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Implications for practice and research from *Doctoral Initiative on Minority Attrition and Completion*

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Introduction

Diversity in graduate education, particularly in science, technology, engineering, and mathematics (STEM) fields is an issue of critical importance to the graduate education enterprise, as well as scientific community in the United States. Although the progress has been made to advance participation of traditionally underrepresented minorities[1] (URMs) in STEM graduate education, a lack of parity remains in comparison to White, Asian, and international students. According to the most recent CGS/GRE Survey of Graduate Enrollment and Degrees (Allum & Okahana, 2015), 19% of the 2014 first-time graduate enrollments in STEM fields were URM students. In addition, the most recent Survey of Earned Doctorates (National Science Foundation, 2015) reported that 13% of all STEM doctorates conferred to U.S. citizens and permanent residents in 2014 were awarded to URM students. This is in contrast to the fact that 36% of the U.S. population between the ages of 25 and 34 are URMs (U.S. Census Bureau, 2014). In the STEM workforce, the gap is more obvious as URMs comprise only 7% of the STEM doctoral workforce (National Science Board, 2015).

While overall enrollment of URM students in STEM fields is on the rise (Allum & Okahana, 2015), more needs to be done to ensure that the U.S. STEM workforce, including the professoriate, reflect the diversity of the communities which they serve and the nation as a whole. Also, studies on graduate education are much needed in order to address America's national capacity to innovate and to prepare

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[1] For the purpose of this paper, the term "underrepresented minority" refers to persons identify themselves as U.S. citizens and permanent residents who are Black/African American, Hispanic/Latino, American Indian/Alaska Native, or Native Hawaiian/Pacific Islander.

graduate students to compete on a global scale (Walker, Jones, Golde, Conklin Bueschel & Hutchings, 2008; Council of Graduate Schools and Educational Testing Service, 2010 and 2012; Gumport 2011).

With generous support from the National Science Foundation (NSF), the Council of Graduate Schools (CGS) has embarked upon an effort to examine patterns of completion and attrition among URM doctoral students in STEM fields and to explore factors likely to affect their ability to complete their doctoral program. The project, *Completion and Attrition in AGEP and non-AGEP Institutions* (NSF grant #1138814), collected the largest dataset of its kind, encompassing student-level data and other qualitative data from twenty-one U.S. graduate schools with large STEM doctoral offerings (Sowell, Allum, & Okahana, 2015).

In April 2015 the selected findings from the project were release in a CGS publication, *Doctoral Initiative on Minority Attrition and Completion* (Sowell et al., 2015). Subsequently, findings and implications of the publication were discussed at the Spring 2015 CGS Research and Policy Forum, which was held in Washington, DC on May 28, 2015. This paper summarizes the proceeding from the forum, in which four authors of this paper participated as speakers. The paper begins with a discussion of URM STEM doctoral completion and attrition rates and programs and initiatives aimed at facilitating success of URM STEM doctoral students, followed by a discussion on directions for future research, and concluding remarks.

National Benchmark for URM STEM Doctoral Completion

As a benchmarking tool, Sowell et al. (2015) is one of the most robust resources available to U.S. graduate schools to describe URM STEM doctoral completion. According to the data collected as a part of the project, the ten-year degree completion rate for URM students in STEM fields was 54% (Sowell, et al., 2015). Although this is not a direct comparison, the result is very close to the 55% ten-year completion rate for all domestic students in STEM fields reported in the CGS' *PhD Completion* project (Sowell, Zhang, Bell, & Redd, 2008). While the participation of URM students in STEM doctoral programs lags behind non-URM students, the data in aggregate suggests that once URM students are in doctoral programs, their success is equally as likely as that of non-URM students.

It is important to highlight the fact that within the URM student body, completion rates varied by student characteristics, such as gender, race/ethnicity, broad fields of study, and prior master's degree status. For example, URM women had a higher STEM doctoral completion rate than their male counterparts (56% and 52%, respectively), and Hispanic/Latino students had a higher STEM doctoral

completion rate than their Black/African American counterparts (58% and 50%, respectively). Even after controlling for broad fields of study and prior master's degrees awarded, these differences between men and women, and Black/African American students and Hispanic/Latino students appear to persist[2]. Findings of this project corroborate much of the prior literature, which tends to focus on URM educational attainment up to the baccalaureate level (See College Board, 2010, Lee & Ransom, 2011, Harper, 2006 for examples), suggesting that men and Black/African Americans are among the more vulnerable subsets of the URM population in terms of educational attainment.

