The Attainment of a Science Degree by African American

College Students at Arizona State University: An

Investigation to Identify The Barriers and Affordances

by

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ABSTRACT

Historically, African American students have been underrepresented in the fields of science, technology, engineering and mathematics (STEM). If African American students continue to be underrepresented in STEM fields, they will not have access to valuable and high-paying sectors of the economy. Despite the number of African Americans in these fields being disproportionately low, there are still individuals that persist and complete science degrees. The aim of this study was to investigate African American students who excel in science at Arizona State University and examine the barriers and affordances that they encounter on their journey toward graduation. Qualitative research methods were used to address the research question of the study. My methodology included creating a case study to investigate the experiences of eight African American undergraduate college students at Arizona State University. These four male and four female students were excelling sophomores, juniors, or seniors who were majoring in a science field. Two of the males came from lower socioeconomic status (SES) backgrounds, while two of the males were from higher SES backgrounds. The same applied to the four female participants. My research utilized surveys, semistructured interviews, and student observations to collect data that was analyzed and coded to determine common themes and elements that exist between the students. As a result of the data collection opportunities, peer support and financial support were identified as barriers, while, parental support, financial support, peer support, and teacher support were identified as

affordances. In analyzing the data, the results indicated that for the student

subjects in this study, sex and SES did not have any relationship with the

barriers and affordances experienced.

DEDICATION

This work is respectfully dedicated to every kid whose one chance might be a solid education.

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GLOSSARY OF TERMS

ACT – This is an abbreviation that stands for American College Testing. The name of the organization was officially changed to ACT in 1996.

affordances – In this investigation, affordances will refer to support systems or entitlements that are in place to help an individual reach a particular goal or destination.

African American – A term that represents individuals who consider themselves Black. In addition, for this study, the expectation is that these individuals were been born in the United States.

ASU – For the purposes of this study, ASU is an abbreviated way to reference Arizona State University.

barriers – In this investigation, barriers will refer to obstacles or impediments that make reaching a particular goal, difficult.

Black – The term Black will be used interchangeably with African American to articulate a particular group of individuals who were born in the United States.

Caucasian – The term will refer to individuals who consider themselves White. Typically, these individuals will be considered Anglo and identify as such.

science education – As it relates to this study, the phrase Science Education references students that are pursing a degree in a field of science. This is not

to be confused with those individuals studying to become educators in science for the grades of K-12.

SES – This is an abbreviation that stands for socioeconomic status. SES communicates the hierarchical rank of an individual and/or family in a community or society. Typically, to calculate SES, occupation, income, and level of education are all used to determine SES. For the consideration of this study, the only indicator that will be used to consider SES is poverty.

White – When used to describe individuals, this term will have the same meaning and will be used interchangeably with the term Caucasian.

Chapter 1

INTRODUCTION

I vividly remember my first day as an undergraduate student at ASU. I migrated to Arizona from Chicago, and as an African American male, I immediately experienced a culture shock in Arizona that made me yearn to return home. According to the United States Census Bureau (2010), Phoenix has an African American population of 5.1%, while 37% of individuals living in Chicago, Illinois, are African American. In 2009, 5% of the total student population enrolled at ASU was African American (ASU, 2011). The morning that I walked into my first science lecture, I knew that I had a difficult journey ahead of me. During my first semester, I was enrolled in an entry-level Chemistry course that had a roster of over 400 students, of which, less than 20 were African American. Being part of such an uneven distribution of diversity would eventually become my everyday existence as a science major at ASU.

I quickly became charged with the responsibility of figuring out how to navigate a unique learning environment. As one of the largest universities in the country, Arizona State presents a large number of perspectives that African American students would only encounter at that campus. ASU has a particularly strong emphasis on research and entrepreneurial endeavors. In addition, there is an exceptionally solid effort to increase the graduation rates of Native American and Hispanic minorities. Because there were a number of barriers that I encountered along my educational journey as an

African American male, it was only a matter of time before I considered changing my major, which I did several times. Eventually, I navigated my way back to science and persisted with my bachelor's degree. Along my journey I made tough decisions, such as deciding not to continue my path in science to become a physician, and instead, embarked on a surprising journey in the field of education.

Today, I work in a field that I love, and I teach science, about which I am extremely passionate. As a high school science teacher, I understand the need to ensure that my students are exposed to the limitless possibilities of pursing an education in science. I also realize how beneficial it is to expose them to opportunities within the field. I am truly fortunate to teach at a small STEM school that has the mission to expose traditionally marginalized minority groups to the fields of STEM. We currently have an extremely diverse student body which is 55% Hispanic, 21% Anglo, 11% African American, 7% Native American, and 6% Asian. Unfortunately, too many African American students across the country do not have access to the STEM learning environment, and this reality fuels my motivation to pursue this research.

Practical Problem

Who is pursuing STEM?

The success of the United States in the 21st century, its wealth and welfare will depend on the on the ideas and skills of its population, which has been the nation's most significant asset (President's Council of Advisors on

Science and Technology, 2010). As the world becomes increasingly

technological, the value of the national asset of ideas and skills will be

determined, in no small measure, by the effectiveness of STEM education in

the United States (President's Council of Advisors on Science and

Technology, 2010). Despite the United States' history of being competitive

and successful in STEM fields, the country now lags behind other nations in

STEM education at the elementary and secondary levels (President's Council

of Advisors on Science and Technology, 2010). In addition, the United States

is not graduating a competitive number of undergraduate students with

STEM degrees.

In an international comparison of STEM education, the United States

has one of the lowest rates of STEM to non-STEM degree production in the

world (Kuenz, 2008). In 2002, the international average for STEM degrees

produced was 26.4% of all degrees. In this same year, the United States had a

rate of 16.8%, while Japan's rate was 64%, China's rate was 52.1%, and India

had a rate of 32.5% (Kuenz, 2008). The inadequate number of STEM

graduates produced by the United States will put the country in an inability

to produce a qualified workforce to fulfill the jobs of the future (National

Lieutenant Governors Association, 2011). For example, the numbers of

current entrants into the aerospace workforce are projected to be

insufficient to fill the workforce pipeline, which will create a gap in qualified

employees in the future (National Lieutenant Governors Association, 2011).

Currently, about 54% of the nation's aerospace and STEM defense workers

are 45 years old or older, and 33% were eligible to retire at the time the study was conducted (National Lieutenant Governors Association, 2011). As of 2012, only about 7.5% of students enter baccalaureate programs in STEM fields, such as engineering, and only 50% of those students graduate (National Lieutenant Governors Association, 2011). This phenomenon of a dearth of new STEM professionals is an issue that is common among many highly skilled professions that require specific STEM training and education.

In addition to the concern that the United States is not producing enough qualified graduates in the field of STEM, it is essential to recognize that, specifically in science, the United States is witnessing an inadequate number of individuals completing bachelor's degrees in the STEM fields. When disaggregating the data for graduates, it is even more concerning that African American individuals are disproportionately represented as graduates with a science bachelor's degree. According to the National Science Foundation (2008), Caucasians accounted for 66% of the United States population, while African Americans accounted for 12% of the United States population. During the academic years 2001-2008, Caucasians made up 58% of the total undergraduate enrollment in the United States, while African Americans accounted for 13%. Of all the undergraduate degrees that were confirmed in 2008 in the United States, 67% were awarded to Caucasians, and 9% were awarded to African Americans (National Science Foundation, 2011). Another interesting point to consider is the reported interest levels of first year freshmen that attend universities in the United States. In 2008,

according to the National Science Foundation (2011), 32% of Caucasian freshmen had intended to major in a STEM field, 32% of African American students intend to major in a STEM field, and 30% of female freshmen intended to major in a STEM field. These figures state that, despite the equivalent amount of interest at the beginning of one's college career, something is preventing the equal number of confirmed degrees between racial and sex groups.

Once African American students enroll in college, the focus shifts to the persistence rates in science fields. The National Science Foundations' Science and Engineering Indicators report (2008) stated that students who begin college as STEM majors have a lower probability of receiving a degree in their initial field than students in other majors. Of greater concern is that women and historically disadvantaged racial minorities who initially intend to major in a STEM field are the least likely to persist toward a degree in one of these fields (Price, 2010). The reasons that minority students are not persisting toward degree completion is unclear, because recent research finds that despite the many educational disadvantages minority students often face, African American high school students have similar or even greater interest in pursing STEM majors in college compared to Caucasian students (Anderson & Kim, 2006; Hanson, 2006). Nevertheless, African American individuals are still clearly underrepresented among recent cohorts of college graduates in STEM fields as well as in the labor force, which indicates that much inequity remains (Lewis, Menzies, Najera, & Page,

2009). Considering the inequity, the creation of new strategies and the implementation of new policies are potential aspects of a much-needed solution.

Even though studies indicate there is equal interest in pursuing a degree in a STEM field at the beginning of college careers, further analysis of the data produces some alarming figures that indicate that African American students are not successfully graduating with STEM degrees. For example, in 1995, Caucasian students comprised about 69% of students pursuing undergraduate degrees in engineering, while African American students comprised 7% (National Science Foundation, 2009). The figures for engineering graduates in 2006 were 69% (Caucasian), and 5.7% (African American) (National Science Foundation, 2009). During the 10-year period 1996-2006, the enrollment of Caucasian students in engineering steadily increased to a net increase in enrollment of over 30,000 persons. Within the same 10-year period, the enrollment of African American students fluctuated and ended up with a decrease of approximately 2,000 persons (National Science Foundation, 2009).

Realizing that there are a disproportionate number of African American students who earn degrees in science fields raises the question "From which areas of study do African American students graduate"? In 2004, an evaluation of statistics by the U.S. Department of Education showed that, at 25.5%, the most popular undergraduate major for African Americans to earn a degree in is business management. The distribution of biological

sciences and engineering confirmed degrees for African Americans is 3.9%

and 3.8% respectively (U.S. Department of Education, 2004).

Why is Science Important?

It is valid to address the question: Why are the science fields even

important? If one considers that humankind is in the midst of a technological

era where the improvement of the quality of life will most likely come from

science research, one could ask, how could this not be of utmost importance?

In 2007, for example, the Bureau of Labor Statistics projected that 54.7

million American jobs would open during the decade from 2004 to 2014, of

which over half (29.4 million) require a college degree. Moreover, the only

job categories in which both demand and wages continue to grow are non-

routine, analytic positions, which require sound judgment, an ability to solve

problems, and strong communications, information management, and

synthesizing skills (Opportunity Equation, 2011). The above-mentioned skills

all mark the aims and prerequisites of an individual pursing an education in

science.

In a press release published by the center on education and the

workforce at Georgetown University, a degree in engineering provides the

highest median earning potential when compared to any other major

(http://cew.georgetown.edu/whatsitworth). Since the 20th century, the

average per capita income in the United States has grown more than

sevenfold, and science and technology account for more than half of this

growth (President's Council of Advisors on Science and Technology, 2010). In

the 21st century, the United States' need for a world-leading STEM workforce and a scientifically, mathematically, and technologically literate populace has become ever greater, and the need will continue to grow, particularly as other nations continue to make rapid advances in science and technology (President's Council of Advisors on Science and Technology, 2010). As documented by the National Science Foundation (2008), mathematics, science, and technology work and research done in universities is an essential part of the foundation for the United States' competitiveness in a global economy.

In addition to global competitiveness, science is also directly correlated to our quality of life. The percentage of elderly persons that make up the United States population continues to increase as the baby boomers age. In addition, Americans are living longer as a result of the technological and scientific advances made over the last several decades (Glass, 2008). As suggested in *Fertilizers, Pills, and Magnetic Strips*, technology has redefined the way of life for the ordinary American and will continue to fuel incredible changes in the very near future (Glass, 2008).

African American Students in Science and Why the United States Should Care

I believe that all students have the potential to be successful in school. Moreover, graduation from high school and college, the pursuit of advanced degrees, and discovering one's niche in a constantly evolving workforce should not be lofty goals; instead, they should be realistic goals for all

students. Unfortunately, student achievement in science is currently trending in a negative direction (National Assessment of Educational Progress, 2009). As mentioned earlier, the United States now lags behind other nations in STEM education at the elementary and secondary levels (President's Council of Advisors on Science and Technology, 2010). International comparisons of the United States' students' performance in science and mathematics consistently place the United States in the middle of the pack or lower. On the National Assessment of Educational Progress, less than one-third of eighth graders in the United States show proficiency in mathematics and science (President's Council of Advisors on Science and Technology, 2010). Now that these figures and statistics have become public knowledge, there has been a focus on improving the quality of STEM education. The connection has been made that a solid science and mathematics foundation will allow individuals to secure premium jobs in the workforce. In addition, STEM education will determine if the United States will remain a leader among nations and whether the country will be able to solve immense challenges in areas such as energy, health, environmental protection, and national security (President's Council of Advisors on Science and Technology, 2010). As the focus on science education continues to gain momentum, it is vital that traditionally marginalized African American students are not left with inequitable access and opportunity.

When evaluating mathematics and science curricula, one realizes that they are essential components of a liberal education; they are the backbone

of logic and analytic thinking developed from childhood through the most advanced levels of learning across the academic disciplines (Opportunity Equation, 2011). Because the curricula create a population of students who are critical thinkers, many would agree that science curricula are great outlets for harnessing students' intellectual capital and preparing students for assuming the role of future problem solvers. The disproportionate numbers of minority students in science fields creates a disparity that resonates throughout economic, cultural, and intellectual opportunities secured by today's youth. Arguably, students that pursue careers in science fields will have the opportunity to create solutions, have access to preferred resources, and be deemed elite professionals more often than their counterparts whom are not provided with reasonable vehicles to pursue these same goals.

Some argue that education is the means for closing the social and economic gaps that exist between Caucasian and minority groups. Summers and Hrabowiski (2006) stated that as international participation in advance science and engineering increases, and as our national population becomes more diverse, it becomes even more important to provide quality science education to all children, including those from racially diverse groups. Leslie, McClure, and Oaxaca (1998) stated:

> Not only do the lack of parity raise obvious social concerns, the quality
> of science and engineering labor force is at issue for even though the
> supply of scientists and engineers appear, at least for the present, to

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be adequate to national needs, larger labor supply pools translate into

high quality scientific workers, thereby increasing marginal labor

productivity and, in turn, the productivity of the overall economy. Put

another way, all else being equal, we would expect that the more

women and minorities enter these fields, which are known to be

powerful contributors to the national productivity, the larger will be

the nation's stock of scientist and engineers, the greater will be the

quality of that stock, and the greater will be the productivity of the

nation's labor force. (p. 252)

As we continue to embark toward brighter economic futures, America must

continue to focus on the current unemployment crises. For the month of

February 2009, the unemployment rate was 13.4% for African-Americans,

10.9% for Hispanics, and 7.3% for Caucasian Americans. Clearly,

opportunities for socioeconomic advancement for all lie in the boundaries of

science education.

Historically, African American individuals have struggled

economically, and have more frequently than other groups, lived in poverty.

The United States determines the official poverty rate using poverty

thresholds that are issued each year by the Census Bureau. The thresholds

represent the minimal amount of annual cash income required to support

families of various sizes (The National Poverty Center, 2011). Table 1

articulates the poverty line in 2009 for persons living in the United States. As

the table shows, 14.3% of all Americans lived in poverty in 2009 (U.S. Bureau

of the Census, 2009). A family is counted as poor if its pretax money income is below its poverty threshold. Money income does not include non-cash benefits such as public housing, Medicaid, employer-provided health insurance and food stamps (The National Poverty Center, 2011). When disaggregating the numbers recorded for 2009, the information indicates that 25.8% of African Americans lived in poverty, compared to 25.3% of Hispanics, 12.5% of Asians, and 9.4% of Caucasians (U.S. Bureau of the Census, 2009).

Table 1

2009 Poverty Thresholds, Selected Family Types

Single Individual	Under 65 years	$ 11,161
	65 years & older	$ 10,289
Single Parent	One child	$ 14,787
	Two children	$ 17,285
Two Adults	No children	$ 14,366
	One child	$ 17,268
	Two children	$ 21,756
	Three children	$ 25,603

Note. Adapted from the U.S. Bureau of the Census, *Income, Poverty, and Health Insurance Coverage in the United States: 2009*, Report P60, n. 238, p. 55.

Having access to a science education will provide a better opportunity to financial security. Considering that African Americans have the largest incidence of living in poverty, it becomes extremely important to support

initiatives and measures that would help encourage financial security, and the means to gaining financial security such as science education programs.

In evaluating the existing body of literature, there are a number of reasons that have been proposed to explain why African Americans are not pursuing degrees in science. Many of the reasons that have been proposed occur prior to students entering college. The reasons included lack of satisfactory instructors in elementary and high school (Kozol, 2005), lack of exposure to the field of science as a young individual (Atwater & Rascoe, 2004), lack of resources, and lack of community and parental support (Freeman, Alston, & Winborne, 2008). Once in college, many African American students express interest equal to the interest of other students in pursing a degree in science, yet African American students are not persisting and attaining such degrees. Reasons that have been proposed include, peer isolation (Joseph Jr., Slovak, & Broussard, 2010), deficit expectations from professors (Boelter & Tyler, 2008), and inadequate support in navigating through a system at predominately white institutions (Milner, 2006). Despite the litany of reasons that exist for the disproportionate number of African American students obtaining STEM degrees, there are still African American students that are actively excelling and persisting towards graduating with degrees in the field of science.

Statement of Purpose

As an African American who majored in science at ASU, which is a predominately White institution, I am aware of the difficulties that are

involved in persisting towards graduation. I understand the importance of having a support system and the skills to navigate through a system that may be foreign and unwelcoming. I also understand the value of having a solid foundation prior to entering college and the necessity to have focus and determination, which aids in persistence. ASU presents a unique learning environment for African American students who are pursing an undergraduate degree in science. As the largest university in the country that is predominately White and located in a state that has a low population of African Americans individuals (5%), students often find themselves in a very uniquely undiversified learning environment. In addition, the focus of minority student support is aimed at Native American and Hispanic students. Even at the national level, African American students are not graduating at proportionate rates when compared to Caucasian students that are pursing science. Despite what is happening at the national level, there are still some African American students that are successfully graduating with degrees in science at ASU. The intent of this study was to look at the barriers and affordances that are present in the lives of excelling African American undergraduate students who are pursing science at ASU.

Of research interest was evaluating the intersection of sex, and SES to determine strategies for success. Additionally, the current body of literature was surveyed to evaluate the barriers and affordances that are in place. Also, having knowledge of the barriers and affordances involved in student success help articulate why the number of African American students is

disproportionately low in the field of science. This information was then used in comparisons of the stories of the excelling African American students of ASU.

In my aim to look at the barriers and affordances of African American students that pursue a science education, I interviewed eight African American undergraduate students, four males and four females, currently enrolled at ASU. The interviews explored the reported barriers and affordances they have encountered and their general interest and experiences in the field of science. The participants who were identified for the study were individuals excelling in their field of study at the time the research was conducted. Of the participants, two of the males and two of the females were from low SES backgrounds, and two of the males and two of the females were from high SES backgrounds. Also, these students were persisting toward graduating and confirming their undergraduate science degrees. The intent of this study was to look at the barriers and affordances that are present in the lives of excelling African American undergraduate students that are pursing science at ASU. While a change model and generalization might not lend itself to this particular study, the possibility of gaining insight that may be used to aid future African American students that study science at ASU remained a very plausible outcome.

Research Question

What are the barriers and affordances that excelling African American students encounter while studying science at ASU?

Sub questions

- How does socioeconomic status influence the barriers and affordances encountered by African American students pursing science at ASU?

- What are the barriers and affordances that African American female students at ASU encounter while performing in science in comparison to their African American male counterparts?

Chapter 2

LITERATURE REVIEW

Barriers and Affordances of African American Students

If one considers that minority students made up 43% of the 50 million

school-aged children in the United States in 2008 (The Condition of

Education, 2008), then it becomes imperative to consider whether there

exists an equitable landscape where students learn. Historically, minority

children have had access to subpar learning environments, and these subpar

environments have had a direct influence on academic progress (Kozol,

2005). Teaching resources, curricula, and teachers have never been equally

available at schools where minority students attend (Kozol, 2005). According

to the National Science Foundations (2008), *equity* is defined as "the

reduction in differences between those traditionally underserved and their

peers" (p. 4). Issues of equity contribute to the disproportionate number of

minority students who have the skills and support to pursue STEM degrees.

