilience of black people amidst assimilation into the mainstream white culture through imposed Western values that facilitate such assimilation and ultimate dependency on historically white institutions.

Fundamentally, equity and access should not only be evaluated by superficial means such as access to schools or access to technology but should delve deeper into the nature of the knowledge being transferred by the schools attended, their overt and covert curriculum, and the kind of technology being used. In other words, we assume that culture is one of the most significant issues to affect education at all levels and in all contexts. This assumption is critical in understanding the motivation of African-American students to pursue a PhD in computing, but it is also critical in understanding motivation in relation to the place that HBCUs occupy in the American society and academia. A deep understanding of the nuanced issues tied to cultural context is foundational to evaluate conceptualizations and theorizations of equity and access—to assume that one context fits all is erroneous and may cause more damage than good. We found that students attending HBCUs are confronted with the conflicting reality of accepting a moderate version of *separate but equal* that allows for a preservation of an African and African-American identity or succumbing to a cognitive-cultural assimilationism, which falls short of being democratic, albeit the fact that, in a context of broadening participation, it seems well intentioned.

Despite our readily identified conceptual and theoretical frameworks, we were open to emerging theories and concepts by employing Grounded Theory (Hilton & Glaser, 2012; Strauss & Corbin, 1998), thus allowing other concepts to emerge from the data and performing NSPD (Necessary, Sufficient, Property, and Dimensions) analysis as they emerge. This means that we engaged in a microanalysis of the data, unveiled other key concepts and analyzed them in the same way we analyzed the readily identified ones. Strauss and Corbin (1998) argue that "doing a line-by-line coding through which categories, their properties, and relationships emerge automatically takes us beyond description and puts us into a conceptual mode of analysis" (p. 66). In advocating for grounded theory, they claim that theory derived from the data is more likely to resemble "reality" and is likely to offer insight, enhance understanding, and provide a meaningful guide to action. They further urge keeping in mind elements of theory, i.e., parsimony, precision of prediction, and accuracy of explanation (Hage, 1972) as well as theoretical questions (i.e., those that make connections among concepts).

METHODOLOGY

We employed mixed methodology comprising three quantitative methods (i.e., power analysis, survey method, and descriptive statistics) and two qualitative methods (i.e., grounded theory and qualitative interviewing). The data comprise a survey of master's students and phone interviews; a faculty survey and interviews; and, the national HBCU master's project, i.e., pilot of the national survey (respondents not included in the national survey), national survey, and focus groups. The national HBCU project constituted the principal source of data on motivation, albeit the fact that we drew insight from the other data sources.

Power Analysis

Statistical power is the conditional probability of rejecting the null hypothesis, i.e., accepting the alternative hypothesis, when the alternative hypothesis is true (Onwuegbuzie & Leech, 2004). In this study, using G*Power, we conducted a power analysis at an α level of .05 and a power of .95. We performed a two-tailed t-test and a means difference for two independent groups in our core data, i.e., HBCU master's project, as a statistical test, with group one (n=11) comprising the pilot group and group two (n=28) comprising the survey group. We observed a d=0.8 effect size.

Grounded Theory and Sampling Issues

Based on insight from Strauss and Corbin (1998), we performed a thematic analysis of the interview data. Regarding context or setting criteria, our study comprised master's students in computing and a model of bridging HBCU students to research (R1) universities, i.e., the Fisk-Vanderbilt Bridge Program. In order to fulfill the event or time and the people criteria, we sought African-American master's students in various HBCUs nationwide (e.g., Fisk University, Alabama A&M University, University of the District of Columbia, Norfolk State University, Howard University, North Carolina A&T University, Florida A&M University, Texas Southern University, University of Maryland D.C., and Morgan State University).

Sampling issues emerged as we attempted to gather a representative sample and as we encountered difficulty in getting responses from those who were to assist us in this task. To meet, ethically, the privacy policies' requirements, our initial strategy was to get help from department chairs or directors of graduate programs. To make explicit the importance and urgency of survey completion, we offered participants a Target store gift card as an

incentive. However, despite numerous attempts and the use of adequate endorsements and incentive, there was a very low response rate to our requests. For instance, our repeat attempts to include four of the identified schools were unsuccessful. To address these sampling issues, we opted for adding an interview dimension and one of us travelled to Florida, Alabama, and Tennessee to conduct focus groups and to request students to complete the survey online, as an alternative.