Figure 1: 10-year Doctoral Completion Rates of URM STEM Students[3]
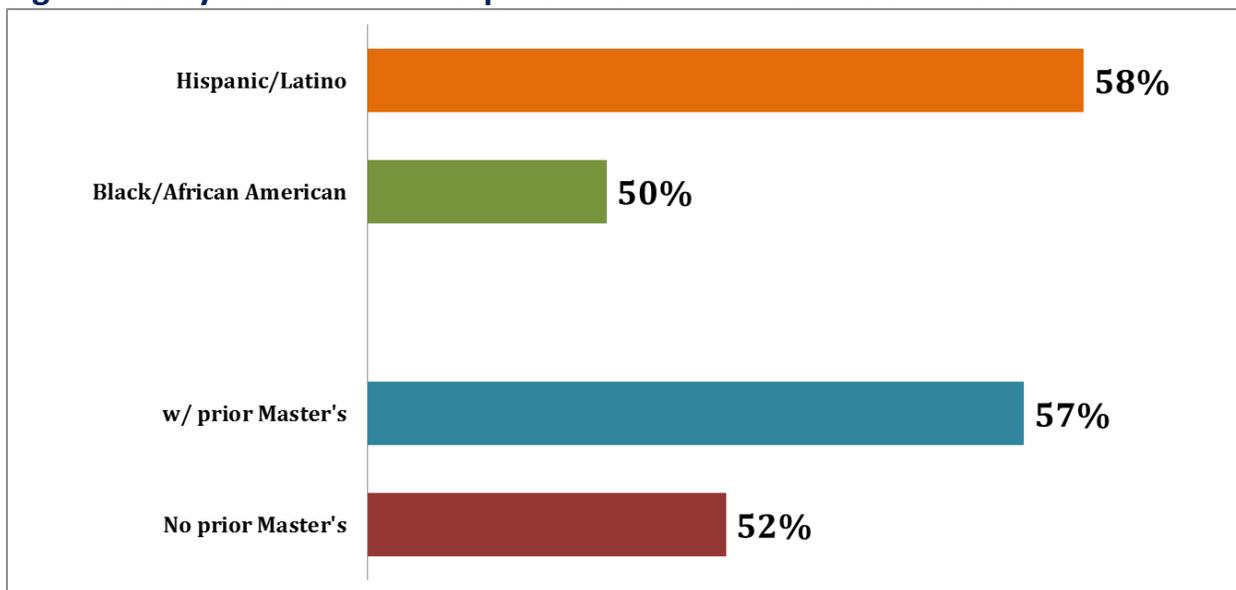
The differences in completion and attrition rates between broad fields were also notable (Sowell et al., 2015). URM doctoral students in life sciences fields reported the highest ten-year completion rate (63%), followed by students in engineering fields (56%), social & behavioral sciences fields (52%), and physical & mathematical sciences fields (45%). One potential explanation for the low completion rate of physical & mathematical sciences fields may be in the workforce. According to NSF's most recent National Survey of College Graduates (NSCG:13), the median earnings for recent doctoral graduates and master's

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[2] Council of Graduate Schools, student-level data from the *Completion and Attrition in AGEP and non-AGEP Institutions* (NSF grant #1138814)" project, unpublished additional analysis by Okahana, H. and Allum, J.
[3] The figure adopted from 10-year Doctoral Completion Rates of URM STEM Students by Selected Characteristics. Reprinted from *Doctoral experience and outcomes of URM students in STEM fields: Implications for future assessment and practice* (Slide 7), by H. Okahana & J. Allum, 2015, a presentation for the CGS Spring 2015 Research and Policy Forum, 2015, May..

graduates in physical & mathematical sciences fields are the same[4]. In other words, in aggregate, the potential earnings premium for attaining doctoral degrees in physical & mathematical sciences fields may not be as great as other fields of study. This could partially explain relatively low completion and high attrition rates for this broad field of study, as students might be choosing the workforce after earning their passing master's degrees. This also suggests that not all attrition is "bad" as withdrawn students may be gainfully employed in areas of their study without a doctorate.