A noteworthy question is: Why are the numbers of minority students

in science fields unusually low? Several answers to this question become

immediately apparent, and I look to examine a few. Barriers that keep

underrepresented African Americans from pursuing science fields include

tracking (ability grouping), academic performance, and discrimination

(Summers & Hrabowski, 2006). Another important factor to consider is

teacher preparedness. Comparatively, teachers in urban markets are less

prepared, qualified, and equipped to teach the courses that they instruct as

compared to teachers in affluent markets (Kozol, 2005). Despite these considerations, some African American students are still able to be academically successful. Several support systems and affordances are in place, which aids excelling African American students that are pursing science. Factors that promote excelling African American student's success include strong pre-college science experiences, family support, teacher encouragement, funding for scholarship, quality advisement, and a network system with mentors and role models (Westbrook & Alston, 2007; Carlone & Johnson, 2007).

Barriers: Tracking, Ability Grouping, and Performance

Regarding barriers, the current practices of tracking, ability grouping, and standardized testing in American educational institutions continues to subvert the efforts of curriculum reform and to miseducate many African Americans (Russell, 2005). These practices continue to limit African American students' access to higher education and opportunities to realize their full potential in science-related careers and professions (Russell, 2005). Many African American students from impoverished, and in some cases, middle-class households are being tracked into classes that will prevent them from pursing more lucrative careers in the sciences, which in turn prevents them from experiencing economic and social mobility (Russell, 2005). One of the reasons for the low participation in science and engineering disciplines for African American students is their lack of academic preparation on the pre-college level. As a consequence, at the

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college level, there are fewer and fewer African American students applying for admission into college with competitive standardized test scores or grades that would allow them the opportunity to major in science (Hrabowski, Maton, Greene, & Greif, 2002). Compared to Caucasian students, teachers and administrators often exhibit lowered expectations for African American students, provide them with fewer opportunities for exposure to science and mathematics role models, and offer them less encouragement to enroll in advanced mathematics and science courses and college preparatory courses (Atwater, 2000; Catsambis, 1995). Simply put, until African American students at the pre-college level are participating at the highest levels in more rigorous, challenging science and mathematics courses in secondary schools, the achievement gap will only become more pronounced (Russell, 2005). If we are to increase the participation and representation of African Americans in science careers and professions, then it is essential to prepare them for more than the basics of scientific literacy (Russell, 2005).

Chambers, Huggins, and Scheurich (2009) believed that tracking the segregation of students by curriculum presents an issue to the schools as weighty as the issue of desegregation was over 50 years ago. They believed that:

The overrepresentation of students of color and low SES (socioeconomic status) students in lower-track classes and their scarcity in higher-track classes, paired with the reverse trend for

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Caucasian and affluent students, has led some to link tracking with

school desegregation efforts after the civil rights movement. (p. 45)

Instead of providing support and encouragement as poor children grow,

learn, and gain confidence in their abilities, oftentimes schools become a

burden to be endured (Anyon, 1995, 1997; Brantlinger, 1993; McLaren,

1988). Many critics have identified the controversial practice of tracking as

the primary reason that poor children do not receive equal treatment in

schools (Oakes, 1995). According to Frazier (1999), "the practice of tracking

involves grouping grade school children based on perceived academic ability.

All too often, the practice ends up placing poor and minority children in less-

challenging classes and Caucasian students in more advanced courses" (p. 2).

When African American students are tracked into lower level science classes,

they do not have the opportunity or exposure to higher level thinking

learning environments (Oakes & Lipton, 1999).

Some claim that tracking actually benefits all students by making

instruction easier and more effective because low-achieving students will

develop more positive attitudes about themselves and education (Nagel,

2001). Many studies find that the exact opposite is often the case. Oakes and

Lipton (1999) were quite clear on their conclusions regarding the matter:

Schooling differences, of course, include the differences in schooling

outcomes that are all too familiar. From at least the fourth grade on,

African American, Latino, and low-income children lag behind their

Caucasian and better-off peers. They more often take low-ability and

remedial classes, and they drop out of school at higher rates. They

consistently score lower on measures of school achievement that

schools claim are crucial. Far few take college preparatory classes and

go on to college; fewer still earn degrees. (pp. 13-14)

The method of teaching that students endure in low-track classrooms is of

serious concern. In low-track classrooms, teachers tend to stress rote

learning, are preoccupied with discipline, and have lower expectations

(Joseph Jr., Slovak, & Broussard, 2010). Additionally, the least-experienced

teachers tend to be assigned to low-track classrooms (Thompson, 2004).

Student performance continues to be a key point of concern used to

explain why African American students are not persisting in the fields of

science. It becomes difficult for students to perform when they are met with

low expectations and come from remedial tracks. Results of the ACT, which is

used to gauge college readiness and is an instrument used to determine

college entrance, provides some critical data on African American student

performance. Disaggregating the data for the graduating class of 2010

indicates that African American students are performing below average at

both the state level (Arizona) and the national level. In Arizona, for the

graduating class of 2010, the average composite score on the ACT for all

students was 21.3, but for African American students the average composite

score was 18.6, while Caucasian students scored an average of 23.3 (ACT,

2011). The National average composite score for all students was 22.0, but

for African American students it was 17.5, while the national average for

Caucasian students was 23.1 (ACT, 2011). When looking at the data just for science, the breakdown of performance is similar. In Arizona, the average for all students on the science portion of the ACT was 19.9, but African American students earned an average composite score of 17.8 on the science portion of the ACT, while Caucasian students earned a 21.8 (ACT, 2011). The national average science composite score for all students was 20.9, but for African American students the average score was 17.2, while the science composite average for Caucasian students was 22.0 (ACT, 2011). If one considers the data to be a true indicator of college preparedness, then it becomes paramount to investigate why African American students are performing below Caucasian students and below the national average on these benchmark assessments. However, even in the face of discouraging data, there are students who are still resilient and persisting in science. These students possibly employ certain strategies and abilities that have allowed them to be successful, and their stories must be heard.

Another considerable impediment to African American student success is the role college professors play. Findings from previous research indicate that faculty members have the strongest influence on students within the first years of their college experience (Canes & Rosen, 1995; Solnick, 1995). When African American students have an African American instructor, the students have a higher probability of persisting with their degree. In a research study performed by Price (2010), African American students that had at least one STEM course taught by an African American

instructor had an 8.1% higher probability of completing their degree. This data suggest that there is an association that connects educator's perceptions of students to student's academic success.

In attempting to evaluate the best measure to take to increase the number of African Americans who pursue advanced science degrees and careers, it is important to take a look at what is happening at the high school level. A particular focus of interest is evaluating the association between students' career considerations and the number of mathematics and science courses taken in high school. Additionally, the number of advanced mathematics and science courses students take in high school is a factor that influences African American students' career considerations (Lewis & Connell, 2005). For example, Griffin (1990) found that enrollment in advanced mathematics courses in high school is one of the best predictors of whether or not a student would pursue a career in mathematics or science. Relatedly, Lewis and Connell (2005) surveyed African American students to determine the relationship between science course selection and career consideration. Their findings suggest that, contrary to popular belief, African American student consideration of science-related careers preceded enrollment in advanced science courses. This suggests that it is necessary to look at other indicators that might predict success in science tracks besides high school course enrollment.

Barriers: Perceptions of Students

Teacher perspectives. It is important consider that perceptions have an impact on student performance and engagement in science. When considering the disproportionate number of African American students that graduate with a science degree, it becomes imperative to investigate the journey throughout a student's academic career. In evaluating perception, it is necessary to consider various perspectives. Students' perceptions of themselves, teacher perceptions of students, and even familial and cultural perceptions of students are all variables that contribute to, or negate, student success.

As a result of a study conducted by Boelter and Tyler (2008), they suggested that teachers' expectations are consistent predictors of performance outcomes for elementary, middle, and secondary students. Low expectations have the potential to derail a student from the path of graduating at the college level before they even arrive at a university. For some African American students, academic difficulties are linked to perceptions of low teacher expectation and the teacher-student relationship (Ferguson, 2003; Noguera, 2003). Also, students' perceptions of teachers' expectations are associated with self-efficacy or competence, which may influence academic performance (Boelter & Tyler, 2008). Rosenthal and Jacobson (1968) were the pioneer researchers to connect teacher expectations to student performance. Their work demonstrated that positive teacher expectations were associated with performance gains, and negative teacher expectations resulted in academic difficulty (Boelter & Tyler, 2008).

Known as self-fulfilling prophecy (Merton, 1948), the literature on teacher

expectations suggested that if a teacher has high expectations for students,

then he or she is likely to create a more effective climate and thus facilitate

academic success (Goldenberg, 1992). This type of belief system and

perspective is a prime example of the limitations a negative teacher could

place on an African American student who is actively pursing an education in

science. For the most part, students for whom teachers have lowered

expectations (a) are given less wait-time to answer a question than high-

expectation students, (b) are given the answers to questions rather than

provided with clues or rephrased question, (c) are praised or given

reinforcement not related to the academic task at hand, and (d) are criticized

for failure more often and more harshly than high-expectation students

(Boelter & Tyler, 2008). Considering that there is ample research to support

that teacher expectation has a direct association to student performance, it is

important to evaluate how knowledge of this association can be used to

positively affect African American student persistence rates in science

education.

The source of teacher expectations continues to be debated and has

developed as a result of a number of different variables. Jussim (1989) and

Jussim and Eccles (1992) argued that teacher expectations for student

performance are typically premised on students' past performance. Others

have linked teacher expectations to student ethnicity (Alvidrez & Weinstein,

1999; Baron, Tom, & Cooper, 1985; Dusek & Joseph, 1985; Jussim, Eccles, &

Madon, 1996; Tenebaum & Ruck, 2007), sex (Myhill & Jones, 2006),

socioeconomic status (Hughes, Gleason, & Zang, 2005), and even

attractiveness (Ritts, Patterson, & Tubbs, 1992). A recent study conducted by

Decker, Dona, and Christenson (2007) found that, among African American

students, perceptions of the teacher-student relationship were predictive of

social-emotional functioning and academic engagement. Though some

research has questioned the association between academic engagement and

academic performance (Willms, 2003), other research has suggested that

student academic engagement is reflective of effective teaching and the

teacher-student relationship (Haselhuhn, Groen, & Galloway, 2007).

Building on the understanding that teacher expectation has an impact

on student performance, it is important to consider which people

traditionally work in education. As the United States progresses further into

the 21st century, African Americans continue to represent a larger portion of

students that report to the school systems (Lewis, 2006). Typically, African

American students represent the majority of student populations in urban

settings (Lewis, 2006). Interestingly, the educators that are employed in

these urban settings are primarily Caucasian, and, in turn, share a different

racial and cultural background than the students that they teach (Landsman

& Lewis, 2006). Research conducted by the U.S. Department of Education

(2004) reported that almost 87% of the United States elementary and

secondary teachers are Caucasian, while only 8% of the teachers at those

educational levels are African American. The discussion about the lack of

academic success and performance of African American students often leads

to the consideration of factors external to the school, such as (a) African

American student's academic performance, (b) inadequate academic

preparation, and (c) lack of family support for African American students

(Douglas, Lewis, Douglas, Scott, & Garrison-Wade, 2008). Given that a

significant number of African American students in American public schools

are largely educated by Caucasian teachers (Landsman & Lewis, 2006), there

is a pressing need to know more about the impact that Caucasian teachers

have on African American students' academic outcomes. When identifying a

possible association, it is worth investigating if there could be an affect on

persistence rates in science education. Engaging in conversations with

African American science students that have been successful might shed light

on perspective.

The National Center for Education Statistics (NCES, 2004) reported

that African American students continue to trail Caucasian students with

respect to educational access, achievement, and attainment. Research on

effective teachers of African American students emphasizes the teachers'

collective belief that African American student potential will not be realized

in classrooms where teachers view African American students from a deficit

perspective (Quiocho & Rios, 2000). Sometimes associated with Caucasian

teachers, the deficit approach does not assume African American students'

potential but aims to compensate for what is presumed missing from the

student's background (Foorman, Francis, & Fletcher, 1998). Because a deficit

model of instruction attempts to make students fit into the existing system of teaching and learning, the model cannot build on the strengths of cultural characteristics or cultural preferences in learning (Lewis, 2006). Researchers (Allen & Boykin, 1992; Darder, 1991: Scheurich, 1993) agreed that some Caucasian teachers work from within a hegemonic, Western, epistemological framework were sometimes predisposed to have lower expectations of African American students and a lack of respect for the students' families and primary culture.

In evaluating the perceptions of African American students, one should consider Milner's (2006) work on theoretical assumptions, which focused on the problems that Caucasian teachers commonly experience when teaching students of color, particularly African American students in K-12 educational settings. Caucasian educators' deficit thinking concerning the academic ability levels of students of color is a theoretical assumption that should be addressed (Douglas et al., 2008). Several scholars have reported that deficit thinking by Caucasian teachers is one of the most powerful forces working against students of color (Hale, 2001; Milner, 2006; Thompson, 2004). Hale (2001) supported this theoretical assumption by stating, "inferior educational outcomes are tolerated for African American children day in and day out, in inner-city, suburban, and private school settings" (p. 52). Furthermore, Thompson (2004) reported that on a daily basis, some Caucasian teachers as a result of either their own beliefs or pressure from administrators at the school site believed that African American students and

many other children of color should not be held to the same academic standards as Caucasian students. As a result, Milner (2006) documented the theoretical assumption that deficit thinking inhibited teachers from valuing the knowledge that students, particularly those who are African American, bring to the classroom. Unfortunately, due to the deficit thinking by some educators, many African American students leave their schooling experiences without being properly trained and equipped for high-paying jobs and admission to four-year colleges and universities (Thompson, 2004). Future evaluation and investigation of theoretical assumptions is needed to address whether this can have an effect on African American college students who are pursing a degree in science.

Although a relatively high proportion of African American students enter college with the intention to major in science-related fields, relatively few graduate with science majors (Brown, 2005; May & Chubin, 2003). Contrary to popular belief, some of those students that eventually abandon science majors and underperform in science and quantitative courses are African American students with high scholastic aptitude test (SAT) scores, impressive high school grade point averages (GPAs), and success in high school honors math and science courses (Grandy, 1998; Ramist, Lewis, & McCamley-Jenkins, 1994). These findings suggest that there are other factors besides pre-collegiate preparation that discourage African American student achievement in science education. These include academic and cultural isolation, motivation and performance vulnerability in the face of negative

stereotypes and low expectations, peers who are not supportive of academic

success, and perceived and actual discrimination (Allen & Boykin, 1992;

Grandy, 1998; Nettles, 1988; Seymour & Hewitt, 1997). In addition, of the

African American students who graduate with science majors, a

disproportionately low number continue on to matriculate into doctoral

programs in the sciences and engineering (Building Engineering and Science

Talent, 2004).

Student perspectives. In addition to considering the obstacles that

play a role in the achievement rates of African American students in science

education, it becomes equally important to identify the self-perceptions of

African American students. If one believes that self-perception influences

academic achievement, then having an understanding of African American

student self-perceptions of academic ability becomes essential for science

teachers (Atwater & Rascoe, 2004). Therefore, understanding self-

perceptions will help science teachers to understand student academic

choices (Atwater & Rascoe, 2004). The perception of classroom difficulty is

also a part of each student's self-appraisal regarding the ability to achieve

(Chapman & Tunmer, 1995). As students age, they become more aware of

their cognitive and social development, which allows them to better gauge

their own ability levels. Younger students can hold positive self-perceptions

of academic ability for science and simultaneously have perceptions

regarding the difficulty of science academic work (Atwater & Rascoe, 2004).

Over time, as students come to realize that experiencing ongoing difficulty in

science is inconsistent with their positive self-perceptions of academic ability, their positive self-perceptions regarding their academic ability may change (Atwater & Rascoe, 2004). One way to encourage positive self-perceptions of ability is to provide learning situations where students feel good about their academic environments and where they can establish a comfort zone (Dixon, 1998). This strategy may be in place for those African American students that persist with a science degree despite the litany of obstacles that work against their favor.

Community perspectives. The idea of collaboration and student support is a topic that has become popular during educational reform discussions. In an attempt to reduce the gap that exists between African American students and their Caucasian counterparts, suggestions point to examining the role of motivation and collaboration in science learning. Motivation is a prerequisite of academic success and becomes an area to research. In an empirical study, Freeman et al. (2008), looked to see whether motivation was enhanced as a result of a learning community initiative. Freeman et al. (2008) surveyed African American students to gauge their satisfaction levels with a program that linked several historically black colleges and universities by combining STEM courses with other disciplines in efforts of increasing STEM success. Students recommended the linked classes and stated that the main benefit was shared experiences with their peers (Freeman et al., 2008). Also, based on analyzing the collected data, there was an increased level of motivation in regard to pursing STEM classes

(Freeman et al., 2008). Developing a sense of community and collaboration provided a system that encouraged academic success. In times of academic and cultural isolation at the collegiate level, African American students sometimes find themselves without an adequate support system. The sense of communal support could be a crucial component that aids some African American students to persist toward graduation and is something that is necessary to explore.

Affordances: Role Models and Mentors

As African American students continue to populate predominately White institutions (PWI), it becomes increasingly valuable for those students to understand how to navigate such a foreign system. Role models and mentors are crucial components of a larger support system that aids excelling African American students in becoming successful in science (Dyer & Breja, 1999). African American students who are surrounded by African American professors are more likely to remain in the science field because they have role models and mentors (Westbrook & Alston, 2007). For example, Grandy (1998) found that students who indicated that they had support from minority role models, support from peers in their ethnic group, and support from dedicated minority staff at their college were more likely to commit to persisting in science by their sophomore year. In the event that African American students are enrolled at a predominantly White institution, selecting and aligning with mentors becomes an important task. It has been suggested that, in scenarios where African American students are not able to

be surrounded by African American professionals who act as role models, it becomes paramount for those students to make connections with individuals that are professionals within their shared field of study (Hrabowski, 2005).

Affordances: Financial, Family, Faculty, and Institutional Support

Financial, family, faculty, and institutional support are all extremely beneficial for minority student success (Stolle-McAllister & Carrillo, 2010). Due to the considerable amount of time required for science-related coursework, it is difficult to achieve success in science majors if obligations such as outside work take up considerable time; thus, funding is critical for academic success (Callen, 1994). The affordances of scholarships and funding offer excelling African American students the ability to focus on academics. In turn, the focus on academics aids them in being more successful.

Navigating a degree in science is often a very difficult journey that requires dedication, focus, and support. Often, students across institutions describe science-teaching styles as cold, elitist, and unsupportive (Newman, 1998). Counterbalancing the difficulties related to learning in the sciences requires strong supports that include faculty involvement, meaningful research experiences, an academically focused peer group, involvement with university staff, and tutoring (Barlow & Villarejo, 2004; May & Chubin, 2003). Support systems that include peers, family, role models, and university staff are especially impactful on minority students' persistence (Herndon & Hirt, 2004).

Affordances: Monitoring and Advising

Another important affordance that aids excelling African American students is appropriate monitoring and advising, which helps science students select appropriate courses, plan for graduate study, manage their personal life, and establish standards and supportive relationships (Stolle-McAllister & Carrillo, 2010). For years, universities have provided minority students with university orientation sessions, which often included information for course recommendations, ongoing academic advising, and monitoring (Treisman, 1983). Treisman (1983) found these types of interventions improved minority students' math grades and increased retention. Consistent monitoring can help identify early warning signs of potential academic or personal problems, which may affect a student's progress (Stolle-McAllister & Carrillo, 2010). Advising can also benefit students by providing input concerning their strengths, weaknesses, and future careers (Gandara & Maxwell-Jolly, 1999; Seymour & Hewitt, 1997). Furthermore, being engaged with someone who can encourage and validate students' experiences and set standards is important for minority students (Terenzini, Rendon, Upcraft, Millar, Allison, Gregg, & Jalomo, 1994).

Affordances: Academic and Social Integration

Compared to Caucasian and Asian students, African American students are more likely to have difficulty integrating both academically and socially at PWIs (Cole & Barber, 2003). However, helping students to become both academically and socially integrated by creating a community of shared intellectual interest (Treisman, 1990) and including a critical mass of

academically talented peers of the same ethnicity can reduce isolation and optimize student outcomes (Brazziel & Brazziel, 2001).