Qualitative Interviewing and Coding

We audio recorded the interviews and coded the data using NVivo after grouping it into two cases: students and faculty. After screening the data many times, we created tree nodes to unearth the factors influencing students' motivation, or lack thereof, to pursue a PhD, that were identifiable in the data. The tree nodes show core thematic relationships characterized as extrinsic and intrinsic factors that motivate, or de-motivate, pursuit of PhD. We defined 'extrinsic factors' as emanating from outside the individual and upon which the individual has no power of influence (e.g., degree of preparedness for PhD level work, availability of funding, and field relevance and employability concerns); 'intrinsic factors' as emanating from within the individual and upon which the individual has power of influence (e.g., perceptions of positive or negative experience in master's degree entrepreneurial drive, intention to pursue PhD, and self-motivation). Our classifying experiences into 'positive' and 'negative' originated from our interest in gaining insight about the relationship between students' experience during their master's degree studies and motivation to pursue a PhD in computing. Our assumption was that positive experiences would contribute toward motivation, or at least would not be a de-motivating factor, and negative experiences would most likely contribute as de-motivating factors.

Data, Instrument, Validity and Reliability

We conducted interviews and administered a survey with master's students to identify their current intentions, perceptions, and possible misconceptions with respect to pursuing a doctoral degree. The survey elicited students' knowledge and beliefs with respect to their reasons for pursuing a master's degree, funding for the degree, knowledge about research and research careers, and their intentions to pursue or not to pursue a research career and the PhD. Twenty-seven first-year master's degree students in computer science responded to the survey and six students participated in individual phone interviews. In the same year, we conducted a survey and

interviews with faculty to gauge faculty perceptions regarding students' motivation to pursue a PhD in computing.

African-Americans are underrepresented, severely, at the PhD level in computing. For example, in 2007, only four percent of all computer science PhD degrees awarded to U.S. residents went to African-Americans. We conducted a national study to understand attitudes of computing master's students in HBCUs about pursuing a PhD. The study comprised three techniques: a pilot to validate the instrument, an online survey using survey monkey, and focus groups. The pilot process involved seven stages: defining the project, mapping the pilot, designing the pilot questions, designing the pilot evaluation, planning the pilot site visits, administering the pilot, and improving the survey. For our core data, 11 responded to the pilot, 28 responded to the national survey, and 35 participated in six focus groups.

The crux of the validity and reliability issues was addressed during the aforementioned stage, 'designing the pilot evaluation.' How we ascertained that the questions were asking what we intended to ask, how we gathered information that helped us determine that, and how we interpreted the information gathered were critical to addressing questions of validity and reliability. In 'designing the pilot evaluation,' the researcher must recognize various kinds of validity. While the national survey required addressing quantitative validity and reliability, our pilot process required addressing qualitative validity and reliability. Therefore, we took into consideration the following kinds of validity (Golafshani, 2003; Maxwell, 1992) when evaluating the survey: (a) descriptive validity, which is primarily concerned with the perspective of the researcher; (b) interpretive validity, primarily concerned with the perspective of the respondent; (c) theoretical validity, primarily concerned with the theory carried by the researcher into the research process; (d) generalizability, concerned with whether the research findings can be generalized beyond the context of the study; and, (e) evaluative validity, concerned with the overall evaluation of the data.

The focus group interviews were an alternative to offset the data gathering difficulties. Since privacy policies require going through the department chair or director of graduate studies in each department, we contacted these gatekeepers yet, despite numerous requests, only a few responded to our emails or phone calls. When able to get through these gatekeepers, we could not control repeat requests to respondents, which jeopardized our attempt to increase, appropriately, the urgency and importance of response. As a result, we decided to travel to HBCUs to conduct focus groups and to request that the students complete the survey online.

FINDINGS AND DISCUSSION

Extrinsic Factors

The master's survey revealed that students who did not intend to pursue a PhD were more likely to have not participated in research as undergraduates and to have not taken a class that had a research component than those intending to pursue a PhD. Students intending to pursue a PhD were more likely to have been research assistants for a professor and to have completed an undergraduate thesis based on research than those who did not intend to pursue a PhD. ANOVA results show that, in regards to intention to pursue a PhD, there was significant difference between students who did not participate in research as undergraduates and those who did, $F(2,24) = 3.7$, $p \leq .05$; there was no significant difference between students who had taken a class that had a research component and those who had not taken one, $F(2,24) = .34$, $p > .05$; there was significant difference between students who had been research assistants for professors and those who had not, $F(2,24) = 3.8$, $p \leq .05$; and, there was no significant difference between students who completed a thesis based on research than those who did not, $F(2,24) = .34$, $p > .05$. The data suggest that participation in research as undergraduate, being a research assistant to a professor, and completing undergraduate thesis based on research have a positive influence on students' intention to pursue a PhD.