Finally, URM students with prior master's degrees also reported higher doctoral completion rates in STEM fields than those who have entered doctoral programs without prior master's degree. This is not surprising as correlation between prior graduate education and doctoral completion has been discussed in prior studies (See Edwards Lange, 2010; Sowell, Bell, Francis, & Goodwin, 2010, both cited in Sowell et al., 2015). A potential implication of this finding may be significant as it suggests that master's education may be a viable pathway for URM students toward successful doctoral experience. In light of further disinvestment in financial support for master's education, this poses a compelling reason to reverse the course.

In addition to informing the national policy on STEM doctoral completion for URM students, the data accumulated in this project is also a useful benchmarking tool for graduate schools. Each of the twenty-one participating institutions was given institutional data alongside with the aggregated data for the all participating institutions. These institutional reports allow them to examine their own enrollment and degree completion figures to determine trends, and perform program and policy analyses. For example, institutions may employ these data to ask questions such as, "If a surge in enrollment during a certain period was due to significant recruitment at the National Society of Black Engineers (NSBE), the Society for the Advancement of Chicanos/Hispanics and Native American in Science (SACNAS), award of a diversity capacity building grant, or similar action," and "If there were fewer graduates in a certain time frame due to the loss of a diversity champion." Since the data collection instruments, as well as full report are publicly available, non-participating institutions can duplicate their own data collection efforts and benchmark their enrollment and completion data against the findings.

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[4] National Science Foundation, the 2013 National Survey of College Graduates data, computation by the authors.

Programs that Support URM Doctoral Success

During the course of the *Completion and Attrition in AGEP and non-AGEP Institutions* project, the data collections efforts have also served as a vehicle to facilitate discussions among key campus stakeholders about this important topic. Subsequent findings discussed in Sowell et al. (2015) provide a valuable foundation as campus stakeholders make cases for programs and resources that support URM STEM doctoral students. For example, at the University of Maryland at Baltimore County (UMBC), the results from the project helped make a case for continuing programming such as the PhD Candidacy Ceremony. The PROMISE AGEP Summer Success Institute and Professors-in-Training workshops, as well as the Dissertation House have also been sustained, as they allow internal and external faculty mentors and champions who provide academic, holistic, and motivational professional development workshops (e.g., teaching with technology, financial education, career-life balance, psychological well-being). Further, implementation of "The Jessica Effect" which welcomes families to all PROMISE AGEP events at UMBC, and programs that promote peer networks have also been good investments.

More broadly, Sowell et al. (2015) found that the most of programs and interventions, which are aimed to facilitate completion of STEM doctoral programs among URM students, tend to be early interventions that focus on recruitment, selection, and first-year transition of new students. The findings also suggested that in the latter stages of the doctoral process, students often rely on more informal support mechanisms, such as peer supports, mentorships, advocates/champions, and personal determination. While the project did not collect the comparative data on experience of non-URM doctoral students, it is widely understood that challenges and rigor of STEM doctoral education may be compounded for URM students. Sowell et al. (2015) found that STEM doctoral process is intensive, solitary, and often complicated experience for URM students. The study also suggested that students who have advanced to candidacy were more likely to be skeptical with faculty or graduate programs ability to address URM issues. They were also more likely to be concerned of their mental health and felt isolated from other students. These findings, in aggregate, point that organizing support and resources for doctoral students in late stages, such as UMBC's Candidacy Ceremony and Dissertation House, may be particularly useful concepts in addressing successful completion of URM doctoral students in STEM fields.