Socioeconomic status. SES is a ranking concept that is used to stratify individuals and families into a hierarchical ranking. Typically, SES is divided into three categories: low, medium, and high. When determining SES, income, occupation, and education are usually considered in establishing the level. When evaluating students' SES, background information is typically derived from the SES of their parents. This particular delineation of a students' family has the potential to be either a barrier or an affordances. Historically, individuals that come from low SES backgrounds have a more difficult time gaining access and succeeding in higher education when compared to their peers that come from middle or higher SES backgrounds. One of the barriers that prevent African American students from low SES backgrounds from attending postsecondary education is the cost of college. Also, there tends to be a difference between students' perspective of importance, value, and attainability of college when comparing perspectives of individuals from low versus high SES backgrounds. Research has also stated that African Americans from low-SES backgrounds have less contact with faculty, study less, are less engaged in campus activities, work more, and have lower grades than their higher-SES peers. Considering this information, SES becomes an important variable to include when evaluating the students that will participate in this study. Using the lens of intersectionality, the race, sex, and SES of students will be considered when determining the barriers

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and affordances that the participants encounter as they navigate through college.

Theoretical Framework

The theoretical framework and lens used for this study is intersectionality. Because one of the research questions focuses on the comparison between African American males and females, it is important to understand the historical implications of sex and race. The term intersectionality was originally used by Crenshaw (1989/1993) to recognize the ways in which the experiences of African American women were situated between the different discourse of sex and race. In a groundbreaking work, Crenshaw critiqued the single-axis framework that is dominant in antidiscrimination law . . . . feminist theory and anti-racist politics" (p. 383) for its focus on the experiences of the most privileged members of subordinate groups (Cole, 2009). She argued that legal cases revealed that Black women plaintiffs:

> Sometimes experience discrimination in ways similar to White women's experiences; sometimes they share very similar experiences with Black men. Yet often they experience double discrimination the combined effects of practices, which discriminate on the bases of race, and on the bases of sex. And sometimes, they experience discrimination as Black women not the sum of race and sex discrimination, but as Black women. (Crenshaw, 1989/1993, p. 569)

In the articulation of intersectionality, the focus is on the experiences of groups holding multiple statuses, which are disadvantaged. In doing so, Cole highlighted the ways that analyses that consider categories such as race and sex independently may be limited because, in practice, individuals experience these statuses simultaneously (Cole, 2009). However, stated Cole (2009) that a corollary to this observation is that some members of disadvantaged groups also hold privileged identities (e.g., middle-class Blacks and White women). This reveals that although much of the literature on intersectionality has been theorized from the standpoint of those who experience multiple dimensions of disadvantage, this framework can also inform how privileged groups are understood (Cole, 2009).

Since its introduction, the idea of intersectionality has taken on different interpretations. Most recently, intersectionality has been described as:

> the interaction between gender, race and other categories of difference in individual lives, social practices, institutional arrangements, and cultural ideologies and the outcomes of these interactions in terms of power. (Davis, 2008, p. 564)

The concept of intersectionality is recognized as one of the most important feminist contributions to understanding the different experiences of women (MCall, 2005). According to Davis (2008), intersectionality addresses the most central theoretical and normative concern within feminist scholarship: "namely the acknowledgement of differences among women" (p. 71). It

allows researches to "ask the other question" in order to explore "the interconnection of all forms of subordination" (p. 71) or, for example, look for patriarchy within racism or heterosexism in sexism (Cole, 2009). In asking questions and exploring interconnections, intersectionality brings together two significant aspects of feminist thinking. Firstly, it presents the impact of race, class, and sex (and other intersections) on women's lives, and how relations of power are produced and transformed through this interaction within women's lives and experiences (Cole, 2009). Secondly, it offers support for the deconstruction of binaries, normalization theories, and homogenizing categories while simultaneously offering a platform that can address the concerns of all women (Davis, 2008).

Another very important figure who has contributed to the understanding of intersectionality is Patricia Hill Collins. Collins (1990) stated that oppression and privilege not only intersect, but also are dependent upon one another to continue. In order to work towards justice, the discourse of oppression must be expanded to include ways that privilege and oppression intersect (Hatt-Echeverria & Urrieta Jr., 2003). Naturally linked to intersectionality is Standpoint Theory, which emphasizes that social positions influence people's knowledge (Landau, 2008). Collins (1986) for instance, advocated the use of Standpoint Theory to analyze race and class in addition to, and in combination with, sex.

When investigating the affordances and barriers that African American students at ASU encounter as they maneuver toward graduation, I

compared the experiences of males and females to investigate the different

storylines. I also used qualitative methods that included one-on-one

interviews with the participants of the study. As discussed by Syed (2010),

qualitative research is central to the intersectionality approach. In the

introduction to a recent special issue on intersectionality in *Sex Roles,* Shields

(2008) stated:

> the theoretical compatibility and historic links between
>
> Intersectionality theory and qualitative methods imply that the
>
> method and the theory are always already necessary to one another.
>
> Intersectionality theory, by virtue of its description of
>
> multidimensional nature of identity makes investigation through
>
> qualitative methods seem both natural and necessary. (p. 305)

An intersectional theoretical framework supported the design of this

research in an appropriate way, and allowed for seamless data interpretation

using intersectionality as the lens. Considering that Intersectionality theory

and qualitative research support each other, I was better able to analyze the

various variables that I uncovered from the interviews with my student

participants (race, sex, socioeconomic status). As illustrated earlier, locating

the intersection of race, sex, and socioeconomic status was the focal point in

the selection criteria of the participants of the study.

Sex and Racial Implications

Much of the recent educational concern, both scholarly and socially,

has revolved around the plight of young, Black men (Lopez, 2003). Although

certainly important, this focus on Blackness and masculinity often implicitly leaves young, Black women marginalized (Morris, 2007). Through research, scholars are developing a body of knowledge to articulate the challenges that African American males face during schooling, but there are many questions about how African American females experience schooling. In the evaluation of sex equality many scholars have found the theory of intersectionality particularly useful (Pyke & Johnson, 2003). Intersectionality underscores combinations or intersections of important modes of social advantage and disadvantage (Morris, 2007). A key insight of intersectional theory holds that modes of inequality, such as race, class, and sex, can combine in ways that alter the meaning and effects of one another (Morris, 2007). Whiteness, for example, creates a myriad of advantages for White women (McIntosh, 1998). In the words of Collins (1990), "White women are penalized by their sex, but privileged by their race" (p. 65). In this assertion, Collins drew on the tendency for masculinity to be held in higher social esteem than femininity (Morris, 2007). However, this point does not mean that all men enjoy the same power as all women. For example, an African American male might put at a disadvantage compared to a Caucasian woman in various areas of social life (Morris, 2007). An Intersectionality theory approach examines "the ways in which gender is racialized and race is gendered" (Glenn, 2002). Race alters the very meaning and impact of gender and gender alters the very meaning and impact of race (Morris, 2007).

Feminist research produced in the early 1990s argued that girls experienced declining self-esteem in school and that boys tended to dominate teachers' attentions (American Association of University Women, 1992; Sadker & Sadker, 1994). In particular, research that has included girls of color, girls of different class backgrounds, and girls living in urban areas highlights variations in experiences and enactments of femininity (Emerson, 2002). Because African American women, for instance, have historically worked outside the home and occupied prominent positions in African American communities, their experience and understanding of being a woman differs markedly from Caucasian women (Fordham, 1993; Thompson, 1998). Indeed, girls not privileged with Whiteness, as well as those not privileged by class status, most likely possess unique tools to carve out counter-hegemonic ways of being female (Bettie, 2003). This intersectional view of femininity rests on the notion that race, class, and gender are socially constructed (Glenn, 2002). From the perspective of what has come to be known as reproductive theory, schools serve as sites for the construction of race, class, and sex identities, and they reproduce existing inequities in these areas (Bourdieu & Passeron, 1977; Dillabough, 2003). Contrary to the common view of schools as equalizers, reproduction theory contends that schools solidify or even exaggerate the inequalities children bring with them to school (Morris, 2007). Reproductive theory has been one of the most enduring frameworks for understanding continuing inequality in education (Morris, 2007).

Literature on education and youth has recently begun to consider

race, class, and sex in an interconnected way (Bettie, 2003; Ferguson, 2000;

Lopez, 2003; Williams, Alvarez, & Andrade Hauck, 2002). Early examples of

the utility of race and sex perspectives can be found in the work of Linda

Grant (1984, 1992, 1994). Grant's examinations of the intersections of race

and sex for African American girls in classrooms show how teachers tend to

treat African American girls differently than they treat Caucasian girls or

African American boys. Furthermore, Grant emphasized how educators

express more interest in promoting the social skills rather than academic

skills of African American girls (Morris, 2007). In Grant's (1992) research,

this emphasis on social skills was less apparent for Caucasian girls, African

American boys, and Caucasian boys. Grant's conclusions tie to the idea of

stereotyping and the tremendous effect it has had on the educational impact

and treatment that students experience. Ferguson (2003, for example,

argued that stereotypes of race and sex combine to make African American

boys appear threatening or potentially threatening, and this image serves to

justify their harsh and persistent discipline in schools. In analyzing the

complex workings of inequality in education, it is essential to view inequality

as multi-faceted and interconnected (Morris, 2007). Now, the theory of

intersectionality extends beyond the set of normative claims that theorists

like Crenshaw (1993) and Collins (1990) first articulated and which

encompassed a broad range of theoretical and empirical work. Calls are

emerging for a consolidation of intersectional work into an emerging

research paradigm (Hancock 2007; McCall 2005) that answers questions left unaddressed by earlier unitary theories of race or sex and sparks new investigations in many disciplines.

Morris (2007) argued that the lens of intersectionality, which presents race, class, and sex as intertwined factors that might alter the experience and meaning of one another, best illuminated the often contradictory experience of educational inequality for African American girls. African American girls who exhibit all the characteristics of young ladies who might have appeared to be good students in their behavior, but the sex - specific qualities associated with a well-behaved student are not always the qualities associated with academic and occupational excellence (Morris, 2007). The idea of investigating the intersection of race and sex is extremely appealing and how race and sex relate to African American females in science programs is an area that needs to be further explored.

Sex differences reported in the literature for the general population suggest that boys and girls might display different tendencies toward social orientations based on the different experiences they have within their families; where boys, more so than girls, are taught to compete and girls, more so than boys, are taught to nurture (Tharp-Taylor & Nelson-Le Gall, 2005). Essentially, this means that, "Differences in members' experiences within the social context should result in differences in the social orientations they formulate" (Tharp-Taylor & Nelson-Le Gall, 2005, p. 249). However, this pattern of sex difference in the social orientations should not

be assumed to be universal (Tharp-Taylor & Nelson-Le Gall, 2005). Researchers (Hershey, 1978; Lewis, 1975; Willie, 1981) have suggested that in the African American family there is less sex -role differentiation and that African American boys and girls have similar family experiences. For example, African American females, just like males, are socialized to be assertive and independent (Hill, 2002) and are taught to be prepared to take on the responsibility of supporting their families by being independent and strong. Sex differences have also been found in boys' and girls' perceptions of their experiences in their academic environments (Shepardson & Pizzini, 1994). Generally, boys are found to report preferences for high competition and individualistic orientations whereas girls report high cooperative preferences (Tharp-Taylor & Nelson-Le Gall, 2005). However, other research with African American students has found little difference between boys and girls in their perceptions and preferences for cooperative behavior in the classroom (Nelson-Le Gall & DeCooke, 1987).

The next scenario to address is the intersection of both race and sex when evaluating the disproportionate numbers of certain groups in the field of science. For example, in the examination of a national sample of high school seniors, Xie and Shauman (2003) found strong sex disparities in the investigation of the intent to declare a science major in college: the probability of reporting an intended science major was 60% less for females than for males. When reviewing the disproportionate numbers of females in the field, it is imperative to look at the intersection between attitude and

achievement. The expectancy model, created by Eccles & Wigfield (2002), has

been used in many studies in the United States and other countries to explore

sex differences in science and math during the high school and college years

(American Association of University Women Education Foundation, 2008).

There is generally strong evidence that females are less confident in their

math and science abilities than their male peers (Eccles & Wigfield, 2002).

Traditionally, the disproportionate number of women in STEM is attributed

to the sex socialization process; however, regardless of the reason, the

consequences play out in women's lower aspirations and subsequent rates of

entry into college degrees and related jobs in STEM fields (Riegle-Crumb,

Moore, & Ramos-Wada, 2011). Correll (2001) found that on a national

sample of high school seniors surveyed, female students' relatively lower

self-perceptions of math abilities were a key factor behind the sex gap in

declaration of a science major. Such attitudinal differences are therefore

likely to translate into lower career aspirations in these fields among young

females during this period of adolescence, when sex identity becomes

particularly salient (Riegle-Crumb, Moore, & Ramos-Wada, 2011). One

reoccurring explanation to justify the relatively low numbers of women in

science continues to be their lower achievement and ability. This idea has

been rejected by research. Aggregate sex gaps in test scores have largely

disappeared (Hyde, Lindberg, Linn, Ellis & Williams, 2008) and remaining

differences are too small to explain the large disparities in intended major

and ultimate degree attainment and employment (Simon & Farkas, 2008; Xie & Shauman, 2003).

Race and sex gaps in science achievement suggest that African American females face a two-part issue involving both race and sex (Buck, Cook, Quigley, Eastwood, & Lucas, 2009). Typically, the educational system in the United States has been framed to focus on Caucasians middle-class needs, which undoubtedly places individuals that do not fit this particular demographic at a disadvantage in terms of equity. Through a qualitative approach, Buck et al. (2009) determined that African American females were moderately high in confidence, and desired to pursue science when compared to males and other ethnic groups. On the basis of their findings, Buck et al. (2009) argued that female students' engagement in science could be increased by using problem-based, student-centered strategies.

Chapter 3

METHODS

Introduction

The intent of this study was to explore the barriers and affordances of African American students pursing science at ASU. In addition, I compared the experiences between male and female African American undergraduate science students at ASU. In this chapter, I will articulate the appropriateness of the research method and detail the design selected for this study. The researched population, procedures for collecting data, and details regarding the validity of the study are all explained.

The method of research utilized for this investigation is qualitative. In an investigative approach, the aim of qualitative research is to seek answers to questions that are posed. In the practice of qualitative research, natural settings are the preferred research landscapes as opposed to laboratories (Rossman & Rallis, 2003). When carried out properly, qualitative research is often transformative for the researcher, and in many cases, the participants are also changed (Rossman & Rallis, 2003). In addition, the qualitative method of investigation attempts to represent human beings as whole persons living in dynamic and complex social arrangements (Rogers, 2000).

To answer some of the difficult questions that I seek to understand, I wanted a research method that would allow for a rich discussion, and that would allow the voices and perspectives of the African American student participants to be documented. Qualitative research has allowed me to

develop the necessary rapport with my participants to gain a clearer

perspective of the issues that they encounter during their academic careers.

Qualitative research allows participants to reveal their personal experiences,

opinions, and beliefs, which all contributes to a rich set of data. In efforts to

produce the richest, most insightful data, I wanted to capture candid

opinions, beliefs, and behaviors from the participants. Using the aims of

qualitative researcher, which includes conducting fieldwork in a natural

setting, utilizing multiple research methods, and posing questions to focus on

learning, I have generated data in the forms of reflection and discussions.

The research question and subquestions considered in this study were as

follows:

Research Question

What are the barriers and affordances that excelling African American

students encounter while studying science at ASU?

Subquestions

- How does socioeconomic status influence the barriers and

  affordances encountered by African American students pursing

  science at ASU?

- What are the barriers and affordances that African American

  female students at ASU encounter while studying science in

  comparison to their African American male counterparts?

Background of Methodological Approaches

When selecting a qualitative approach, it is important to understand that there are various avenues by which one can pursue data. The most common genres of qualitative research include ethnographies, phenomenological studies, sociocommunication studies, and case studies. Ethnographies are qualitative methods that look to investigate the culture of people and places. Typically, they are long term, sustained inquires. Ethnographies attempt to address questions such as "How do people's beliefs and values guide their actions and their understanding of those actions" (Rossman & Rallis, 2003, p. 42). Phenomenological studies seek to understand the lived experiences of a small number of people. These types of investigations highlight what an individual has experienced. Sociocommunication studies are designed to look for meaning in words, gestures, and signs. Oftentimes, these studies involve the tape and video recording of speech events to analyze signs and systems (Rossman & Rallis, 2003). Case studies are generally considered to be an overall strategy rather than a distinct genre of research (Stake, 1995). Case studies are in-depth and detailed explorations of single examples that are "an instance drawn from a class" (Adelman, Jenkins, & Kemmis, 1983, p. 17) of similar phenomena. Finally, case studies seek to understand a larger phenomenon through the intensive study of one specific instance. These studies are descriptive, heuristic, and inductive (Rossman & Rallis, 2003). Case studies look to figure out what is going on in each particular case the study presents. The design selected for this investigation was a case study.

Purpose of the Study

ASU presents a specific learning environment for African American students who are pursing an undergraduate degree in science. As the largest university in the country that has a predominately White student population and is located in a state that has a very low population of African Americans individuals (5%), students often find themselves in a learning environment with a large number of perspectives that they would not encounter anywhere else. To add to the lack of diversification and minimal support for non-White students, when there is support available, the minority student support is aimed at Native American and Hispanic students. By focusing on a limited portion of the minority student population, groups such as African Americans in science programs are neglected and encounter more obstacles as they pursue their degrees.

At the national level, African American students are not graduating at proportionate rates when compared to Caucasian students who are pursing science. Despite the disproportionate rates at the national level, there are still some African American students who are successfully graduating with degrees in science at ASU. The intent of this study was to look at the barriers and affordances that are present in the lives of excelling African American undergraduate students who are pursing science at ASU. As a result of this study, we may better understand the journey of these students at ASU. While the results of this study may not be appropriate for creating a change model or for making generalizations, there is a possibility of gaining insight that

may be used to aid in the success of future African American students who study science at ASU.

The Research Context

In general, case studies are the preferred strategy when how or why questions are being posed, when the investigator has little control over events, and when the focus of the study is on a contemporary phenomenon within some real-life context (Yin, 1994). To effectively incorporate the particulars of my investigation, I have decided to pursue a case study method. My research was designed to understand what barriers and affordances African American students at ASU encounter as they pursue science, and to identify the elements that encourage these students to persist in science. The case study format allowed me to focus on the eight participants in the study and to capture detailed, rich information to help answer the questions posed. The case study approach lends itself to multiple methods for triangulating data to validate the warrants of the research.

The Bounded System

The unit of study (the case) in this investigation is the African American undergraduate student experience of pursing a degree in science at ASU. The bounding of this study has developed into one case, in which sex and SES have no impact on the data (acting as constants), and there were some emerging themes from the participants in the case. When developing the bounding for this case, there were several limitations. A limitation to the study was the demand that the participants be African American

undergraduate students at ASU who are currently pursing a bachelor's degree in science. These students were either in their sophomore, junior, or senior year of their undergraduate studies. In addition, these students were classified as excelling, and were persisting towards graduation as indicated in the recruitment surveys that were administered to each of the participants.

An additional point to consider for this study is that even though this study was framed as a case; there were some exceptions to note that are traditionally common to cases. For example, throughout my data collection process, I have documented the perspectives of the students (participants) in this investigation as the major source of data. I have also engaged in observations, but with two of the eight participants. Additional converging lines of data are needed to truly define this investigation as a case. Instead, this study is case-like, and only focuses on the perspectives of the students. Other potential converging lines would include engagement with professors, or with the parents of these students.

Internal Validity

Internal validity deals with the relationship between research findings and reality. According to Gay and Airasian (2009), "validation is a matter of degree; it does not exist on an all-or-nothing basis" (p. 170), and producing valid and reliable knowledge is a goal for all research. Humans are the primary instrument of data collection and analysis in qualitative research. Therefore, the interpretations of reality are accessed through the researcher's

observation and are processed through the researcher's own assumptions, worldview, and theoretical assumptions. In this study, the goal was to collect the data in a sensible way that was consistent and dependable. To ensure dependability, the following techniques were used: articulation of the experiences of the group being investigated, use of triangulation, describing how data were collected, and discussing how decisions were made throughout the investigation.

Triangulation

In a qualitative study, triangulation increases the strength and rigor of the conclusions drawn from the results of the study. Yin (1994) recommended the use of multiple sources of evidence (a form of triangulation) to address issues validity. In this study, triangulation was accomplished through a variety of methods and sources in the following ways.

1. Potential participant data were collected using a questionnaire that was distributed prior to those students being selected for the study.

2. Participant data gathered during two interview sessions with each of the selected participants who were involved in the study.