Finances constituted the most influential factor to prevent potential enrolment in a PhD program; amongst all factors, lack of funding was the highest-ranking factor at 52 percent, the second highest-ranking factor was work opportunity after master's degree at 41 percent, and the time it will take to get a regular job ranked fourth at 22 percent. Most students reported being funded through teaching assistantships and research assistantships (48% respectively); these were followed by fellowships/grants (41%), loans (30%), and personal finances (18%). None of the students reported funding from employer. The fact that students rely on teaching assistantships, research assistantships, fellowships, loans, and personal finances to fund their studies confirm that lack of funding is indeed the primary preventer of potential enrolment in PhD (only 18% are able to support themselves yet, given their minority and economic disadvantaged status, this may imply a tremendous sacrifice from some within this group); thus, availability of funding through assistantships, fellowships/grants, and employer-sponsored scholarships constitutes a key incentive for students' enrollment in a PhD program. Table 1 shows that the three key extrinsic factors likely to discourage students from pursuing a PhD are funding, not having an advisor or mentor with whom to discuss options, and not having someone to provide with a recommendation.

From the results in this study, we can safely conclude that extrinsic factors such as participation in research, being a research assistant, and access to funding play a key role in students' intention to pursue a PhD.

Table 1
Factors Likely/Unlikely to DISCOURAGE Pursuing a PhD

Answer Options	Very Likely	Somewhat Likely	Likely	Unlikely	Somewhat Unlikely	Very Unlikely	Response Count
Funding for (or cost of) PhD	6	9	4	2	0	1	22
Not having an advisor or mentor with whom to discuss options	4	3	6	8	1	0	22
Not having someone to provide me with a recommendation	4	1	7	7	1	2	22

In the faculty survey, 25 percent of the faculty estimated that, in the past, at least one master's student applied to a PhD program and 25 percent estimated that at least one student was admitted to a PhD program. This low number of students applying and being admitted to a PhD program resonates with the common sentiment among faculty that "to talk about a PhD is a long shot." In interviews, faculty shared a need to address factors that trigger anxiety about pursuing a PhD; financial concerns were among the main obstacles to transition students to PhD, followed by a concern for adjusting to a new culture (e.g., that of R1 institutions) since most HBCUs do not have PhD programs.

Our research highlighted the fact that human networking facilitates integration into the research community and that peer mentoring is essential for beginning students. Students acknowledged that nurturing takes place in their relationship with an advisor or professors. They claimed that, "… they look after us and help us go through graduate school. It (the relationship) helps transition into an environment in which it feels as though you are 'thrown to the wolves,' by providing skills that are needed to survive." While the other factors did not transpire as issues in our focus, lack of funding transpired as a major contributor to their ruling out the possibility of pursuing a PhD. One student stated the following:

> I work full time now and I don't think I could do that while trying to get a doctorate; I think I could do it getting a master's and working

> full time, but getting a doctorate and working full time… for me, I think that's just pushing it.

The focus groups highlighted degree of preparedness as a factor that determined whether they felt ready to pursue a PhD, or not, and the overwhelming observation was that they did not feel prepared.

> I don't want a struggle… when going to the next level knowing that I don't know as much as everyone else knows that has a master's degree from another college or a university. I don't want to have to just deal with trying to learn everything I need to learn that I don't know.

There was a sense of redundancy, as they perceived to be learning the same things as they did during undergraduate studies, which placed them at a disadvantage in comparison to those acquiring a master's in a majority institution. Some manifested a sense of wasting their already limited funds in a program that would not guarantee them a bright future, thus ruled out the option of spending money to acquire a PhD. One student argued as follows:

> But I can have the confidence I can work for NASA or whatever, but I'm not gonna fight to go there because I'm scared I didn't learn as much as I should. But if I get it, I would try to be in the same level, but to fight to that position, it's kinda like do I really? No! Do I really? No! … It hurts when you realize how much money [you] pay when you sit there… it hurts so much! Even though you end up with a title…

On the other hand, there were students whose perception of what a PhD encompassed was the same as their perception of the master's program. In other words, the redundancy would continue through the PhD level. They argued that, "in a master's, especially, you have learned pretty much all aspects of computer science; so, I guess if you go for a PhD, you're pretty much going just for the title" and "'cause what I heard… when I was talking to… he's getting his PhD… he does the same thing… it's basically the same six core classes that we take here… so, it's basically the same thing."