Additionally, results discussed in Sowell et al. (2015) reiterate the importance of further engaging graduate schools in the topic of URM participation and completion in STEM doctoral programs. For example, Sowell et al. (2015) showed that the doctoral student survey respondents felt that faculty were

largely unaware of the issues that underrepresented students face. Facilitating discussions at levels such as meetings of faculty and deans, and sponsoring opportunities for faculty to participate in diversity conversations at national conferences could increase awareness of issues. Sowell et al. (2015) also found evidence to suggest that doctoral students were more affected by their program's climate than their advisor and faculty support. Motivation and determination was the number one personal factor affecting achievement of degree objectives (see Figure 2). This evidence suggests that developing or replicating constructs that include these elements could be transformative.

Figure 2: Factors that Influenced URM STEM Students' Ability to Stay in Doctoral Programs[5]
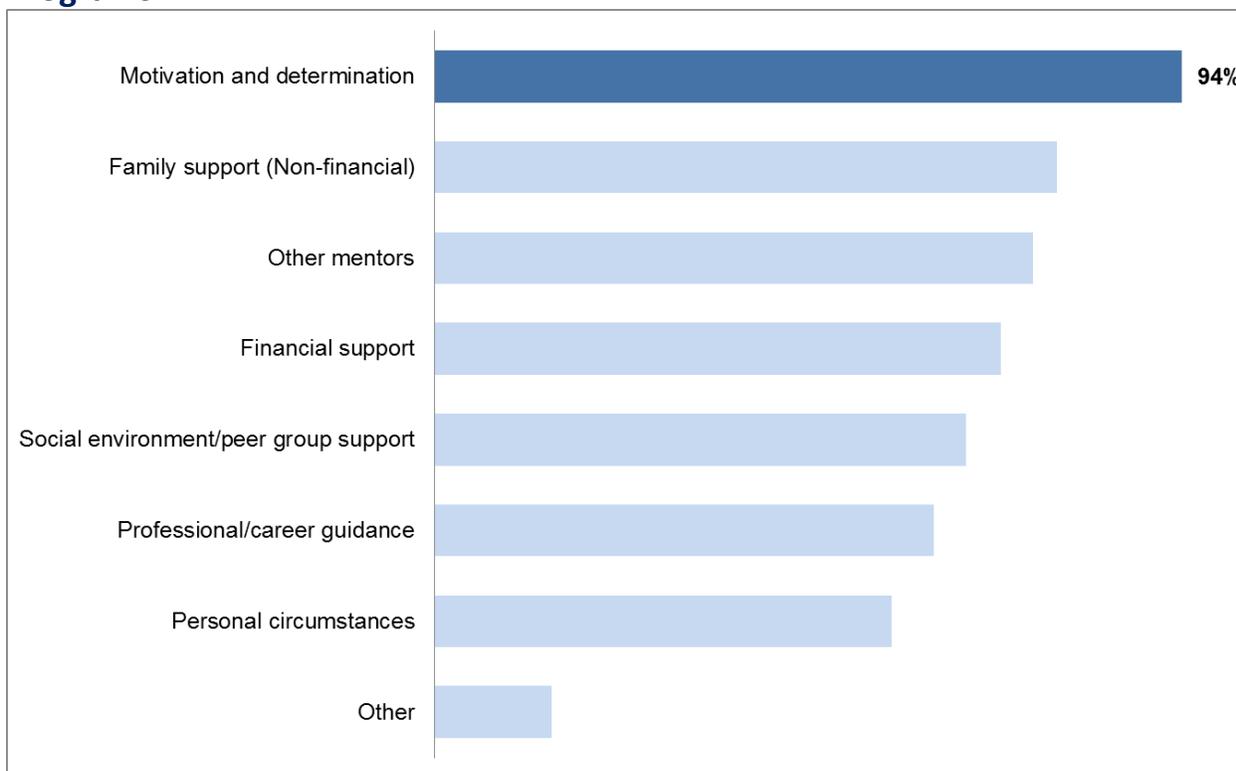
The report also noted that constant turnovers of leadership make it difficult to sustain student-led initiatives and efforts that aim to facilitate success for URM STEM doctoral students. Thus, institutionalized support mechanisms that support such efforts may be a good investment. These findings should give good reasons for graduate schools to consider developing a supportive, motivating