3. Information presented in the literature review was used to develop the interview questions.

4. Information collected using the questionnaire aided in the development of the interview schedule.

5. Support group observations were carried out for participants to further detail the engagement and interaction with peers, as detailed in the literature review.

6. Transcriptions of audio-recorded interviews were checked by participants to ensure accuracy of data that were collected.

Pilot Testing

The questionnaire and interview protocol both went through pilot testing prior to data collection. For the pilot study, two African American undergraduate students (one male and one female) who were both upperclassmen (matching the requirements for the participants in the final study) were selected. The students who were selected were also excelling academically and successfully navigating through their college experience. The pilot study participants were not science majors because the pool of qualified participants for the actual study was extremely limited and it was preferable not to disqualify any potential future participants. In order to find qualified pilot study participants, existing ASU contacts were used to find students that met the requirements. At the conclusion of the pilot test, the questionnaire and interview protocol were modified based on participant feedback and researcher determination.

Researcher Biases

The way a researcher views the world can influence the results of a study. Because of this, it is important that a researcher articulate personal views and assumptions about the group that is being studied. As discussed at

the beginning of this study, I am an African American male that pursued an undergraduate science degree at ASU. Entering into this investigation, I recalled the journey that I embarked upon as I pursued the completion of my degree and graduation. As a result of personal experiences at ASU, I may have certain biases about the engagement of African American students studying science at ASU. In an effort to remain transparent, the following is an accounting of my current views.

1. ASU has a very small African American population and it is easy for African American students to get lost trying to navigate the graduation process without ample support.

2. As an African American student, it can be very difficult to engage in a class where you are the minority and others look to you to represent the perspective of an entire race of individuals.

3. Finding support while struggling through a science major can be difficult if you are introverted and do not easily engage with peers.

4. Students and instructors engage in profiling based on appearance, sex, and race. These practices can make it more difficult for individuals that are not a part of the majority to find support and be successful.

To reduce the influences of these biases on the research findings, triangulation, member checking, and a search for disconfirming evidence was integrated into the project. Triangulation, the use of multiple data collection methods, was incorporated to avoid bias. In addition, to ensure the accuracy

of details of participant engagement and interviews, members checked the interviews for accuracy. Also, emerging themes were shared with the participants, which were developed as a result of the interview process. Finally, a deliberate search for evidence that disconfirmed previously held views was used to ensure that the findings were not skewed in the direction of the researcher's biases.

External Validity

External validity concerns the generalizability of study findings. In regard to this study, the results of the investigation are only specific to this study. The purpose and intent was to uncover the details and experiences of the eight participants in this investigation. The results of these participants cannot be transferred to other populations because the experiences are unique to the population studied. Therefore, the results of this study should not be applied or linked to other demographics or scenarios.

Data Collection Methods

The Site: ASU

The ASU campus was selected as the research site. This particular site was selected because it is a predominately White institution with a disproportionately small population of minority students. The aim of the study was to make connections to some of the barriers and affordances that African American students encounter. The literature review and stories from the participants in the study help to inform how barriers and affordances affect educational experiences.

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Recruitment

Participants for the study were contacted during the fall semester of the 2011-2012 academic year. Ideal candidates for this study were individuals who identified themselves as African American. Additionally, all participants were either sophomore, junior, or senior undergraduate students who were majoring in a science field at the time of the interviews. Participants of the study were also excelling academically. An excelling status was defined as maintaining a minimum of a 3.0 cumulative grade point average on a 4-point scale. For the study, I identified and selected eight participants: four male undergraduate students and four female undergraduate students.

The initial step in pursing participants for my investigation was to make the appropriate contacts to identify students at ASU. During the academic year of 2010-2011, I worked in partnership with ASU to help develop and open a new high school charter program. Because of my involvement with this program, I had established a network of Arizona State employees that served as initial points of contact, which allowed me to access my target demographic. After speaking with ASU personnel, I requested a list of science professors who would be likely to allow me to engage with their students. These science professors taught classes such as Biology 181/182, Chemistry 113/116, Genetics 340, Anatomy and Physiology 201/202, and Physics 113/116. After approaching five instructors, I realized that surveying entire lecture halls was not going to be realized. Considering that the African

American student population was extremely small in these science courses (on average, less than 5%), it was a futile effort to survey entire, large lecture halls of students during class time when each class had on average 400 students enrolled. Because surveying entire lecture halls at the beginning of each class was no longer an option, my next effort required me to sit in and audit courses (visiting a class without getting credit) to personally and individually recruit potential participants after each class ended.

During a week-long vacation from my full-time job, I established a schedule that required I visit five ASU classes per day, Monday through Friday, to look for students that would be eligible for participation in the study. I audited four sections of General Biology 181/182, four sections of General Chemistry 113/116, two sections of Organic Chemistry 234, three sections of Anatomy and Physiology 201/202, two sections of General Genetics 340, two sections of Animal Behavior 360, three sections of Physics 112, and five sections of Mathematics 210. The intention was that through these visits, I would be able to approach students individually and administer my questionnaire in hopes of finding the eight participants that I needed. Throughout the week, I approached a total of 27 students and only one qualified as an ideal participant. I visually spotted and counted a total of 53 students, but it was very difficult to speak to more than one student at a time per class. Typically, I approached students at the dismissal of the class and by the time I completed my introduction and recruitment speech to a student, the other students were already gone.

The major obstacle that prevented more students from qualifying for this study was meeting the minimum GPA requirement of 3.0. Of the 27 students who were approached, 21 of those students did not have at least a 3.0 GPA. The second discriminating factor that limited my recruitment success was that the participants had to be at least a sophomore in classification status. Eight of the 27 students were classified as freshmen. I also encountered three students who explicitly stated that they did not identify as African American, and instead, clarified that they were African. Of the 27 students that I approached, only one student met all of the requirements and agreed to participant in the investigation. Attempting to leverage the one recruit, I asked if there were additional students that could be recommended that were qualified for the investigation. I was told no. This eventually became a reoccurring theme. Confirmed students did not have qualified students that they could recommend because their academic circles were diverse and not just filled with excelling African American peers. After the initial week of recruitment efforts, I immediately became discouraged, and I realized that finding qualified participants would be nearly impossible without additional help and resources.

After considering the options that were available to me, I contacted a close colleague who worked at Barrett, The Honors College, within ASU. According to their website:

Barrett, The Honors College at ASU, is a selective, residential college that recruits academically outstanding undergraduates across the

nation. Named "Best Honors College" in the nation, the Barrett

residential community has more National Merit Scholars than MIT,

Duke, Brown, Stanford, or the University of California-Berkeley.

(http://barretthonors.asu.edu/about/)

Table 2 illustrates the level of selectivity for incoming Barrett freshman

students.

Table 2

Barrett, The Honors College Student Profile

Average unweighted GPA of entering first-year students	3.84
Average SAT scores for incoming students (Fall 2010)	1314
Average ACT scores for incoming students (Fall 2010)	29
Percentage of Female Students	54%
Percentage of Male students	46%
Percentage of entering freshman in the top 10% of high school class	78%

Note. Table created from information available from Barrett, The Honors
Collage, Arizona State University, 2011 (http://barretthonors.asu.edu/).

With the assistance of my contact at Barrett, The Honors College, I was given

a list of four African American males who were possibly eligible for

participation, and I was also instructed to contact the School of Life Sciences

for assistance. I immediately emailed the four males, explained the study, and requested that they complete the questionnaire. I eventually heard back from two males; only one qualified, and he later became a participant. The male that did not qualify carried the required GPA, but was not a science major. Several days later, I visited the office of The School of Life Science to request assistance with finding qualified students for the study. I was instructed to compose an email to state to the exact qualifications and characteristics I was looking for in student participants, and I was told to email the message to the director of the program. After composing and sending the email, I immediately heard back from the director, who stated that he ran a query of the students who were life science majors and 28 of them meet my requirements. He sent the 28 students an email and included the details of my study as well as my contact information. Through this email, I secured the four females that I needed, and one additional male participant, who all responded to the solicitation. Unfortunately, I still lacked the last two males.

To secure the last two male students, I spent three more full days at ASU over the course of a two-week period auditing classes and attempting to find the last two, qualified male students. After visiting 12 classes (three Biology181, two Chemistry 116, one Physics 112, and six Mathematics 170), and engaging with seven males, I remained unsuccessful, as none of the males had the required GPA. Next, I met with the director of the Multicultural Student Center to seek assistance with locating two male students. After evaluating the student database, 19 male students were identified as

potential matches. The matches were contacted by the director via email to solicit participation. Eventually, two male students responded to the solicitation and were interviewed.

Table 3

Student Recruitment

Method of Recruitment	Total students enrolled	African American students contacted	African American students qualified	Students not qualified	Students confirmed
Auditing (visiting) Classes	3,869	27	1	26	1
Barrett Contact	3,129	4	1	2	1
School of Life Science contact	n/a	28	28	0	4
Multicultural Office Contact	n/a	19	19	0	2
Total Number of Students	6,998	78	49	28	8

Each of the eight students participated in multiple data collection opportunities to triangulate and secure the most valid data possible. Once students were secured as participants for the study, they were given my biographical and background information, the purpose of the study, and a brief explanation of the study's purpose Participants were also required to read and sign a consent form, which has been included in Appendix A. The details of the case study will be outlined in the rest of the chapter.

Interviews

After each participant completed the recruitment survey, interviews

were scheduled. Each student participated in semistructured individual

interviews that were guided by an interview protocol listed in Appendix B.

Each interview was conducted on the ASU campus and in a private setting

where students were free to express themselves openly and candidly. The

total interview time spent with each participant ranged between two to three

and a half hours, pending the amount of information each participant shared.

The questions in the interview were open-ended to provide flexibility in the

interview setting. Also, the questions that were selected for the interviews

were constructed based on the affordances and barriers that were outline in

the literature review. I decided to pursue interviews with each participant

because I was truly interested in each of their stories; therefore, the

interview method provided the best technique to gather the information I

needed. Interviewing allows the voice of the participants to be heard, clear,

and uninterrupted. Regarding interviewing, Patton (1990) stated:

> We interview people to find out from those we cannot directly
>
> observe… We cannot observe feelings, thoughts, and intentions. We
>
> cannot observe behaviors that took place at some previous time. We
>
> cannot observe situations that preclude the presence of an observer.
>
> We cannot observe how people have organized the world and the
>
> meaning they attach to what goes on in the world. We have to ask
>
> people questions about those things. The purpose of interviewing,

then, is to allow us to enter into the other person's perspective. (p.

196)

For the interview structure, I decided to employ a modified version of

Dolbeare and Schuman's (1982) three-part interview series. Instead of the

traditional three-part series, the interviews were condensed into two parts.

This decision was made because it was very difficult to schedule three,

separate meeting times with each of the participants because of their hectic

college schedules and lives. Using this approach, I primarily asked open-

ended questions. The major goal was to build upon and explore the

participants' responses to those open-ended questions. The task during this

format was to have the participants reconstruct their experiences related to

the current study (Seidman, 2006).

Guided by the research questions and literature review, a question

protocol was developed to facilitate the semistructured, two-part interviews

for the participants in this case study. In part one of the interview, the

students were requested to highlight their family and backgrounds and

reconstruct their academic and schooling experiences prior to enrolling at

ASU. At times, it was difficult for some participants to recall all of the details

of their experiences prior to entering ASU as an undergraduate student,

because a substantial period of time. Part two of the interviews were

designed to capture details about each student from the time they enrolled at

ASU, and to discuss their future aspirations. I asked the participants to recall

as much detail as possible. For example, I asked the participants to recount a

typical day as an undergraduate student to elicit as much detail as possible about their academic experience. In the effort to make sense or make meaning, participants were required to look at how the factors in their lives interacted or contributed to their present situation (Seidman, 2006). The construction of the interview questions allowed for flexibility to discuss future implications and aspirations in the second session. Considering that all of the students were extremely busy and difficult to schedule for interviews, in some cases, interview sessions were combined for the sake of accommodating the participants' schedule.

Dolbeare and Schuman (1982) suggested a 90-minute format for each of the interview sessions. This session length helps to prevent the typical clock watching that occurs in a traditional 60-minute format, but does not seem as long as a 120-minute session (Seidman, 2006). The recommended time between each of the sessions is at least three days and at most one week. This timeframe allows the participant to mull over the preceding interview, but is not enough time for the participant to lose the connection between the two sessions (Seidman, 2006). The window of time is considered ideal for securing the best results, but there is opportunity for alterations pending changes needed by the participants. The length of interviews can be tailored as well as the time between sessions. Also, all interviews were audio recorded. After all of the interviews were completed, I hired a professional to transcribe the audio-recorded interviews into text.

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Engaging in the interviews proved to be a unique experience for me, and also for some of the students, as they had never participated in a reflective process like this before. For some, engaging in an interview that required them to reflect on their life was somewhat challenging and appeared difficult. One participant had recently experienced the death of a younger brother, which continued to affect him emotionally and academically. Two participants recalled parents going through divorces, which impacted their academic performance. For others, they welcomed the opportunity to voice their story in order to allow their opinions to be memorialized. My history and experience as an educator allowed me the necessary tools to engage as a facilitator and to ask the leading questions that generated the most productive dialogue. At times, I even found it difficult to listen to the stories of some of the students, as some of them uncovered things that they had never previously spoken to another person. In these instances, the participants recounted cheating and the feeling of disappointment, as some of the students still carry the burden of letting down some family members. It was also a pleasure to witness the enlightenment of some of the students as they came to new realizations, just by participating in our dialogues. Two students thanked me at the conclusion of the interview sessions for allowing the opportunity to reflect, as they became more appreciative of their support systems and proud of their accomplishments thus far. The participants shared a wealth of information, and I knew that when it came time to analyze the data, I would have a

difficult task, as I feared not being able to accurately capture their stories or potentially omitting pertinent information. As a researcher, it was very important for me to balance my emotions and opinions and to be aware of my bias, which was discussed earlier in the chapter.

Observations

The third and final stage of data collection consisted of two observations that I made at organized study sessions that participants of this study attended. As discussed in the literature review, one of the affordances that encourage African American students to be successful is the organization of support groups and interaction with productive, like-minded peers. During the interview protocol, there was a question to determine what support groups, if any, each participant was affiliated with, both academically and socially. Although every student stated that their peers were instrumental in supporting their success at ASU, not every participant engaged in organized, collaborative study efforts. Several students relied on informal note sharing, or asking questions of their peers.

There were two students who explained that they openly engage in organized study sessions. Both of these students invited me to observe one of their student sessions, which was each organized in preparation for finals that were taking place at the end of the fall 2011 semester. While I was observing the study session, I intended to record the dynamics of the study group. My interests included the total number of participants, the number of males versus females, and the racial composition of the study groups. I was

also interested in the length of the study session and how the sessions were organized to facilitate productivity. The organization was interesting because a number of the participants in the study stressed that it was imperative to understand the most efficient way to study as a strategy for success. Also, as supported by the literature review, the success of African Americans in science can be accompanied by the support of motivated peers. I was very interested in the relationship among sex, race, and support. Many components went into obtaining observation data, and the interview protocols, sample questions, and consent forms utilized for the date collection are all included in the appendices section of this dissertation.

Confidentiality

Confidentiality was important to this investigation because it allowed the participants the ability to feel more comfortable sharing their personal stories. All of the participants' names have been changed to ensure confidentially. The names that appear throughout this dissertation are aliases that have been made up to replace the actual names of each individual. In addition, the names of schools have been changed to ensure confidentially, though all students did attend ASU. The files and transcriptions were stored on a password-protected computer.

<div align="center">

Research Participants

</div>

Eight participants were selected for this study. Of the eight participants, four were male students and four were female students. Of the four female students, two were selected from a low SES status, while the

other two were selected from middle or high SES status. Likewise, the male

participants had two participants from low SES backgrounds and two from

middle or high SES backgrounds. In the attempt to secure qualified

participants for the study, I experienced difficulty in finding such qualified

individuals. A recruitment survey (see Appendix A) was developed and

administered to identify those individuals who would meet the minimum

requirements for participation.

Overview of the Student Interview Participants

The data that has been collected as a product of the questionnaires,

interviews, and observations have been organized into individual participant

narratives. These narratives have been structured around the four emerging

themes that have been identified: parental support, financial support, peer

support, and teacher support. Table 4 provides background information

about each of the eight participants.

Table 4

Overview of the Eight Participants

Student Name	Classification	Major	Sex	SES status
Michelle	Sophomore	Biology	Female	Low
Marlon	Senior	Molecular Biology and Biotechnology	Male	Middle/High
Brenda	Sophomore	Biological Science	Female	Middle/High
John	Senior	Biological Science	Male	Low
Vanessa	Senior	Molecular Biology and Biotechnology	Female	Low

Michael	Senior	Chemistry	Male	Middle/High
Selena	Sophomore	Biological Sciences	Female	Middle/High
George	Junior	Biology	Male	Low

Measuring SES (Poverty)

One of the descriptors for each of the participants was SES. Measuring SES status remains a very difficult endeavor because there are several calculators and equations that have been used to determine the status of individuals. Typical measurements of SES include the factors of occupational prestige, income level, and level of education (Thomas & Hickey, 2005). For the purposes of this study, I have used the level of income and poverty statistics to determine class status. By using income level, I was able to use the measurement system for poverty as determined by the United States Census Bureau. The United States Census Bureau (2009) measured poverty by setting money income thresholds that vary according to family size and family composition. If a family's income is below the monetary threshold established by the government, then every member in that family is considered in poverty. Because college students cannot be measured for poverty on their own merit, I have used their family's information to determine if participating students come from families that are in poverty. The financial indicators that are used to determine the poverty threshold have been outlined are illustrated in Table 1. Once the family's income information was determined, students and their families were categorized as low, middle, or high class. According to the American Class model by Thomas

and Hickey (2005), high class is defined as households with incomes over $500,000 a year. The class model also determines that middle-class families have an income between $35,000 and $100,000 a year. Low-class families typically have household incomes below $16,000 a year.

Demographics and Figures

This investigation was executed in the state of Arizona. Additionally, the participants indicated in their respective interviews that they were educated in various school districts throughout the Phoenix metropolitan area. The intention of this section is to provide statistical information about the state of Arizona and some of the school districts that students identified as having attended during some point in their academic journey. Table 5 presents the demographic information for Arizona.

Table 5

Arizona Demographics

Arizona Population, 2010	6,392,017
White Persons, percent 2010	73%
Black Persons, percent 2010	4.1%
American Indian and Alaska Native Persons, percent 2010	4.6%
Asian Persons, percent 2010	2.8%
Native Hawaiian and Other Pacific Islander Persons, percent 2010	.2%
Persons reporting two or more races, percent 2010	3.4%
Persons of Hispanic or Latino origin,	29.6%

percent 2010	
White persons not Hispanic, percent 2010	57.8%

Note. Data derived from Population Estimates, American Community Survey, Census of Population and Housing, State and County Housing Unit Estimates, County Business Patterns, Nonemployer Statistics, Economic Census. From the U.S. Census Bureau: State and County QuickFacts.

One of the largest school districts, which service the Phoenix metro area, is

Phoenix Union High School District. Table 6 has information for the profile

for Phoenix Union High School District.

Table 6

School District Profile

Student Enrollment	26,311
Hispanic, Percent, 2011	78.9%
Anglo, Percent, 2011	5.6%
African American, Percent, 2011	9.4%
Native American, Percent, 2011	2.8%
Asian, Percent, 2011	2.4%

Note. Phoenix Union High School District website, data from 2011. include the website in the caption.

Data Analysis

Upon the completion of all of the interviews, I submitted the interview

audiotape files to a professional transcriptionist. After receiving the

completed transcriptions, I reviewed the tapes against the transcriptions to

ensure accuracy. After I had the opportunity to review the transcription, I

sent each of the participants the transcription their individual interview to check and ensure that the text was accurate from their perspectives. Using the barriers and affordances that were framed in the literature review, the coding system was used to discover what data from the interviews corresponded with the literature, was in opposition with the literature, or was completely new. When coding, I used the following procedure developed by Moustakas (1994) to analyze the data:

1. Listing and preliminary grouping: List every expression relevant to the experience.

2. Reduction and elimination: To determine the invariant constituents, test expressions for two requirements:

   a. Does it contain a moment of the experience that is a necessary and sufficient constituent for understanding it?

   b. It is possible to abstract and label it? If so, it is a horizon of the experience. Expressions not meeting the above requirements are eliminated. Overlapping, repetitive, and vague expressions are also eliminated or presented in more exact descriptive terms. The horizons that remain are the invariant constituents of the experiences.