Although most students were not aware of what exactly a research methods course was, as it transpired in the survey, they seemed to understand that there is something out there called 'research' that led to publication and that both these things were important in a PhD program and career, thereafter. They shared the following:

> I don't see any classes here that teach you any publication or nothing… if you don't take thesis, you graduate; I'm just like 'I don't know how to write anything! How am I gonna publish it? How am I gonna… I'm going for a PhD? C'mon, I don't even have a paper!' It's just so scary! So, for me, I'd like to go for a PhD to be called doctor so-and-so, but it's just like… If you can have that title and still don't know how to write and get the publications and stuff like that…
>
> (…)
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> I would love to take that one [referring to taking a research course] because from what I've experienced in those seminars outside the country, you cannot move anywhere and they cannot listen to anything, unless you come up with a publication… anything! Even though you come with a PhD, they will be like, 'where's the cd… what did you publish?' Nothing!

In regards to whether students have taken a research methods course, or not, in the survey, 17 students responded that they have taken a research methods course in their master's and 10 said they have not; and, eight in the focus responded that they have not taken a research methods course nor do they know what that would look like. However, in the pilot, four students said that the question was not clear; this observation of 'lack of clarity' made us wonder if that had anything to do with them not having taken a research methods course or with the fact that such course was not offered in their program, thus an unfamiliar term. They expressed that (a) the question and its answers were slightly difficult to grasp when reading it for the first time; (b) the question needed to have an example at the end to give a better understanding of what was being asked, (c) the term 'research methods' was confusing and it needed an example; and, (d) they had to read this question twice, to get a full understanding of what it was asking.

Table 2 shows that factors likely to encourage pursuing a PhD are career choices after completing the PhD, requirement to take research methods courses, conducting research, and funding for (or cost of) PhD. This is corroborated in the focus groups as students claimed that the lack of a guaranteed job following the PhD, lack of research methods courses, and the cost of the PhD contributed to their ruling out the possibility of pursuing a PhD.

Table 2
Factors Likely/Unlikely to ENCOURAGE Pursuing a PhD

Answer Options	Very Likely	Somewhat Likely	Likely	Unlikely	Somewhat Unlikely	Very Unlikely	Rating Average	Response Count
Requirement to take research methods courses	10	7	1	2	1	1	4.91	22
Conducting (doing) Research	9	5	4	2	0	1	4.86	21
Funding for (or cost of) PhD	10	1	3	6	1	1	4.45	22
Career Choices after completing the PhD	13	4	3	3	0	0	5.17	23

Some students in our focus groups were adamant that an HBCU graduate degree in computer science would not open employment opportunities, thus were thinking of acquiring a degree in business or education after completing their master's or pursue entrepreneurial ventures. Majority institutions have recognized that one indispensable ingredient in fostering an entrepreneurial drive in students is the physical presence of a support system in the form of a business incubator, an ingredient that is still lacking in HCBUs. Ron Busby (2012), president of the U.S. Black Chamber, Inc., reporting about the White House HBCU Entrepreneurship Conference, posited the following:

> America's Historically Black Colleges and Universities (HBCUs) must commit themselves to: develop the next generation of Black business leaders; be centers of excellence and thought leaders on entrepreneurship; jumpstart innovation in the communities they serve; and encourage and foster entrepreneurial activity among students before graduation. (n.p.)

While entrepreneurship is an intrinsic factor, we include it here to emphasize the fact that it emerges as a reaction to students' perception that a degree in computer science is an inadequate preparation for the job market. The following were some of their assertions:

> It's funny to me because right now you have people that's getting certificates, that's getting jobs just off a certificate. So, for me, that's another reason I wouldn't do the PhD because if I specialize in the network, you know they have the A+. [Other: Yeah, a lot of jobs now look for you to have certification like A+ … A+ Networking, CISCO] And see, if you get this, that certificate alone can get you a good job. So, why get a PhD in computers… you know what I'm saying?! If

> you could do this in one semester or one year, you might as well do that. There are so many other options now that, to me, it just sounds like a PhD alone, even when I say it, it sounds like it's going to be long and hard work and… You know what I'm saying?!
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> (…)
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> If you went from bachelors to master's then get your PhD if you have no work experience it's going to be hard to find a job because most people… they're gonna tell you you're either over qualified [Other: or no experience] or this stuff… what they want you to know is outrageous! They want you to have a security claim that if you had never had a job you have no security claims… and you have nowhere to lean on.
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> (…)
>
> … Basically I've got the mentality of working for myself. I just, I don't… I won't say I don't take directions… basically I would rather be my own boss… so to handle my own business and operate my own business is something that I would rather conquer than to do the whole computer science…

Some students claimed that they had to pursue graduate studies (including a PhD) because there was nothing else to do; in other words, they perceived graduate school as some sort of purgatory stage while awaiting employment opportunities.