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[5] The figure adopted from Table 4.2 URM Graduate Student Experience by Candidacy Status. Reprinted from *Doctoral Initiative on Minority Attrition and Completion* (p.42), by R. Sowell, J. Allum, & H. Okahana, 2015, Washington, DC: Council of Graduate Schools. Copyright 2015 by the Council of Graduate Schools.

environment, which identifies elements that are important to retention, and develop a suite of formal support mechanisms, including activities to address academic and holistic competencies. The expectation is that graduate deans can apply the findings discussed in Sowell et al. (2015) to the individual campus contexts where they can address overt and covert issues with faculty, deans, and other decision makers. They should also consider interventions that exist and are working, those that exist but are not working, and those that might need to be developed.

Directions for future studies

The findings and results of *Completion and Attrition in AGEP and non-AGEP Institutions* summarized in Sowell et al. (2015) have informed both scholarship and practice on the doctoral experience and outcomes of URM in several ways. Sowell et al. (2015) addresses a critical gap in doctoral education research related to attrition, particularly for historically marginalized groups. Importantly, statistical trends illuminate significant systemic disparities among students who finish doctoral study and those who don't within STEM fields. Sowell et al. (2015) has also advanced general concepts related to attrition in doctoral education research (i.e., lack of financial support, isolation, lack of academic support) (Gardener, 2009; Lovitts, 2001; Lott, Gardener and Powers, 2011; McAlpine and Norton, 2006).

There continues to be tremendous opportunity to further explore and examine STEM student experiences regarding the pathway toward doctoral study, including: the role of institutions and understanding students' academic progress and decision-making at the undergraduate level (Lundy-Wagner, Gasman, and Vultaggio, 2013; McGhee and Martin, 2011); exploring student perspectives of institutional environments and academic success support systems while engaged in doctoral study (Le and Gardner, 2011), and the ways students prepare for post-degree completion into their disciplines/professions (Thiry, Laursen, and Loshbaugh, 2015).

Also, in more technical aspects, data collection efforts could be augmented to facilitate deeper qualitative inquiry of student and/or doctoral degree completers' perspectives to understand the ways in which efforts to support doctoral student experiences are perceived by students and multiple stakeholders involved with the doctoral process. Future studies with case study, phenomenology, ethnography, or narrative research designs would provide deeper and more meaningful analysis of how students manage barriers to degree completion and the ways they specifically avoid academic pitfalls leading to attrition.

Further inquiry should emphasize the experiences of historically marginalized students and academic/organizational systems supporting degree completion through transformative approaches to academic success, through academic advisement and mentorship, gendered, racial, cultural processes, and personal and programmatic efforts supporting socialization, (Barker, 2011; Bertrand Jones, Wilder & Osbourne-Lampkin, 2013; Blockett, Felder, Collier & Parrish, 2015; Felder, Gasman, & Stevenson, 2014; Gasman, Anderson-Thompkins & Haydel, 2006; Gasman, Gerstl-Pepin, Anderson-Thompkins, Rasheed & Hathaway, 2004; Gildersleeve & Croom, 2011; Gonzalez, 2006; Baker, Pifer & Griffin, 2014;Harper & Hurtado, 2007; Hurtado, Clayton-Pederson, Allen & Milem, 1998; Hurtado & Ruiz, 2012; McCallum, 2015; Morrison, Rudd, & Nerad, 2011; Patton, 2009; Tierney, 1997; Weidman, Twale & Stein, 2001).

Concluding remarks

As our nation's higher education system continues to address the effects of changing demographics and the intellectual, cultural, and technological demands of its constituents, conducting research focused on the processes of completion, both generally and by discipline, is critical to supporting doctoral students toward strengthening our national capacity. Sowell et al. (2015) fills a critical gap in understanding of completion and attrition of URM students in STEM doctoral programs. In addition to its contribution to the scholarship, the report and the data collected through this project serve as an important benchmarking tool for U.S. graduate schools. There is still considerable work to be done to narrow the attainment gap of URM students in these fields, particularly in doctoral programs, but Sowell et al. (2015) furthers the discussion by presenting robust data that can be benefited by both campus leaders and policy makers.

Note

Suggested citation

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