3. Clustering and thematizing the invariant constituents: Cluster the invariant constituents of the experience that are related into a thematic label. The clustered and labeled constituents are the core themes of the experience.

4. Final identification of the invariant constituents and themes by application: Validation check: check the invariant constituents and their accompanying theme against the complete record of the participant.

   a. Are they expressed explicitly in the complete transcription?

   b. Are they compatible if not explicitly expressed?

   c. If they are not explicit or compatible, they are not relevant to the participant's experience and should be deleted.

5. Using the relevant, validation invariant constituents and themes: Construct for each participant and *individual textural description* of the experience. Include verbatim examples from the transcribed interview.

6. Construct for each participant an individual structural description of the experience based on the individual textural description and imaginative variation.

7. Construct for each participant a textural-structural description of the meanings and essences of the experience. Incorporate the invariant constituents and themes.

8. Synthesis and unification by developing a representation of all interviewees through descriptions of experience and meaning from individual interviews.

Through the procedure outlined here, the data was collected, transcribed, constructed, and then approved by the participant. The procedure helped

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produce material that would help answer the questions of this investigation, which was conducted to determine the barriers and affordances of African American students who are pursing science at ASU. The findings based on the data are presented in the following chapter.

Chapter 4

FINDINGS

This study was a qualitative investigation, which explored the barriers and affordances experienced by excelling African American undergraduate students pursing a degree in science at Arizona State University. Also, I investigated the ways the sex and socioeconomic status of the participants impacted the barriers and affordances encountered by these African American students. In this chapter, I will present the data. The data will include the narratives of the participants in the study, and how those narratives help to answer the research questions.

Emerging Themes

Data were collected from the participants through the recruitment survey, interviews, and observations. In compiling and coding the collected data, four major themes emerged. The themes included parental support, financial support, peer support, and teacher support. In the following, the four themes are described and are incorporated into narratives of each of the eight participants.

Parental Support

All of the students, with the exception of one, reported that their parents or guardian was instrumental in their success early on in their lives. Students recalled that their parents had always placed a premium on education, regardless of the personal financial situation or level of educational status of the parents or guardian. One participant explained:

My mom has always had very high expectations for me. She would

never let me slack off and was always concerned about how I

performed academically. She told me that it would be difficult as a

Black female, to do well, without a solid education.

For some, parents used monetary rewards as an incentive to encourage

academic success. As another participant recalled:

My dad glorified grades. Whenever I would come home with straight

A's, he would give me whatever I wanted. He bought me a cell phone,

clothes, a scooter, gave me money, all just for getting good grades. At

that point, I knew that good grades were what he was proud of.

For others, their parents' level of approval was paramount, and the focus on

achievement encouraged them to stay academically active. This sentiment

was demonstrated in the following quote:

[Dad] was pretty hard on me when it came to education and grades, so

I feel like he would push me a lot. When I did not perform, he would

be extremely disappointed, and would question if I was his son.

Throughout the interviews, it became obvious that all of the participants

were grateful for the sacrifices and decisions that their parents made, even

though they did not always understand the logic or rationale for their

parents' choices when important academic decisions were being made.

According to one participant's experience:

[My Parents] always wanted me to do what I wanted to do. I think

before I really realized it, my parents were trying to push me into

places that would help get me where I wanted to go because even now

I realize that shipping me out to Ahwatukee to go to school, like, that

was benefitting for me.

This quotation, and others, demonstrates the various ways in which the

emergent theme of parental support was present in the interviews.

Financial Support

Financial support was another theme that emerged from the

interviews. Six of the eight participants in the study received full

scholarships, which cover the cost of their tuition. As one of the six

participants who received a full scholarship explained:

One hundred percent of my tuition is covered because of my

scholarships. I only worked to earn pocket change to support my extra

curricular activities. My job is an on-campus job, so I do not have to

worry about going when my school schedule becomes too demanding.

The other two students who did not have full scholarships had parents that

paid for their tuition in full. Not having to worry about financing their

education has been an extremely important affordance for the students that

participated in the study. One of the students whose parents paid for tuition

said during the interview: "I don't have to work. My mom makes good

enough money to take care of my tuition. But I work to have extra-curricular

spending." Even though the students' tuition has been covered, most of them

work part-time jobs because they are accustomed to having to work. The

flexibility of not having to work provides the additional time, when needed, to focus on academics as they pursue their degrees.

Even though all eight of the students reported scholarships or financially able parents who covered the cost of their tuition, two of students still found it a barrier to have to worry about the rising cost in tuition and living expenses. With annual tuition increases, some students are not able to make the scholarship money last as long, and this creates a situation where students have the burden of working as a necessity as opposed to as a luxury. One participant expressed this clearly:

> One thing that I am constantly concerned about is the rising cost of tuition. I am trying to hurry and graduate because each year the tuition increases, and soon my scholarships will not be able to cover all of my expenses. At that point, I will have to work to cover whatever my scholarship won't pay for. I am worried about that because then I will have to work, and will no longer have the option of not going in [to work] when I have a lot of school work to maintain.

Students reported that time at work is time that is not being used for studying, and having the luxury of not working during more challenging semesters has always been very beneficial. Losing this flexibility could have a dramatic impact on class success and GPA.

Peer Support

Yet another theme that emerged from the interviews and data collected was the theme of a peer support system. All the students reported

that it had been extremely important to surround themselves with focused, like-minded, determined peers. As one participant reflected, "I have peers that are good role models for me just because they are people that are super focused, you know, super motivated, and people that get things done." The association of peers who share the same academic major and scholastic goals has been identified as one of the more important affordances that these participants have experienced. For example, one participant commented:

> I am one of the few people that actually enjoys studying in a group so I find that having the cohort system to be a key part of that. Just having like-minded individuals who are passionate about like what you are studying, and willing to put in twelve-hour study sessions is the key.

Regardless of ethnicity or sex, determined peers were a consistent variable in the lives of each of the participants. Academically, pursuing a degree in science is a very demanding and sometimes daunting task, but finding individuals who are pursing this same goal appears to encourage success. Once participant explained that there is a close relationship between people who study together and support each other academically and that the "[Study partners] are all very cool and tight." The same participant went on to assert that, "Going through this major together makes it easier because we know that at the end of the day we have each other for support." In ways such as these and many others, peer support emerged as a theme present in the data.

Teacher Support

The majority of the students who participated in the interviews recalled having extremely supportive teachers throughout their academic experiences. These teachers were the individuals who encouraged them to go on to college, and were also the individuals who exposed them to the field of science, which would eventually lead to their selection of a science major in college. During one interview, a participant explained:

> I really got close to my biology and chemistry teacher. She was the one that actually really made me want to do [science] because she made her class so interesting. She was really the one to support and encourage me to pursue science.

For two students, supportive teachers have been the only constant in their life, while at home they experienced divorce, deaths, and other unfortunate events. During the interview session, one student said, "Mr. G. was my Physics teacher. . . . He was the only person that I ever had for Physics, and I love it. I learned everything from him. I could talk to him about anything, like personal stuff." For three students, supportive teachers were the individuals who guided the students through the steps necessary for entrance into college because they were the first in their families to attend.

Teacher support is an impressive affordance, whereas lack of teacher support can be an impactful barrier. While in attendance at Arizona State University, two students reported the quality of professors as a barrier that hindered their academic growth. One male student stated that it was difficult for him to do well when the professors are not engaging. He realized the

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relationship between his academic achievement and interest level. As he put it in his own words when asked about barriers, "Barriers? . . . my professors. If my teacher sucks, it's hard for me to work and get a good grade." Another student stated that she objected to the teaching practices of some of her professors, stating that it was "difficult to gauge your content knowledge when professors fail to provide adequate feedback and curve assessments." Teacher support emerged as a theme, both in terms of the teacher support as an affordance, and lack of teacher support as a barrier.

Individual Participant Profiles

The following provides a narrative for each of the eight participants. The narratives serve as qualitative data and were created to articulate the relationships between each of the four emerging themes of parental support, financial support, peer support, and teacher support. Each section begins with a poignant quote from the participant. The sections then provide the narrative as well as a discussion of how what the participants reported ties to each emergent theme. Background and personal information is given for each student to provide a context and reference point. The names used in the narratives are pseudonyms to protect the anonymity of the participants.

Michelle's Story

" I didn't realize how big race was until actually I got to middle school and high school where people were constantly picking that out, especially about me, like being bi-racial and stuff."

At the time of her interviews, Michelle, a sophomore undergraduate student, was pursuing a degree in biology. Michelle maintained a GPA above 3.0 while working part time and living off campus. Michelle was raised by her mother, and still continues to have a less-than-healthy relationship with her biological father. Michelle's father never attended college and did not finish high school. Her father and mother never married, and her father was absent the majority of her life. Her mother struggled to make ends meet financially while supporting her two daughters, and she eventually pursued a career in nursing. Michelle, her mom, and younger sister were considered to be low SES.

Michelle was my first participant (not including the students who were involved in the pilot study), so navigating through our interviews proved to be a learning experience for me, and a reflective opportunity for her. Growing up, Michelle spent the first 10 years of her life moving from place to place. During her travels, she recalled always being behind as a student. As Michelle recalled, "I know whenever I went to school in Tucson and then whenever I moved to Phoenix, well Ahwatukee, and went to school I was behind." Eventually, with the aid from family and teachers, Michelle began to excel academically, which allowed her to become a successful science major.

Parental Support

Prior to entering Arizona State University, Michelle was strongly supported by the high expectations of her mother. Michelle's mother always demanded the best of Michelle, and encouraged her to consider an education

in science. Michelle's mother also stressed the importance of hard work and dedication, which is ultimately needed as an African American pursing an education in a science field. What follows is a large excerpt from Michelle's interview that demonstrates her mother's impact on her academic career and success.

> My mom, she's hardcore. She's very . . . she always stresses how important it is for me to do well in school. Her thing is, is that because you're African American, opportunities aren't always going to be as readily available because we have to work twice as hard to get what we want . . . because a lot of times it's not what you know, sometimes it's, like, next to you, like, who you know, and even when you're sometimes like being African American versus when you're in say, like, a White family whose family members all have those connections because they all went to college and they all know people or they have well-established careers so kind of making, getting those connections is easier for them whereas, like, I'm the first one to go to university in my family . . . with the exception of my uncle, but, like, I'm the first one to go to college on both sides of my family. I don't really know . . . other than that . . . so my mom is like, it is really important for me to go to college. And now that I am in college I do see how, like, what she was saying . . . and now that I realize, like, how hard it is to even just, like, support yourself with waitressing, like, I couldn't even imagine that . . . like, that, not going to college, and that being the only thing I

can do is having a minimum wage job or a job that doesn't require

college.

The unwavering support and high expectations of her mother remains an important affordance as Michelle continued her education.

Financial Support

As an Arizona State University student, Michelle identified that earning numerous scholarships had been a very important affordance, which has supported her academic success. Considering that Michelle came from a low SES background, it was extremely important for her to find financial support prior to entering college. Because Michelle was academically consistent with high grades in high school, she qualified for scholarships, which have covered the cost of her tuition as an Arizona State University student. Now that tuition is constantly rising, Michelle is starting to feel the strain and pressure of having to work to cover increasing expenses.

Peer Support

As a young student, Michelle struggled to find supportive and like-minded, academically motivated peers. Peer support was missing from her academic journey, prior to entering Arizona State University. As Arizona State University student, she was actively working on developing more meaningful and supportive relationships with her peers, and at the time of this study she stated that peer support was "a work in progress."

Teacher Support

Growing up, Michelle always had good and strong relationships with her teachers. She also explained that the reason for some of her success now is because of the hard work and influence of several teachers that she had as a younger student. As she recalls:

> Early on, in middle school, I was behind, but I caught up and, like, actually got ahead the next year because I had a teacher really sit down and focus on like subjects with me. And that was when I really began to, like, excel in math subjects. I didn't really get into the sciences until high school when I had Ms. Winslow because she was very thorough in teaching subjects, especially, like, making sure we memorized things. I liked her teaching style, I really liked biology.

By the time Michelle reached high school, she had enrolled in an urban high school that was predominately African American and Mexican. Here she stated that she was not really prepared to move on to college, and, as a college sophomore, she wished she had a more rigorous experience because she felt that she would have been in a better place academically.

> Academically [in high school], I could have done better. Academically, I honestly wish I went to a high school other than Majestic High School because I probably would have been a lot better off than I am now. I feel like, academically, I am disappointed in the education I received because even whenever I reached, like, my sophomore or junior year, I wanted to get out of Majestic High.

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Even though Michelle was not consistently challenged as a student, whenever she was challenged, she rose to the occasion. For example, Michelle exceeded on all parts of the AIMS[1] state assessment, which is a statewide assessment that all high school students must pass to graduate. Michelle even admitted that while growing up, her biggest obstacle was not academic, but instead social. In her words:

> [The obstacles] were mostly like social stuff that I dealt with. I don't know, I tend to be an insecure person and so, like, anything anyone says to me, like, bothered me probably way more than it would bother other people so I feel like if that was anything that was like a barrier or obstacle going through in K-12 that wasn't anything academic.

Michelle discussed issues with social interactions and introversion, but, for Michelle, the emergent theme of teacher support was indeed an affordance.

Conclusion

As an Arizona State University student, Michelle's biggest support systems were her mother and her academic advisor. As an honor student, she had access to special advising, which fostered her growth and maturity as a college student. Michelle believed that African American people fall prey to living up to existing stereotypes, and this prevents them from moving forward with exposure in science. According to Michelle:

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[1] Arizona Instrument to Measure Standards

I feel like [African Americans] have like this screwed up image of what it means to be African American and so they do . . . they act . . . they let their surroundings mold who they are . . . or what they think is right when it is not.

She believed that the government should place more of a premium on education, and create access opportunities for additional resources. As she put it:

I feel like money that is being spent government wise needs to be spent more wisely. I mean they cut all of our education . . . and I feel like if anything, that's the one thing that is most important, especially at a young age.

At the time this study was conducted, Michelle was continuing with her major in biology, but constantly struggled with the reality of whether or not she was cut out for the course of study. She oftentimes felt isolated and intimidated because she is a minority, but she continued to actively persist towards graduation.

Marlon's Story

"After being mediocre in junior high, I really thought I wanted to do better, both academically and just overall life."

At the time of his interviews, Marlon was a senior undergraduate student pursing his degree in molecular bioscience and biotechnology. Marlon's parents are from Africa, but he was born in the United States. He stated that he identifies as African American because he was born and raised

in the United States. He spent the early parts of his life being raised and educated in Hawaii before he eventually moved to Arizona in the fifth grade. Once he moved to Arizona, he noticed a slip in his grades due to the different teaching methods employed in Arizona versus the very strict practices that he was accustom to in Hawaii. Marlon was raised as an only child, and has always been supported by the high expectations of his parents, who would be categorized as a middle class family based on the details reported on the recruitment survey.

Parental Support

Marlon has always been supported by the high expectations of his parents, who helped to fuel his drive to succeed beyond high school. Marlon explained:

> My dad was, because he grew up in a pretty strict family himself in Africa, he was pretty hard on me when it came to education and grades, so I feel like he would push me a lot. Like, I don't know if this is a great thing, but if I were to make a mistake or, like, if my paper wasn't up to par with his expectations, he would question if I was his son, he would be extremely disappointed and I would be, like, ahh, and I would try to get back on "son" status with him.

Because Marlon was enrolled in mostly advanced placement (AP) courses in high school, he explained that he experienced a fairly rigorous education, which he felt adequately prepared him for college. After being pushed by

parents and his academic counselor, Marlon decided to attend Arizona State University.

Financial Support

As a result of Marlon's hard work and commitment to academics in high school, he received several scholarships to help fund his college experience. At the time the study was conducted, Marlon did not have to finance any part of his education. Marlon made the decision to attend Arizona State University because they offered him the more funding for his education than University of Arizona, which was the other school that he was initially considering. Because finances were not an issue for Marlon, he did not have to worry about constantly working. Not having to worry about working afforded Marlon the time needed to focus on school and maintain his level of performance.

One of the obstacles that Marlon identified was the increase in tuition fees. Although he received numerous scholarships and grants, Marlon expressed fears that if the cost of school continued to increase, then he might have to seek employment. If he were to get a job, his time spent at work could distract from his education and negatively affect his academic success. Concurrent to the study, his scholarships and grants covered all of his expenses, but if another increase in tuition were to occur, then he would have a remaining balance to pay for every semester.

Peer Support

Once Marlon made the transition to Arizona from Hawaii, he recalled attending schools that were predominately Caucasian. He recalled:

Getting used to being one of the few African Americans in class. At first [being one of the only African American students] gets to you and then you learn to, like, roll with the punches, so to speak, and then, like, kind of play with it and then just turn it around and then play it off.

Initially, he experienced a significant culture shock, which he went so far as to describe it as an obstacle. He also discussed how he perceived his peers' reception of his enrollment in high school AP courses. As Marlon put it, "I'd have to say that they didn't really think highly of African Americans so to be in there you must at least know a lot . . . so they had higher expectations of me." In some ways, the high expectation of his classmates functioned as an unintentional peer support.

After navigating through his middle and high school career, Marlon developed the ability to connect with peers. While attending Arizona State University, he sought out like-minded, motivated students who had the same major and who would eventually become a support system for Marlon and for each other. Marlon spoke about his molecular bioscience and biotechnology (MBB) cohort specifically:

Our major, MBB, is pretty small, there are not a lot of us and we tend to move as a group, a very strong group. We study together. We take

mostly the same classes, so it's just, if we have an exam I know we

always convene and like we'll study together.

After discussing the importance of his peers, Marlon invited me to visit and

observe a study sessions including him and his peers. The opportunity to

attend a study session allowed me to gather some data regarding the

interactions between like-minded, supportive students.

The day after our interview, Marlon informed me that his regularly

scheduled study partners were meeting for a study session and he invited me

to attend to make observations. The study session was set for 5:30 PM, and

located in a conference room that was reserved on the second floor of the

Memorial Union on the campus of Arizona State University. The conference

room had one dry-erase whiteboard and 12 chairs. Marlon informed me that

this particular study group usually met once every other week, but this

particular session was going to focus on preparing for the final exam. The

students were enrolled in a General Genetics course. I was also told that the

students had a study guide, and they were supposed to come to the session

with as many of the problems worked out as possible. They were also

supposed to come prepared to the session with specific questions regarding

the problems that they could not work out. I met Marlon at 5:15 PM at the

Memorial Union, and by 5:45 PM, nine students were in attendance for the

study session. Of the nine students, six were males and three were females.

Marlon was the only African American male, and there was one African

American female, who was one of the participants in the study. The rest of the students were Caucasian.

At the beginning of the session, the students each shared the problems they were able to successfully navigate, and then shared the problems they had difficulty figuring out. The group then spent time working together through the problems that the majority struggled with while the few students that understood took the lead in explaining the solutions and process of determining answers. The session proceeded and it took two hours to complete the initial set of problems. At 7:45 PM, the students broke up into two smaller groups to work through the remaining problems and questions that they shared. Again, the leadership roles were shared throughout the group, as no one individual emerged to have every answer, and they truly relied on the knowledge of the collective body to navigate through their study guide. At roughly 9:00 PM, the study session ended and the students departed from the Memorial Union. Several students made additional arrangements to meet up later in the week to continue to prepare for the final exam.

The interactions and experiences observed in the study session further supported the idea proposed in the literature review: that a strong set of like-minded peers is a valuable affordance for excelling African American students who are pursing science. It is also interesting to note that, regardless of gender and race, like-minded, and determined individuals can be a very good support system for those pursing degrees in science.

Teacher Support

Marlon described his performance early in his academic career as being just average. He went through a transitional phase after his family moved to Arizona from Hawaii. In Hawaii, most of his instructors were Japanese, and there was a very high level of expectation that he just did not encounter once he moved to Arizona. Marlon explained further:

So everything was good [living in Hawaii], and then, apparently we had to move to Arizona, so that's when I started going to school here and I noticed that my grades started to drop a bit. So, they weren't the same. And I'm not sure whether, like, it was just the atmosphere or the teachers but the teachers in Hawaii were definitely more strict.