> You'd be looking for a job forever instead of… you better come and waste your time here, [Other: … sometimes you put a million applications!] sometimes it sounds like it. Sometimes coming here to school is not because I want to, it's because there's nothing to do out there, I'm doing the same thing over and over… so, I'm like 'oh well, why should I not be taking classes at night and then just get on with this…?!' Sometimes we're just here at school because [Other: there's nothing else to do!] exactly!

Another perception is that money, exposure, relationships, and being in a familiar environment are important factors for HBCU students to pursue a PhD program in computing. This was evident in conversations with HBCU computer science chairs and faculty who believe that a seed needs to be

planted early enough for students to be able to make the decision to pursue a PhD or else they may find it difficult to move away from their surroundings and family without knowing what it really means to get a PhD. This concern for the impact of moving away from familiar surroundings in order to pursue a PhD is reflected in the responses to our national survey question, "how are the following factors likely/unlikely to influence your selection of prospective schools?," which revealed that more than 50% of the students considered "proximity to my home, i.e., five hours drive or less" and "similar weather conditions as those of my home state" as factors that would influence their choice. This suggests that relationships and being in a familiar environment is an important factor for most students. In the focus groups, students corroborated this fact while others claimed their parents, family members, and professors as the key inspiration:

> My father… he tell me to keep my head up and stuff like that. But really the inspiration he really gave me was how he got his education. My father he got a GED like when I was four. And then, uh, I actually went to a junior college and then he decided to go to a junior college with me and stuff. Like uh… he had to go to work all the time and same time he went to school at the same time we went to school and it was like an everyday thing. And at the same time he had time for me and my sister. So… he never complained once; so, I can't complain…
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> (…)
>
> I would say it would be very hard because my support system is my family. I come from a big family. I would say the professors here as well because if you need help you can get it. Whether it's somebody in your class or your professor, and uh… but as far as getting help with a class, you can get help here; but as far as emotional help I have a support system as well… I would say I'm very blessed to have a big support system and without that I don't think I would have… I would've learned, of course, but it's just… it makes it so much more deserving and such... when you have a support system cause they're proud of me…

Intrinsic Factors

According to the national survey, more than 50 percent of the students were likely to enroll in a PhD program within the first three years after

completion and most unlikely to enroll beyond the three years after completion. To gauge if those intending to pursue a PhD in computing had other fields in mind, we inquired about likelihood to pursue a PhD in computing, PhD in another engineering or scientific field, and/or EdD. More than 50 percent were likely to pursue a PhD in computing, exactly 50 percent likely to pursue another engineering or scientific field, and less than 15 percent likely to pursue an EdD. Consequently, we can infer that the majority would prefer pursuing a doctorate focused on research.

From the master's survey, we learned that 59 percent were considering pursuing a PhD in computer science while 37 percent were not; and, 59 percent projected their enrollment into the PhD to be immediately after completion of their master's degree and 41 percent for after working for a few years. Eighty-nine percent of the responses revealed that students' were pursuing a master's degree primarily to gain more specific knowledge in computing, 78 percent to learn about more computer science topics, 44 percent to conduct research, and only 30 percent for a job-related reason. The data suggest that most students are motivated, intrinsically, by academics; a plausible reason to infer a high likelihood that these students will pursue a PhD. We can further support this inference by the fact that the majority are aiming at an academic faculty career.

CONCLUSION, IMPLICATIONS, AND FURTHER RESEARCH

Our research showed that, without a foundational conceptual knowledge of 'what research is' and 'what a PhD is,' HBCU students are unlikely to be motivated to pursue either a PhD or a research career. We identified several basic misperceptions that HBCUs need to address in order to enhance students' motivation to pursue a PhD. The perception that a PhD is just a little more than, if not the same as, an undergraduate or master's degree; has no value apart from getting a special certification; and, has no value apart from one being able to boast the title 'Dr.'