Due to the lower expectations, he recalled falling into a series of academic slumps that were further perpetuated in high school when his parents got a divorce. In Marlon's reflection, he said that "My grades did slip a bit sophomore year and junior year of high school but that was because, I think, my parents were going through a divorce at that time so there was that whole fighting situation." Early on, Marlon really did not have any strong relationships with his teachers, nor did he have any supportive relationships with his peers. As an Arizona State University student, Marlon really did not interact with most of his instructors, but he eventually developed a very supportive relationship with his mentor teacher.

Conclusion

As an excelling student, Marlon has identified that it is important for him to compartmentalize the different aspects of his life. Marlon went on to explain:

> Separating school from social life. Like, here in the lab I tend to . . . I like to focus on academics and then so that when I go home it's my time, so, like, compartmentalizing to my life provides like some structure and organization as well as just having a core group of people that have the same interests and the same classes enable you to study and like relate better.

Marlon believe that predefined stereotypes prevented more African American students from pursing science, and also felt that increase amounts of early exposure could be one possible solution to help encourage more students to become involved in the field. In Marlon's opinion:

> I guess, other than just exposing them more to the interesting parts of science, just initially to get their attention, because there's more to science than just like explosions or like discovering viruses and stuff. There's, like, the work in between but I think early on, just capturing their imagination, like, with crazy stuff that they won't be able to work with for a while but just, like, you know something to get their attention, I think. Exposing them to that would be a key.

As a result of this belief that African American students should have science exposure, Marlon attributed some of the success that he experienced to being exposed to science as a young child.

Brenda's Story

"I know there were situations where the Blacks were, or the African Americans
were, kind of stereotyped and picked on. I had a situation like that in high
school and in middle school where I was in the office every day, and I never was
a bad student."

At the time of her interviews, Brenda, a sophomore undergraduate
student, was pursing her degree in biological sciences (animal physiology
and behavior), while working part time and living off of campus. Brenda was
excelling academically with a GPA over 3.0. Both her mother and father
raised Brenda and her family had a middle-class SES based on the details she
reported on the recruitment survey. Both Brenda's parents are college
graduates and she came from a household filled with high academic
expectations and support.

One thing that became immediately apparent during the interview
process was that Brenda was a very determined and focused young lady.
Since as early as she can remember, she always wanted to pursue a career in
science. As a young child, Brenda recalled watching surgeries and health
shows on the Discovery Channel during her spare time for entertainment.
Exposing herself to such things demonstrated her determination, and she
was her own biggest motivator and developed a very specific blueprint for
her academic trajectory. She admitted that her biggest barrier growing up
was the lack of college-level science courses that she had exposure to in high

school. Her major regret was not earning more college credit during her high school years. As she explained:

I came [to ASU] with some credits, like, maybe a semester's worth, but if I would have been, like, a year done or something . . . I don't know, I want to be done faster because I have such a long way to go.

Brenda chose to attend Arizona State University because she wanted to remain close to her support system, which included her parents and boyfriend who live in the Phoenix area. As an undergraduate student, Brenda had not developed any lasting relationships with her professors, and does not interact with her peers. She stated that because she is independently motivated and determined, she excels by herself, and prefers the challenge of figuring things out without assistance.

Parental Support

Despite being raised in South Phoenix, an urban area well known for having a concentration of minority families, Brenda was always bused to schools in Ahwatukee, a predominately Caucasian part of Phoenix. Even against Brenda's wishes, her parents shipped her out of her neighborhood because they placed a premium on education and wanted the best experiences for her during her formative years. Ahwatukee had opportunities for better educational and formative experiences. In the interview, Brenda reported:

I think before I really realized it, my parents were trying to push me into places that would help me get where I wanted to go because even

now I realize shipping me out to Ahwatukee to go to school, like, that

was benefiting me. Because I feel like I got a lot more exposure, I got a

lot more, you know, teaching and opportunities out there than I would

have somewhere else. And then you know pushing me to go when I

didn't want to go.

After attending elementary and middle school in Ahwatukee, Brenda

eventually returned to inner-city Phoenix to attend high school.

Financial Support

Because of her aptitude and dedication in high school, Brenda earned

numerous scholarships, which covered the cost of her education at Arizona

State University. Brenda still chose to work part time to help cover her

personal expenses. Brenda's part-time job allowed her to work from home as

a customer service representative. The job allowed the flexibility of working

from home while providing additional monetary support. Brenda had the

ability to adjust her schedule as needed, which helped to support her

education when she became overwhelmed with her academic requirements.

Peer Support

Several times during our interviews, Brenda consistently delivered

the message that she is a very motivated individual who works well alone.

She recalled having friends throughout her life, but even as a successful

college student, she did not rely on peers or friends for support. Brenda was

resolved to succeed and figure things out without the assistance of

instructors or peers. As a teen, Brenda always had a network of friends, but she stated that they were merely used for social purposes and not academic.

Teacher Support

Throughout her education, Brenda encountered teachers who she liked, but she never developed any strong bonds with her teachers. She remained grateful for the teachers' persistence, which helped to make her the determined individual she is today. She is very proud of the science education that she received prior to entering Arizona State University, and attributed her collegiate success to her strong educational background. During the interview, she explained in her own words that, "I think that my high school science education was, like, amazing because I'm doing labs in college now that I did in high school." She went on to explain "You know, so I just fell in love with [Anatomy] . . . I really think I had a really good science education, specifically in high school." During the interview, it became clear that the schools Brenda attended prior to Arizona State University were predominately Caucasian, and there were few, if any, African American instructors that she interacted with. In fact, Brenda discussed the realization of just how few African American instructors were part of her academic career: "I know for sure I didn't have any black teachers, I personally didn't have any black teachers at. . . . I'm trying to think if there were any black teachers. I don't even remember there being any black teachers at all." As far as the rest of the student population, Brenda was "in Ahwatukee and I was black and I was one of the few, you know pepper grains in the salt-shaker."

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Conclusion

As a successful undergraduate student, Brenda's biggest support system has been her ability to remain determined and motivated independently of what was going on in the world around her. Her biggest barrier as a college student was dealing with the routine of college, or, as she put it: "my biggest obstacle right now, is getting up and going to class, to lectures." As an excelling African American student who is pursing a degree in science, she determined that the strategy of taking multiple science classes at once has encouraged her success. She stated that there are natural overlapping opportunities within the science courses, and this schedule allowed the natural support that she needed

In the effort of getting more African Americans involved in science, she feels that encouragement is needed. From her perspective, the African American community views the sciences as a "taboo area because they feel as if they can't engage because it is extremely difficult." She had several ideas, including the following: "I think that encouragement with help, and mentorship, would help them (African Americans) become more comfortable with saying okay, I want to go into a science field." Brenda believed that encouragement and exposure is the answer to filling the existing voids of African American students and women.

John's Story

"I hang out with a lot of White people because I'm in the honors college, and then they want to start saying things like, oh you're the Whitest black person I

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know. Just because I speak to you in a way you can understand doesn't mean

that I am any less Black than this dude on the football team over here, you

know?"

At the time of his interviews, John, a senior undergraduate student, was pursing his degree in biological sciences. John came from a two-parent household that fell into a low SES class, and he grew up with his younger sibling. Initially from the outskirts of Detroit, Michigan, John spent the majority of his young, formative years being educated in private and charter schools. His parents placed a premium on education and made the necessary sacrifices to send both him and his brother to the best schools, which included busing them out of their local neighborhoods. Because John excelled academically in high school, he was eventually accepted into Barrett's, The Honor College at Arizona State University.

Parental Support

Even though John never truly excelled early on in his academics, his parents pushed and supported his academic career beyond graduating from high school. In the interview, John explained:

> I feel like my parents gave me a really big head start. And they really
>
> put in my mind at a really young age that education was super
>
> important. They would tell me that I am smart, you're going to go to
>
> school, don't try and start hooping or anything. You're not going to be
>
> Michael Jordan you know, don't start trying to do that, like, don't start

thinking that you're going to be a rapper, don't start thinking you are

going to do all this foolishness.

When he reflected on his path to college, John remembered that his parents

were extremely instrumental is setting him up for success. When John spoke

more on the project, he said: "As far as coming into college, I feel like my

parents gave me a really big head start. And they really put in my mind at a

really young age that education was super important." His parents refused to

accept anything less the than the best from him, and always encouraged him

to strive for academic excellence.

Financial Support

John was fortunate enough to earn a scholarship, so he has few

financial responsibilities related to paying for college. Eventually, after

becoming more focused and discovering his niche within science, John

performed well on the PSAT in high school and earned a full scholarship to

Arizona State University, which is why he chose to attend. Even though he

has scholarships, he still works part time on campus to help cover some of

his personal expenses, so that he doesn't have to rely on his parents for any

monetary support. His on-campus job allows him the flexibility to adjust his

schedule at the points of the semester when his classes are demanding so

that he can shift his focus from work to school.

Peer Support

As a young student in middle school, John stated that he never put

forth an incredible amount of effort into his academics, and he claimed that

he only did enough to get by. He stated that because he was usually the only

African American in his class and that he never wanted to look like the smart,

nerdy black kid. Instead, he wanted to just fit in. Then, as a student at Arizona

State University, John never developed any noteworthy relationships with

professors. He did, however, discover that it was important to surround

oneself with like-minded, motivated students. When he was accepted into the

Barrett, The Honors College, this ensured he would indeed be surrounded by

a strong, peer-support system. John went on to say:

> I have some peers that are good role models for me just because
>
> they're people that are super focused, you know, super motivated and
>
> people that get things done and, you know, are always brainstorming
>
> ideas, new things and aren't just people that are kind of sitting
>
> around, you know, doing the same old thing, watching TV and wanting
>
> to just chill all the time, but there are people that are actually out
>
> going, you know what I mean and that's something that has really
>
> helped me out.

Even as an Arizona State University student, John still found it difficult to

navigate through a university where he remains a minority and stated that

being the only African American in a class can still be an uncomfortable

situation. John described what it was like to experience certain situations in a

class with peers of a different race:

> I remember being in a class where the topic was slavery, and I was
>
> just sitting there listening to what people were saying and I wanted to

say some crazy stuff, it wasn't crazy but I was, at certain points I

would get kind of upset and just wanted to just go off on people but,

you know, I'm not about to just be that crazy black guy in the corner of

the class that doesn't really say much.

John appeared to be a very motivated student and stated that when he spoke

with his old high school friends, they were still doing the same, dead-end

jobs. He is reminded of how much he wants to be successful in the future.

John's desire to succeed is a large part of the motivation that keeps him

focused when things get tough.

Teacher Support

Growing up, John never really had any particular teacher that stood

out, but he remembered that he had always had a passion for science. In

addition, he recalled that, while being the only African American student at

times, within his school, he encountered unjust treatment by some of his

former teachers, such as condescending interactions and lower expectations.

In this case, teacher support could have been a barrier to motivation and

ultimate success.

Conclusion

John had strong parental support and financial support as he pursued

his science degree at Arizona State University. He had several ideas about

how to engage more African Americans in the science field. John believed

that African American students needed to understand that it is cool to be

smart. He mentioned that there were stigmas that existed in African

American communities, and he felt that these stigmas prevented African American students from pursing science as a result.

Vanessa's Story

"I honestly think that if [high school] students had, like, exposure to the lab that I got exposure to in college, more people would think science is really fun."

At the time of her interviews, Vanessa, a senior undergraduate student, was pursing her degree in molecular biosciences and biotechnology. Vanessa was employed on campus as a part-time tutor and was maintaining a GPA over 3.0. Vanessa was raised by both her mother and father and grew up with two siblings. Considering their background and based on the information reported on the recruitment questionnaire, Vanessa's family was categorized as being in a low SES class. Vanessa's father is a college graduate, while her mother only attended some college.

During Vanessa's early formative years, it was commonplace for Vanessa to attend, very small, predominately all-Caucasian schools. The high school that she attended was a small charter program that focused on the arts. Unsure of what she wanted to pursue after high school, Vanessa decided to attend the art program because she had an older sister who had previously attended. During the interview, Vanessa explained:

> Well I went to a charter school. It was pretty small. It was an art school so I actually didn't get very much of a science education at all. . . . It wasn't a very good school at all but I ended up taking chemistry."

She reflected on her academic experience, and identified that she really did not get a rigorous education at the charter program, and especially recognized that she was not adequately prepared in science.

Parental Support

Even though Vanessa was not challenged at school, she always encountered high expectations from her parents. As she explained in the interview:

I didn't feel like I was really challenged that much in high school. So I think that if I didn't have my parents there to sort of like expect more from me, I probably, like a lot of my friends, not end up going to college.

She recalled being motivated to perform academically because she would receive report card money from her father. In addition to the monetary incentive, she never wanted to disappoint her parents. As a high school student, Vanessa recalled being very uptight, quiet, and studious, which accounted for her graduating third in her class, which is something that she is very proud to have accomplished. Vanessa identified her parents as being extremely influential for her success as a young child and determined that her lack of academic preparation was an obstacle that she had to overcome when transitioning to college.

Financial Support

Vanessa made the decision to attend Arizona State University because she was offered the most funding by the program. As a result, she does not

have to pay any money out of pocket to cover the expenses of attending

college. As mentioned, Vanessa works a part-time job on campus. She only

works because, having worked since the age of sixteen, she is accustomed to

a job being part of her life. Not having to worry about finances has

undoubtedly been one major affordance that Vanessa experienced while in

attendance at Arizona State University.

Peer Support

Vanessa admits that, even early in her childhood, she was very quiet

and did not relate much with her peers. As a college student, however, she

has developed some very important relationships with the students in her

major. These relationships continue to be a very important support system

that encourages her academic success. Regarding her peers, Vanessa

conveyed the following sentiments:

They are all really cool. I feel like we are all friends, like all the

students in my lab and the students, I pretty much know all the MBB

students. Like, Marlon, he's one of them too. He's actually in my lab

and in a few of my classes. Because I tutor, people come in, I'll get to

know them because I'll be there every day. I think I'm kind of chatty

sometimes. I think . . . I don't know . . . I get along with people pretty

well. In our lab it's pretty independent so I have, you know, a goal and

I kind of set my own pace. That's really good because I have such a

busy schedule . . . and sometimes there will be other students working

in the lab, sometimes there wouldn't be. I get along with everyone

> pretty well. I think at this stage, because of all the students in my
>
> classes are also seniors and they are kind of, like, goal oriented, I feel
>
> like we have more in common, maybe we have the same ideals or
>
> goals so that we kind of, like, are on the same page or maybe like . . .
>
> versus sort of, like, losing things in common with friends that still
>
> never went to college. But everyone is pretty cool. I don't really talk
>
> about science with that many of my friends, even when I work in lab
>
> we joke about other things. It's pretty laid back.

These close-knit, friendly relationships have become very commonplace for
Vanessa as a senior MBB major.

Teacher Support

At the early stages of her college career, Vanessa did not spend a lot
of time interacting with teachers or peers, because she was attempting to
discover her niche within the Arizona State University community. After
Vanessa decided on her current major, MBB, she developed a tremendous
support system that included both her professors and peers. Because her
program is extremely small, almost a cohort-style program, the level of
support and familiarity between peers and faculty was tremendous, which
provided a distinct support and advantage when compared to other students
who have to navigate their college career without continuous support.
Vanessa explained her experience with teachers:

> I feel like all of the MBB professors, because the class size is a little bit
>
> smaller, are a lot more personal, and I actually just go to any of them

fore advice. . . . They are really personable, I feel like I don't really have any problems, like, going up and asking them questions. So there are, like, three science professors I talk to for advice.

Vanessa stated that she faced one reoccurring obstacle: the fact that a lot of the professors curve their classes. With the curve, Vanessa stated that she finds it difficult to really gauge how much information she truly knows.

Conclusion

While growing up, Vanessa attended programs that lacked diversity. In addition, Vanessa testified that she never encountered tracking, and was always accepted by peers and teachers. Initially, Vanessa had no idea about what major she wanted to pursue. As a result, she switched her major several times. When Vanessa experienced her first biology course at Arizona State University and became engaged in laboratory investigations, she realized how interested she was in the sciences. Eventually, once she decided on science, she realized how unprepared she was for the material as a result of her deficient high school experience.

Vanessa felt as if African American students could significantly benefit from exposure to science early in their academic careers. She believed that, without exposure to the discipline, African American students do not have the chance to adequately understand the opportunities that exist with a career in science. Vanessa elaborated:

I think if people, if Black and other minorities were afforded

opportunities to maybe even get out of, like, household situations that

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might be holding them down, like with programs, extra-curricular,

things, like, that could really expose them to what else there is out

there that could really broaden their minds and what is possible for

them.

Vanessa also believed that teachers were crucial in developing exposure

opportunities for young African American students. With quality teachers,

African American students can get the necessary encouragement and

exposure.

Michael's Story

"I can count the number of Black people that I went to school with, all the way

through high school."

At the time of his interviews, Michael, a senior undergraduate student,

was pursuing his degree in chemistry. Michael was raised by a single mother

in California and grew up as an only child. As a registered nurse, Michael's

mother, with the support of his grandmother, always exposed Michael to the

possibilities of getting a solid education by enrolling him in the best schools

in California. Michael's family would be considered middle class, based on the

response on the initial recruitment survey.

Parental Support

While growing up, Michael remembered struggling academically, and

admitted that he really did not get serious about his education until he

reached college. As a young student, Michael recalled his mother and

grandmother pushing him to strive for the best in terms of academics. His

mother supported his education by always enrolling him in some of the best schools in California, which happened to be predominately Caucasian. Michael had always been interested in science because his mother encouraged him to pursue the field when he was a young boy. He admitted that, his personal goal was to be a part of discovering the solutions or remedies for problems that humankind face.

Financial Support

Michael stated that his mother was financially stable, and that she paid for 100% of his tuition. Michael went on to explain that he wanted to focus on school and perform well because his mother was paying for his education. Michael worked off campus to help offset some of his college expenses so that he did not have to rely on his mother for full financial support. He remained appreciative of her help, but also wanted to be a contributor to his education. In addition, Michael admitted that he did not want to struggle once he became an independent adult. This desire and consideration of his adulthood truly fueled his motivation to be successful in school.

Peer Support

Michael admitted that it was always very difficult attending school because there were not a lot of African American students. Oftentimes, his mother used fake addresses to make him eligible to enroll in the excelling schools in the area. Though the schools were excellent in terms of academic, they lacked diversity. This created a cultural isolation for Michael. Perhaps

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due to the lack of supportive peers that he encountered, he never really

persevered academically. Instead, Michael claimed he did just enough to get

by.

Michael recounted that, as a young kid, it was difficult to attend school

where the people where so different than he was. He explained further:

Socially, I just . . . not to say that I didn't get along with my friends that

are not black or African American, but it's kind of different when you

go to school every day and you're surrounded by these White people

and going to classes and they're living in really affluent areas. I lived in

Rancho Cucamonga, which is probably, like, one of the biggest

suburbs in California . . . so, I go to school and these people are making

$500,000 a year and live in these big old houses on the mountains and

coming down and I'm seeing the Blacks that I'm hanging out with, I

mean, we go to school all day with White people but then, you know,

as African Americans during free time we're hanging out with each

other, so we're all going back down and we're going to our

apartments. So, I mean, socially that was kind of a challenge. It was

kind of awkward to see, like, okay, well are we in the same playing

field as these people because, I mean, we're not making all the money,

I mean, I would say . . . I can count . . . like, we, me and my friends

would have conversations, like, "Oh well, these people have all this

money, all they have to do is . . . all they have to worry about is school.

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They don't have to worry about anything else. When I was in high

school we'd have to work after our sophomore year.

For Michael, navigating relationships with his peers was complicated

because of how he was positioned between two economically and racially

different sets of peers.

When it was time to attend college, Michael decided to go to Arizona

State University because he and his mom had relocated to Arizona because of

a job opportunity. There was nothing in particular that was attractive about

Arizona State University; instead, it was just more of a place of convenience.

As a college student, Michael battled with being the minority in his classes,

but had found a way to use his peers as support when it came to academics

and studying. In a discussion of studying with classmates, Michael said:

I mean, it has helped a lot socially. . . . I mean, me not being from here,

I don't know anybody so its helped me that way and then it helped me

in school as well because I'm getting this outside exposure from

somebody and maybe can explain it a different way than the professor

did or maybe I can help them with something else.

One of the obstacles that Michael faced was being a minority student at

Arizona State University. Based on the interviews, it seemed as if Michael

was still developing the ability to become comfortable as an individual, which

is understandable considering the dynamic of being a minority and having a

different perspective than the majority. However, Michael discovered how to

successfully engage with peers that are of a different ethnicity. He also

improved his ability to seek out like-minded peers who shared a cultural connection.