These aforementioned misperceptions were fueled by a sense of curricular redundancy, as students perceived to be learning the same things as they did during undergraduate studies, which placed them at a disadvantage in comparison to those acquiring a master's in a majority institution. Considering these misperceptions, it is not surprising that some students were adamant that an HBCU graduate degree in computer science would not open employment opportunities, since it was inadequate preparation for the job market, thus saw an escape elsewhere. Such students contemplated either acquiring a degree in business or education, after completing their master's, or pursuing entrepreneurial ventures. Despite the misperceptions, most

students seemed intrinsically motivated by academics *per se*, a positive influence to pursuing a PhD, preferred a doctorate focused on research, and aimed at pursuing an academic faculty career.

Since students were likely to enroll in a PhD program within the first three years after completion and most unlikely to enroll beyond the three years after completion, HBCUs need to 'catch them while they are ready.' In doing so, HBCUs must put in place, efforts toward integrating students early into the research community and for peer mentoring of beginning students. The focus groups highlighted degree of preparedness as a factor that determined whether they felt ready to pursue a PhD, or not, and the overwhelming observation was that they did not feel prepared.

Since employability influences the value that students place on their degree, HBCUs may benefit from pursuing a strategy similar to that of majority institutions, which have recognized that one indispensable ingredient in fostering an entrepreneurial drive in students is the physical presence of a support system in the form of a business incubator or similar. Of course, this will require developing strong links with the business community.

Factors likely to encourage pursuing a PhD are career choices after completing the PhD, requirement to take research methods courses, conducting research, and funding for (or cost of) PhD. This is corroborated in the focus groups as students claimed that the lack of a guaranteed job following the PhD, lack of research methods courses, and the cost of the PhD contributed to their ruling out the possibility of pursuing a PhD.

Extrinsic factors such as participation in research, being a research assistant, and access to funding play a key role in students' intention to pursue a PhD. Moreover, participation in research as undergraduate, being a research assistant, and completing undergraduate thesis based on research have a positive influence on students' intention to pursue a PhD. Reliance on teaching assistantships, research assistantships, fellowships, loans, and personal finances to fund graduate studies confirm that lack of funding is indeed the primary preventer of potential enrolment in a PhD (only 18% are able to support themselves, but with a lot of personal sacrifice). Therefore, availability of funding through assistantships, fellowships or grants, and employer-sponsored scholarships constitutes a key incentive.

From a justice standpoint, low-income students (i.e., the population that is most likely to attend under-resourced HBCUs offering a terminal master's degree), are likely prone to lower educational quality and inadequate preparedness for employment. Students in HBCUs do not seem to be getting the right kind of education since money, access, and equity are all interrelated; consequently, albeit the fact that majority institutions would require minority students to succumb to a major cultural adjustment, many black students

aspire to attend majority institutions as an escape from the socioeconomic *status quo*. For instance, such students tend to agree that majority institutions provide access to the necessary knowledge and resources. The Fisk-Vanderbilt Bridge Program and the Advancement of African-American Researchers in Computing (A4RC) are examples of attempts to facilitate students' access to the kinds of knowledge and resources available in majority schools, albeit the cultural discrepancies.

Faculty shared a need to address factors that trigger anxiety about pursuing a PhD. Financial concerns constituted the main factor, followed by adjustment into the new culture of R1 institutions since most HBCUs do not have PhD programs; thus, HBCU faculty involved with BPC hope to increase the number of African-Americans who would go to R1s and return to HBCUs as faculty or researchers. Ultimately, HBCU faculty hope to build research partnerships with R1 faculty and leverage the perception that research of R1 faculty is more valuable than that of HBCU faculty and level the field.

This brings us back to our point regarding the need for grounding BPC initiatives on a theory of justice. For as long as there are disparities in resource allocation and capabilities between HBCUs and predominantly white institutions, HBCUs will continue to lag behind and their success will remain contingent on whether, or not, predominantly white institutions are willing to take them under their tutelage. In order for justice to prevail amidst these efforts, there is a need to level the playing field by shifting from an organizational change perspective, assuming that the practice of justice springs from putting in place institutions and policies to promote justice, toward a pursuit of equity of access and participation grounded on a theory of justice. Because "no matter how proper the established organizations might be, if a big fish could still devour a small fish at will then that must be a patent violation of human justice as *nyaya*" (p. 20-21).

This study focused on the experience of black students as a whole (population). Nonetheless, we recommend that future studies disaggregate the data by gender; socioeconomic status; and, immigration, citizenship, and residency status (e.g., citizen or permanent resident, DACA, international student, etc.) to gain further insight about how these factors might influence students' motivation. Moreover, we acknowledge that although significant improvements in equity take a long time, we recommend that future research looks at trends in the last decade.

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