Teacher Support

As a young student, Michael never developed any lasting relationships with his teachers and simply found ways to coexist with his peers. Michael has made progress with regard to interacting with his professors. He interacted with more college professors than with teachers in high school. He realized that professors are important assets, and can be helpful in supporting his education.

Conclusion

It became clear during Michael's interviews that he did not participant in any on campus organization, and he was still developing some on-campus mentors. He had never had an African American professor, which led him to worry about the job market and financial burden of graduate school after completing his future academic programs. Michael believed that African Americans were not engaged in science because they feel like second-class students in comparison to Caucasian students. He also believed that African Americans have the misconceptions that science is too hard, and not something that they are not capable of, which is something that is an internal issue, but supported by external stereotypes. As Michael put it in his own words:

I think African Americans have felt second to White students. I mean, just across the board in everything, I mean, not even just in school, but

just, period. So I think when you think of science, you think of doctors

and engineers, and [African Americans] say okay, this is not

something that we are supposed to do.

His solutions to the underrepresentation of African American in science

included prioritization of what is important, which is something that he

practices, and also exposing young African American students to the sciences

at a young age. In addition, Michael proposed exposing students to African

American role models in hopes that this can provide the motivation and

support needed.

Selena's Story

"[My high school science teacher] didn't treat anyone the way she treated me

just because I did so well in her class. She was the one that was like. 'You are

going to go to college. You gonna do this. You can do whatever you want.'"

At the time of her interviews, Selena, a sophomore undergraduate

student, was pursing her degree in biological sciences. Selena worked a part-

time job while maintaining a GPA of over 3.0. Selena was raised by her father,

with the exception of two years with her mother, and also has two siblings.

Based on her recruitment survey responses, Selena comes from a middle

class SES. Selena's mother spent some time in college, but did not finish her

degree. Her father is a college graduate.

Parental Support

Selena recalled growing up in rough neighborhoods with subpar

schools. Because Selena's father placed such a heavy premium on education,

she was always bused out to charter programs that provided a better quality of education. The schools that she attended early in her education successfully prepared her for college by exposing her to technology and other resources that enriched her educational experience. Eventually, after completing middle school, her family moved from California to Arizona, which is where she attended high school.

Growing up, Selena was fueled to do well because of her father. According to Selena's logic, her father sacrificed to provide opportunities for her, and the least she could do was perform well in school. He never pushed her about grades, but she saw the repercussions of her older brother not performing and decided that she wanted to set herself apart from her brother. Selena decided to attend Arizona State University because it was convenient for her. She was approached by a college recruiter and found the recruiting pitch that was used to encourage her to attend very appealing. In retrospect, she was pleased that she made the decision to attend Arizona State University. As she reported in her interview: "I really, really love it here—my peers, the support systems in place—it has been awesome so far." By selecting Arizona State University, Selena was also able to remain close to members of her family.

Financial Support

Selena's education was funded by her father. She did not have to take out loans, nor did she have to work, because her father has agreed to cover

all of her tuition while she was an undergraduate student. Selena admitted

that having her tuition covered allowed her to focus on school and not have

to worry about working to cover her expenses. In Selena's case, her financial

support is a substantial affordance.

Peer Support

When Selena attended school prior to college, she found it a challenge

being one of the few minorities in her school environment. According to

Selena:

I just felt like I had to be competitive because I knew . . .you know,

when you go to middle school, I'm a minority, minorities at this point

everybody thinks they are less educated and things like that and you

don't want that image reflected off of you so you definitely try hard in

class and stuff like that. But it wasn't really that I couldn't do it, it was

the fact that I wanted to prove that I could, so that was definitely a

drive for me and I wanted everyone to see that, you know, it might be

true but it's not true for everyone. There are some people that

actually, you know, work hard for what they want no matter what

color you are—age, gender, whatever.

As a student at Arizona State University, Selena realized the importance of

aligning oneself with goal-oriented peers. She constantly studies with peers

and identifies this study practice as a very important support system. Selena

invited me to observe her study sessions, which allowed me the chance to

observe the collaboration of like-minded, goal-oriented students.

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One week following our interview, Selena had a scheduled study session with a number of her peers from her chemistry course. She stated that she initiated the session by sending out an email to the class LISTSERV, asking if there was any interest in planning a meeting to prepare for the final exam. In the email, she suggested a meeting time of 7 PM, and a study location of Hayden Library. I arrived at Hayden Library at 6:45 PM and met Selena at the main entrance. We went to a group study room, which had been reserved by Selena earlier that week. The group study room included of a dry-erase whiteboard and 10 chairs. By 7:30 PM, there were 15 students who were participating in the study session. Attendees included eight female and seven male students. Selena was the only African American student. There was one Hispanic female, and the rest of the students were Caucasian. By 9:30 PM, four of the students left the group, and by 10:00 PM, the study session had ended.

During the study session, the protocol was very simple. The students informally asked each other questions based on past lectures and labs, and those students who were familiar with the material led the discussion and demonstrated how to solve those problems. Once the problem was fully understood by all students, the group moved on to the next problem. Throughout the study session, every student had the opportunity to lead the group when it came to a problem that he or she was comfortable with. At no time was there one individual who dominated the study session. Five of the students who participated in the study group admitted that they had studied together previously.

Teacher Support

Selena recalled that, throughout her life, she had always attended schools that were predominately Caucasian, and this would be true for both California and Arizona. Selena reported that she developed some very influential and important relationships with teachers. Such teachers eventually proved to be a big reason for her current success. There is no question that the early support from these teachers and her father would prove to be important to her growth and success as a student.

Selena first got engaged in science when she took a class with Ms. Hampton. This is where she fell in love with biology. When she explained her love of biology she said, "biology is: here's the problem, there's a bazillion ways you can fix it, there's a bazillion ways you can look at it and you have to figure it out yourself." Selena described herself as being very social, so she did not shy away from reaching out to teachers whenever she needed help.

High School High was a really good school for me as far as high school goes because everybody really had a personal relationship with their teachers there so it made it easier coming to them and say "Hey, I need help with this. I need . . . " You know, and then you had . . . they even, like, if you were a good student they would stay after school with you, they went . . . you know, they took that route to help you out however you needed. And I got really close with my biology and chemistry teacher there. She was the one that actually really made me want to do this because she made that class so interesting.

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As of result of developing strong relationships with her teachers at the high school level, Selena stated that it has been an easier transition for her to develop relationships with her college professors.

Conclusion

The biggest obstacle Selena encountered as a student was preparing for life after graduation. She aspired to be a doctor, and was under a great deal of stress while preparing for the MCAT and taking the other necessary steps to continue her education upon completion of her undergraduate studies. While she identified that worrying about life after graduation as an obstacle to her future success, she stated that her family helped her remain grounded and focused. The support of her family in addition to her continued relationship with Ms. Hampton, her high school science teacher, has allowed her to continue down her path to success and kept her motivated to pursue the steps necessary to enter medical school

Selena believed that many African American students are raised in very impoverished neighborhoods. Because of the poverty, she concluded that schools must be subpar. As a result, young students are not exposed to the wonders of science and Selena said: "I think that exposure is definitely a big thing . . . and at a very early age." Based on her own experience, Selena believed it was extremely important to allow students to gain exposure to science through different programs and experiences that would allow them to witness the fields of science first hand.

George's Story

"It just is hard because I remember everyone saying you can do great things, George; you can do great things. And it's, like, it's weird, because it's, like, I want to know what great things that I can do and I don't know."

At the time of his interviews, George, a junior undergraduate student, was pursing his degree in biology. Originally from New York, George and his family moved to Arizona when he was nine years old. George was raised by his mother, and grew up with two brothers. Financially, George's family was considered low SES. Regardless of their financial situation, education was always a priority. George endured some very difficult experiences, including the death of one of his brothers while George was a freshman at Arizona State University. George's father was never very active in George's life, and George's mother is disabled. As the oldest child, George receives a great deal of pressure to perform and be a role model for his younger siblings. He also feels the pressure to excel and succeed because he wants to give back and ultimately take care of his family.

Parental Support

George is driven to be a successful individual. This motivation stemmed from his impoverished upbringing and was fueled internally. George never attributed his success to his mother; instead, he repeatedly reminded me that he did not want to struggle as an adult. In some ways, the role of parental support is reversed with George in that he in some ways functions as role model and support system for his younger siblings. The

absence of his father may also contribute to his drive to achievement and his sense of responsibility regarding his younger siblings.

Financial Support

George chose to attend Arizona State University because it was close to home. He also decided to attend Arizona State University because he was able to get more scholarships money than if he had attended University of Arizona. At the time of the study, George worked part time because he felt obligated to help out at home. Because his mother was disabled and lived on a fixed income, he decided to take on some of his family's financial burden by working throughout his college career. At times, George admitted that he felt stress about balancing his academic and financial responsibilities.

Peer Support

As George transitioned from middle to high school, he remembers being a social outcast because he was different than the majority. The schools that he attended where predominately Caucasian, and being that his family was originally from Africa, he stated that he was just different from everyone else. He recalled being teased and made fun of throughout his childhood. He reported being called "crybaby" and "gumball," a name he was called because he was overweight growing up. Eventually, as he transitioned to college, George began to surround himself with peers that helped to support his academic goals. As George explained:

The thing is, I mostly go to my tutor, or my classmates, more than my

teachers because I know they are too busy. And the thing of it is, is I'm

really busy too because I work like 25 hours a week.

At Arizona State University, George successfully developed a number of

healthy relationships with his peers that have become a support system

contributing to his academic success.

Teacher Support

Early on, many of George's teachers unofficially diagnosed him with

attention deficit hyperactivity disorder (ADD), but his mother refused to

have him medicated. As George thought back on his education, he reported

that teachers had always been supportive. He was told that he had a high

learning capacity, but considered himself to be an apathetic student.

According to George, "A lot of people said I was pretty intelligent, I never

really considered myself intelligent, just able to memorize stuff easily." As a

student in high school, George developed some very important relationships

with teachers who reliably supported and encouraged his academic success.

When he spoke about his high school physics teachers, he said, "I learned

everything from him. I can talk to him about anything. We could always have

a conversation about life." This type of relationship helped to support his

academic achievement, and influenced his decision to pursue science.

In addition to the support from his teachers, George had a very strong

relationship with his high school counselor. This supportive relationship

helped him apply and qualify for the scholarship through the Barack Obama

Scholars Program. The scholarship ultimately went on to pay for his college education. This was necessary because his mother is disabled and would not have been able to financially support his college academic endeavors.

While teacher support was a significant affordance in his school education, it had not been the case at Arizona State University. One of the barriers that George encountered at Arizona State University was some of the professors. George found it very difficult to perform and do well in a class when he believed that the professor lacked quality. For George, there was a direct correlation between performance and interest level, and an instructor's attitude and approach to education was a major impact on interest.

Conclusion

For George, balancing has remained something with which he struggled with. At times, he felt discouraged. The need to meet academic requirements, in addition to family, work, and social expectations were at times overwhelming. One major motivating factor for George to succeed was that he never wanted to struggle financially. He recalled how difficult the financial situation was for him and his family, and wanted to prevent that in his own the future. George explained how this desire drove him:

Like I said, [I] never want to be a server, never want to be a server. That motivation pushes me so hard. Pushes me so hard, I don't want to work a typical 10 to 10. You know what I mean; I just push myself so hard. At the same time, I always struggle just to get the approval of my peers. I just

want people to see me as successful, you know what I mean. That's why I try so hard.

Summary

In this chapter, the eight participants' stories were recounted and emerging themes were identified. The interviews were candid, honest, and reflective. The themes that developed as a result of the interviews were parent support, peer support, financial support, and teacher support. Through this experience, much information was captured, but in no way can this information be generally applied to all African American students. Harkening back to what was discussed in the introduction, Arizona State University is a very unique learning environment for African American students who are pursing science.

Chapter 4 began by looking at the emerging themes and then moved into the individual stories of each of the participants. The interviews were rich with information relevant to this study. In the following chapter, I answer my original research questions and related the results of the study back to the literature review. Implications, recommendations, and further discussions conclude the study.

Chapter 5

CONCLUSIONS AND IMPLICATIONS

Introduction

This qualitative case study examined the barriers and affordances that excelling African American students encounter as they pursued their undergraduate science degree at Arizona State University. As articulated in the literature review, a number of barriers and affordances exist. The suggested barriers and affordances account for the current, disproportionate enrollment numbers of African American students in the sciences. This chapter focuses on examining the findings of this research study and comparing these results to the information provided by previous research, including the studies discussed in the literature review.

This case study was navigated using a qualitative approach. African American students who were excelling at the time of the study and who were pursing a science degree at Arizona State University were targeted to be participants. An initial questionnaire was used as a recruitment tool to gather initial data to determine if students were eligible for participation. After the questionnaires were reviewed, eight African American students were selected to participate in a two-part interview. Four of the participants were male and four were female. Also, students were selected to represent varying socioeconomic backgrounds. In addition to the interviews, two students volunteered to allow me to observe them with their peers during collaborative study sessions. The observations from these study sessions

further supported the idea suggested in the literature review that aligning with like-minded, focused peers is an affordance that can work in favor for African American students who are pursing science.

The questionnaire, interviews, and observations all took place on the campus of Arizona State University during the fall semester of 2011. Once the data were collected, they were analyzed, coded, and themed to organize the information in a way that it would later be used to address the initial research questions. In an effort to solidify the data, it was important to seek outside feedback. One manner of outside feedback included member checking, which further validated the results and claims that this chapter makes. After each of the interviews, a professional transcribed the audio recordings, and then I shared the text with each of the participants to check for accuracy. For all transcriptions, the participant confirmed the accuracy of the transcriptions. In addition, it is important to understand that this is not a study in which the results can be generalized to the larger African American population, considering that both Arizona, and Arizona State University are very unique places.

In the following section, each of the research questions will be further discussed and then answered based on the findings of this study and as supported by previous research. Following the discussion of the research questions, the chapter will provide recommendations for improving the experience for future African American students who may consider pursuing

a degree in science at Arizona State University. Finally, the close of this chapter will end with the implications of the study and a reflective summary.

Conclusions

Research Questions

The design and data collection process for this study were guided by the research questions. There is one overarching research question and two subquestions, and all three questions shaped the focus of the study. Each of the questions is discussed separately. In each discussion, answers are proposed and the there is an analysis that connects the questions with previous literature and other studies.

Research question. *What are the barriers and affordances that excelling African American students encounter while studying science at Arizona State University?*

As a result of the investigation, the barriers that were reported by the participants include both peer and financial support. Most of the participants reported that, throughout their academic career, they recalled attending academic intuitions where they were the minority and at times experienced cultural isolation. For some of the participants, they continuously battled with peer support in the form of cultural isolation as they navigated through Arizona State University. It is noteworthy that, while there were testimonies of cultural isolation, none of the participants reported instances of tracking and ability grouping as a barrier, as suggested by Russell (2005). The fact that the participants do not recall tracking speaks to the level of readiness

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that these students displayed while in school. Performing well at a younger age, to some degree, has the ability to aid students in not being inappropriately labeled, which results in placement in academic tracks characterized by lower expectations.

The second barrier that was identified by participants was the rising cost of tuition and expenses (financial support). While the participants in this study identified experiencing financial security as a result of scholarships and parents, several participants were concerned with the continued increase in expenses. Furthermore, they were concerned with the possibility of needing to search for gainful employment, which would detract from their academic endeavors.

When comparing the barriers experienced by the participants in this investigation to what was proposed in the literature review, perceptions were not articulated as a barrier. Several students recalled dealing with inaccurate perceptions by both teachers and peers; yet, they did not describe these interactions as a barrier, which had been suggested by Boelter and Tyler (2008). In regard to perceptions, most of the students recalled that negative perceptions were not a part of their academic experiences. This appears to be a potential barrier that most of the participants did not have to deal with as a student. There were two students who did identify that they recalled encounters where teachers or peers looked at them differently. In the case of Marlon, he remembered that his high school peers had higher expectations of him, considering he was one of the only African-American

student enrolled in AP courses. According to Marlon's peers, he must have been an exceptional student if he was enrolled in AP courses as an African American. John also recalled instances when teachers and peers treated him differently because of his race. He discussed scenarios of excessive discipline and unfair treatment based on him being African-American.

The affordances experienced by participants in this investigation included teacher support, parental support, financial support, and peer support. Several students indicated that they developed strong and lasting relationships with teachers throughout their academic careers. These relationships were pivotal in the academic and social development of the students in this study. Some of student-teacher relationships mimicked the role model-mentor relationship suggested by Dyer & Breja (1999). Vanessa and Marlon both reported that their mentor professors were instrumental to their academic success. Both of these students majored in molecular biology and biotechnology (MBB) and testified that it was a very small, cohort-style major, which allowed them to develop very close and supportive relationships with their mentor professors.

Another affordance identified by participants was peer support, yet, for other participants, peer support was identified as a barrier. Many of the participants concurred that it was difficult to navigate Arizona State University as an African American student, but realized that aligning themselves with like-minded, academically motivated peers as a key support system encouraged their success. Students' engagement with motivated

peers is the type of social and academic integration that has been reported to help and support students' success (Treisman, 1983).

Finally, students indicated that both parent and financial support were instrumental affordances that encouraged student success. All of the students were either on full scholarship or had financially stable parents who funded their education. This financial support relieved them of the responsibility of working to fund their education. Additionally, parent support was a constant theme that resonated with the eight participants in this study. The financial support and parental support experienced by the participants aligned with the affordances proposed by Stolle-McAllister & Carrillo (2010).

Table 7 compares and details the barriers and affordances experienced by the participants in this investigation in connection with the studies discussed in the literature review.

Table 7

Barriers and Affordances in Literature Review and Current Investigation

	Research – Literature Review	Current Investigation
Barriers	1. Tracking 2. Performance 3. Perceptions 4. Teacher preparation	1. Peer support - cultural isolation 2. Financial support – rising cost of tuition and expenses
Affordances	1. Role models and mentors 2. Monitoring and advising	1. Teacher support – strong relationships with teachers 2. Parental support

	3. Academic and social integration 4. Financial, family, faculty support	3. Financial support – scholarships, financially stable parents 4. Peer support

Subquestion 1. *How does socioeconomic status influence the barriers and affordances encountered by African American students pursing science at Arizona State University?*

After reviewing the data, it became apparent that within this group of students, socioeconomic status (SES) did not produce any unique insights regarding barriers and affordances the participants experienced. Many of the student participants, regardless of SES, faced a lack of peer support prior to entering Arizona State University. Some of these same students still had difficulty navigating Arizona State University's campus, where they were minority students. The two students who reported deficit perspectives from instructors where both from middle class background and not from impoverished, low SES backgrounds. The affordances for economically disadvantaged students suggested in the literature included being surrounded by African American professors (Westbrook & Alston, 2007), financial, family, and institutional support (Stolle-McAllister & Carrillo, 2010), and associating with a critical mass of academically talented peers of the same ethnicity to help reduce isolation and optimize student outcome (Brazziel & Brazziel, 2001). In this investigation, most of the students, regardless of SES, reported similar affordances. Five of the students reported

that it was critical to have supportive teachers in their lives. In addition, five

of the participants reported that the support of like-minded, goal-oriented

peers, regardless of ethnicity, was an important affordance. Five of the

participants representing all SES classes identified that supportive peers

were an affordance. This indicates that the support system is not subjected to

or related to SES.

In this investigation there was no direct relationship between SES and

barriers and affordances in the experiences of these students at Arizona State

University. When disaggregating the data, there were no unique themes that

emerged from the two subgroups (low SES, versus middle to high SES). This

finding is true for both the identified barriers and affordances. Tables 8 and 9

show the barriers and affordances that were experienced by the student

participants involved in this investigation. The articulated affordances were

consistent throughout both subgroups. The barrier themes followed the

same pattern, such as peer isolation, as suggested by Joseph Jr. (2010), which

was experienced by students from various SES groups and not just students

from low SES backgrounds.

Table 8

Barriers Experienced by Student Participants

Barriers	Students	
Peer support	Low SES	Mid to high SES
	Michelle	Marlon
	John	Michael
	George	Selena

Financial support	Low SES <u>Mid to high SES</u> Michelle Marlon Michael

Table 9

Affordances Experienced by Student Participants

Affordances	Students
Teacher support	<u>Low SES</u> <u>Mid to high SES</u> Michelle Marlon Vanessa Selena George
Parental support	<u>Low SES</u> <u>Mid to high SES</u> Michelle Marlon John Brenda Vanessa Michael Selena
Financial support	<u>Low SES</u> <u>Mid to high SES</u> Michelle Marlon John Brenda Vanessa Michael George Selena
Peer support	<u>Low SES</u> <u>Mid to high SES</u> John Marlon Vanessa Selena George

Parental support was key for most of the students, and education was placed at a premium in every student's life. From this, it is possible to conclude that, regardless of SES, the participants had parental support at an early age, and this support helped to encourage academic success throughout each student's life. In addition, because every student attended schools

where they were the minority, the majority expressed similar barriers of cultural isolation (lack of peer support), which transcended simple economics. After students make it to Arizona State University, they all experienced the affordances of financial security (financial support), which had been more of traditional barrier for students who come from impoverished backgrounds. For this group, however, financial support was no longer a concern. In addition, while evaluating the entire group, it became immediately apparent that with the efforts of their teachers and families, these students had been academically challenged and supported.

Subquestion 2. *What are the barriers and affordances that African American female students at Arizona State University encounter while performing in science in comparison to their African American male counterparts?*

There are historic disparities between male and female attainment of science degrees. Because of this, I wanted to investigate if there were differences in barriers and affordances reported by the African American male and female participants in this study. The emerging themes in the participant interviews indicated that the majority of the barriers and affordances were uniform for both male and female students. There was only one exception.

The male participants reported cultural isolation (lack of peer support) and being one of a few African American students as a barrier. Three of the four male participants in the study reported that being one of

only a few African American students in their school was a barrier growing up, while only one of the female participants reported this as a barrier. While most of the males reported that it was difficult being one of the only black students in their schools prior to entering Arizona State University, the number who reported this as a barrier they experienced decreased. Two males still found it challenging to navigate through a campus that was predominately Caucasian. One male no longer viewed this as a barrier that had a direct affect on his academic performance.

In general, the females in this study experienced the same barriers and affordances as the males, discounting the cultural isolation, which was experienced by one female and not the majority. Uniformly expressed affordances and barriers experienced by the females in this study differed from the framework of intersectionality, as proposed by Crenshaw (1993). The female participants experienced the same teacher, parental, financial, and peer supports as their male counterparts. They also experienced the same financial barriers. At no time during any of the interviews with the female participants did any state that they were treated unjustly or not exposed to opportunities because of their sex. One unifying variable among the females was that they all articulated that they were encouraged and supported by parents from an early age. It is possible to conclude that this unwavering support and encouragement allowed the female participants to believe that they could be successful in any endeavor that they choose. Cole (2009) suggested that factors of race and gender could sometimes result in

discouragement from external factors. However, it is this researchers' belief that the encouragement from parents allowed these female students to persevere in the face of any obstacle that may have been unknowingly encountered, which rendered them free of discouragement from external factors because of their race and gender.

Recommendations

As a result of being vested in this research, and having been personally exposed to the stories of the individuals who participated in this study, there are several recommendations. These recommendations are important for future African American students who intend to pursue science at Arizona State University to consider. Recommendations are divided into two sections. They include the recommendations for students prior to entering Arizona State University, and a section for current Arizona State University students.

Recommendations Prior to Attending Arizona State University

Parental involvement. Parental support is key for student success. At a very young age, the participant's parents realized the importance of education and made the necessary sacrifices and arrangements to ensure that their child received a quality education, thus preparing them for college. The fact that these parents were active in the lives of their students supports the idea that regardless of SES and upbringing, parents can be pivotal in the academic lives of their children. To help increase the likelihood of student success, it is important that parents determine some method to stay actively

involved in their children's academic journey. For those parents who are unfamiliar with the ways to encourage student success, support systems have to be created. In order to create such support systems, it may be necessary to implement social services or programs. These social services should be provided at the school level to encourage and train parents how to be properly engaged in their students' academic life and provide proper supports to positively contribute to student success.

Solid teachers and adequate preparation. Teachers are targeted as the single most important variable in a student's academic development. As the participants in this study articulated, teachers have the influence to expose students to the wonders of science, and they help support and encourage developing student interest. It is paramount that politicians and policymakers understand the value and influence of good teachers and continue to fund initiatives to support and encourage teacher development. In addition, participants in this study recalled being actively engaged and supported in science by their teachers. It is extremely important that both male and female students alike are engaged in science at the earliest possible ages. In most cases, engagement in high school is too late; by high school age, traditional social norms are already in place.

Additional exposure opportunities. When students come from impoverished environments, it becomes difficult to strive for something that has yet to be experienced. In other words, it is hard to pursue a career path or goal that you do not know it exists or are encouraged to pursue. Poverty

and low expectations tend to be cyclical. If we are to expect students to do well academically, it is important that we expose them to all of the wonders and opportunities of science. When students have the opportunities to be exposed to science, there becomes the possibility to ignite a curiosity to fuel future motivation. For many inner-city students, their everyday existence is surrounded by negative external factors that often times deter academic success. Having the chance to visit potential careers and professions outside of their immediate neighborhoods can be instrumental in fueling the fire needed for the pursuit of science. The students in this study had the chance to explore various areas of science regardless of SES at some point in their lives. These exposure opportunities became the motivation needed to strive towards their academic goals. All students should have access opportunities to develop the necessary intrinsic motivation that support their academic success.

Adequate training for college funding opportunities. The participants in this study reported that they have benefited from not having to worry about financial concerns related to funding their education. At some point during their academic career, they were guided through the necessary steps to qualify for and pursue academic scholarships. It is important that students get this assistance because of the amount of time that will be required to focus on academics as a science major. Even before applying for scholarships, however, it is important to reinforce the benefit of performing academically throughout one's pre-college academic experiences. Without

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the appropriate drive and work ethic, many students will discover that they will be ineligible for such funding opportunities. It is also important that programs are in place for parents at the secondary level to aid them in navigating the system of pursing scholarships and other funding opportunities.

Recommendations for Arizona State University College Students

      Peer groups associations. In conducting this investigation, nearly all the participants stated that it was extremely important to be surrounded with like-minded, motivated peers to help support their academic endeavors. When recruiting for the study, I found it extremely difficult to find qualified participants. The participants reported that it was also difficult for them to locate like-minded students with whom they could identify. At the time of the study, Arizona State University had a number of programs in place for African American students to join for support, but it would be extremely beneficial to create an accessible roster that included student information and major. This could be centrally located and be a resource for African American students at Arizona State University. Such a resource would help students find positive, like-minded peers. This, in turn, could encourage an easier transition and promote success. The current summer bridge programs and mixers could be an outlet for securing information and disseminating resources.

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Discussion

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The participants in this investigation communicated the barriers and affordances that encountered as they pursued a science undergraduate degree at Arizona State University. The participants in the study articulated peer and financial support as barriers and teacher, parental, financial, and peer support as affordances. These findings are specific to this group and cannot be applied to other contexts because Arizona State University, where these students were enrolled, is a specific learning environment. Generalization of these findings is not appropriate for other scenarios, but can be considered for other African American students who pursue science at Arizona State University. This investigation was the first of its kind that focused on Arizona State University. Therefore, the body of literature that discusses African Americans who pursue science now contains information that applies to this specific academic institution. As suggested in the literature, these barriers and affordances can help African American students be successful in science programs, but this study also might provide strategies that help African American students succeed in any academic endeavor. Nonetheless, this study identified the hindrances and aids to the aspirations of the eight participants who were planning to graduate with a degree in science at Arizona State University. Additionally, the theoretical framework of intersectionality did not produce any unique data, but it is this researcher's belief that it was because of the uniqueness of this group of participants.

Implications for Extended Research

The investigation of the barriers and affordances that excelling

African American students encounter while pursing a degree in science at

Arizona State University is a very unique study and the first of its kind.

Because of the novelty of the study, there have been limitations of this study

and there are implications for additional research in the future. The focus of

this study was on African American students who were at least a sophomore

in classification, and undergraduate students were the only focus (as

opposed to graduate students). In addition, there was unequal

representation from the cohorts. Future researchers might consider a similar

investigation, but instead look at the variable of classification (freshman,

sophomore, junior, etc.) to determine if there is any relationship between

barriers and affordances and year of college. This type of investigation has

the potential to produce additional, useful data.

Another opportunity for investigation is to develop a study that

focuses on graduate students. There is an inverse relationship between

advanced degree attainment and the number of African Americans who

confirm such degrees. This investigation focused on undergraduate students.

These two different sets of data could then work together to create a larger

picture and storyline of African American students and science at Arizona

State University.

Another implication for extended research on the topic is the

opportunity for a comparative study. When I was looking for qualified

participants for my investigation, I met a number of students who would not

be considered excelling, yet they were majoring in a science at Arizona State University. An investigation to capture their stories and identify the barriers and affordances that they have encountered may be an area of interest. This study could then be used to compare results and to make additional recommendations that may aid a larger population of students at Arizona State University.

Initially, that research presented in the literature review stated that traditionally an equal numbers of African Americans have the intentions and desires to pursue science, yet the number of graduating students does not support this idea. Another area of interest for future research is to investigate freshman students and to track their initial interest in major. A longitudinal study to track the changes in majors by African American students is another important area. These various opportunities for additional investigation each have the potential to bring different and unique perspectives to the discussion in looking at this important subject matter. Once investigated, better answers and solutions can be proposed, which may result in better programming and opportunities.

Summary

The purpose of this study was to determine some of the barriers and affordances that excelling African American students who are pursing an undergraduate degree at Arizona State University encounter as they navigate through their collegiate academic career. The primary source for data for this study came from the two-part interviews with eight participants. Additional

data were secured via observations and questionnaires to frame the narratives of each participant.

Finding qualified students for the study was a major challenge. The fact that it was difficult to find such students supports the need for similar research. Once the participants were identified and the interviews were carried out, the next challenge was to organize and analyze the data. Analyzing the data required many hours of work and persistence to filter through all of data. At times, it was challenging to determine what should be left out of the students' stories. It was necessary to include the most informative quotations, but there was fear of not accurately capturing the full accounts of each student. After I embraced the narratives of the student participants, it was less of a challenge to make the larger connections and address the initial research questions.

The first chapter provided a personal introduction of my background and laid the foundation for the necessity of this study. The practical problem was outlined, which articulated the importance of pursing this investigation. Chapter 1 also presented the statement of purpose, which included a discussion of research intentions. The second chapter focused on the literature review and provided the theoretical framework for this study. The literature review also provided a priori coding system that would be used in the findings chapter. Documented barriers and affordances were identified and were later compared to the results of this investigation. The third chapter detailed the research methods of this investigation. This study used a

qualitative lens to explore the initial questions that facilitated this investigation. The research design for this study was a case study. The bounded system for this case was outlined, and the details of recruiting participants for the study were explained. In Chapter 3, the process that would be used to analyze the collected data was outlined.

After the data were collected, the findings were analyzed in Chapter 4. Individual narratives were created for each of the participants in the study. Also, emerging themes were identified. Next, the barriers and affordances were identified. The barriers and affordances were then compared to those that were identified in the literature review. Navigating through this process was extremely engaging and exciting for me. The final chapter was intended to evaluate the initial research questions based on the data that were collected in the study. The evaluation included a comparison to the information presented in the literature review. Recommendations and implications were articulated. Finally, a reflective summary was composed. The ultimate hope is that the information provided in this study will help other African American students who pursue science at Arizona State University.

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APPENDIX A

RECRUITMENT DOCUMENTS

Pilot Study (for the two participants to test the interview protocol)

Consent Form
African American Students and Science

Date:

Dear_____:

       I am a doctoral candidate working under the direction and leadership of Professor, Dr. Kimberly Scott, whom is in the Department of Education and Society, Culture, and Equity, within the School of Social Transformation at Arizona State University.

       As part of my dissertation in the doctoral program in Educational Leadership, I am conducting a pilot study, which explores the barriers and affordances that African American students at Arizona State University encounter as they pursue an education in science. The purpose of this form is to provide you information that may affect your decision as to whether to participate in this research and to record the consent of those who agree to be involved in the pilot study.

       I am recruiting African American participants who are current students, majoring in a science field, and that are enrolled at Arizona State University. You have been invited to participate in this pilot study based on your responses to the questionnaire. You will be asked to participate in two, one on one interviews. I would like to audiotape this interview. The interview will not be recorded without your permission. Please let me know if you do <u>not</u> want the interview to be taped; you also can change your mind after the interview starts, just let me know. If permission is granted, the interview will be audio recorded and then transcribed. I will give you a copy of the transcription to review to ensure the accuracy of the interview. I will construct a narrative of your responses to the interview questions and identify reoccurring themes that present themselves. The tape recordings will be erased at the completion of the study.

       Your participation in this project is voluntary. You will be asked to participate in two, one on one interviews, which will last approximately 60 – 90 minutes each and if you choose not to participate or to withdraw from the project at any time, even if you have previously said yes, it will not affect you in any way. During the interview you may skip any question(s) that you do not want to answer. The results of the research will be used to test out the interview protocol for my dissertation. Your name and identity will be confidential and will not be used at any point. All data will be kept confidential and stored in a password-protected computer. In order to participate in this pilot study, you have to be 18 years of age or older.

       Although there may be no direct benefit to you, the possible benefit of your participation includes identifying potential strategies for increasing science participation among African-American students at Arizona State University. To be considerate of your time, a $25 American Express gift card will be awarded as compensation for your participation.

If you have any questions concerning the pilot study or your participation in the study, before or after consent, you can contact me at 602.350.0489 or quintin.boyce@asu.edu. Additionally, you can contact the professor that I am working under at: Dr. Kimberly Scott, Kimberly.a.scott@asu.edu, 480.965.5380. Sincerely,

Quintin Boyce

With my signature, I give consent to participate in the above study.

Name (printed) _____

Signature _____ Date _____
If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, at (480) 965- 6788.

Recruitment Script for the Classroom

I am a doctoral candidate working under the direction and leadership of Professor, Dr. Kimberly Scott, whom is in the Department of Education and Society, Culture, and Equity, within the School of Social Transformation at Arizona State University.

I am conducting a research study to evaluate the barriers and affordances that African American students encounter at Arizona State University, as they pursue their undergraduate degree in science.

I am recruiting individuals to take part in two, one-on-one interviews, which will each take approximately 90 minutes. If selected, and agreed to participate, participants will receive a $25 American Express gift certificate as compensation for their time.

The first step in recruitment, is that I ask that each of you will take 3-4 minutes to fill out the enclosed questionnaire, which will allow me to identify qualified candidates for this study. To participate in the questionnaire, and study, it is required that you are 18 years of age or older.

Your participation in this study is voluntary. If you have any questions concerning the research study, please call me at (602) 350 – 0489, additionally; my email is quintin.boyce@asu.edu

Recruitment Cover Letter for Questionnaire

COVER LETTER
African American Students and Science

Date

Dear _____:

I am a doctoral candidate working under the direction and leadership of
Professor, Dr. Kimberly Scott, whom is in the Department of Education and
Society, Culture, and Equity, within the School of Social Transformation at
Arizona State University.

I am conducting a research study to evaluate the barriers and affordances
that African American students encounter at Arizona State University, as they
pursue their undergraduate degree in science.

I am recruiting individuals to take part in two, one-on-one interviews, which
will each take approximately 90 minutes. Individuals will be invited to
participate in the interviews based on their answers to the enclosed
questionnaire. The questionnaire should only take 3-4 minutes to complete.
If selected, and agreed to participate, each participant will receive a $25
American Express gift certificate as compensation for his or her time. It is
required that you must be 18 years of age or older to participate.

Your participation in this study is voluntary. You can skip questions if you
wish. If you choose not to participate or to withdraw from the study at any
time, there will be no penalty. Additionally, participation in the questionnaire
and resulting study will not affect your grade.

Although there will be no direct benefits to you, the results of this
questionnaire will allow me to contact and select qualified participants for
this study. Once selected and the research is carried out, the possible benefit
is to the community, in understanding the story of African Americans that
choose to pursue an education in science at Arizona State University. There
are no foreseeable risks or discomforts to your participation.

Your responses to the questionnaire will be confidential. The questions will
be reviewed and sorted to identify qualified candidates for the research
study. Once those individuals have been contacted and selected, the unused
questionnaires will be destroyed. The questionnaires that are selected to

identify future participants of the study will remain confidential, meaning that the names of the students will be removed from the questionnaire to ensure confidentiality. The results of this study, if you are selected, may be used in reports, presentations, or publications, but your name will not be used to protect the confidentially agreement.

If you have any questions concerning the research study, please contact the research team at: (Prinicipal Investigator – Dr. Kimberly Scott, Kimberly.a.scott@asu.edu, 480.965.5380 or Co-Investigator Quintin Boyce, quintin.boyce@asu.edu, 602.350.0489). If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the Arizona State University Office of Research Integrity and Assurance, at (480) 965-6788.

Return of the questionnaire will be considered your consent to participate.

Sincerely,

Questionnaire

Name: _____

Email: _____   **Phone number**: _____

Gender: _____   **Ethnicity (Race)**: _____

Current Pursued Undergraduate Degree: _____

Classification – Circle One
1. Freshman   2. Sophomore   3. Junior   4. Senior   5. Graduate
Student

Cumulative G.P.A. (grade point average) – Please circle one

a. 0.0 – 1.9   b. 2.0 – 2.9   c. 3.0 – 3.9   d. 4.0 +

Level of your parent(s) education – Circle One

Mom (or Guardian 1) = 1. Less than high school   2. High school graduate

        3. Some college   4. College graduate   5. Unknown

Dad (or Guardian 2) = 1.Less than high school   2.High school graduate

        3. Some college   4. College graduate   5. Unknown

Parent(s) Occupation – Please circle one

Mom (or Guardian 1)
        1. Managerial, Professional, Technical   2. Sales or Administrative

        3. Service Occupation   4. Farming, Precision Crafts, Operators

        5. Unknown   6. Other _____

Dad (or Guardian 2) =
        1. Managerial, Professional, Technical   2. Sales or Administrative

        3. Service Occupation   4. Farming, Precision Crafts, Operators

        5. Unknown   6. Other _____

Estimated average annual family income growing up (Prior to entering college) – Please circle one …
a. Less 9,999 per year   b. 10,000 – 14,999 per year   c. 15,000 – 19,999 per year

d. 20,000 – 24,999 year   e. 25,000 – 29,999 per year   f. 30,000 – 49,999 per year

g. 50,000 – 74,999 per year   h. 75,000 – 99,999 per year   i. 100,000 per year or higher

Average number of people in your household growing up (Prior to college) Fill in the Blanks

Adults ___ Children ___

Research Study (for the eight participants of the research)

Consent Form
African American Students and Science

Date:

Dear_____:

I am a doctoral candidate working under the direction and leadership of Professor, Dr. Kimberly Scott, whom is in the Department of Education and Society, Culture, and Equity, within the School of Social Transformation at Arizona State University.

I am conducting a research study to evaluate the barriers and affordances that African American students encounter at Arizona State University, as they pursue their undergraduate degree in science.

The purpose of this form is to provide you information that may affect your decision as to whether to participate in this research and to record the consent of those who agree to be involved in the research study.

I am recruiting African American participants who are current students, majoring in a science field, and that are enrolled at Arizona State University. You have been invited to participate in this research study based on your responses to the questionnaire. You will be asked to participate in two, one on one interviews. I would like to audiotape this interview. The interview will not be recorded without your permission. Please let me know if you do <u>not</u> want the interview to be taped; you also can change your mind after the interview starts, just let me know. If permission is granted, the interviews will be audio recorded and then transcribed. I will give you a copy of the transcription to review to ensure the accuracy of the interview. I will construct a narrative of your responses to the interview questions and identify reoccurring themes that present themselves. The tape recordings will be erased at the completion of the study. In addition to the interviews, I would like to observe you and your interaction if you grant permission when you attend any type of support group, which aids your in your academic journey (study sessions, tutoring session, etc.)

Your participation in this project is voluntary. You will be asked to participate in two, one on one interviews, which will last approximately 60 – 90 minutes each and if you choose not to participate or to withdraw from the project at any time, even if you have previously said yes, it will not affect you in any way. During the interview you may skip any question(s) that you do not want to answer. The results of the research will be used for my dissertation. Your name and identity will be kept confidential and will not be used at any point. All data will be kept confidential and stored in a password-protected computer. In order to participate in this pilot study, you have to be 18 years of age or older.

Although there may be no direct benefit to you, the possible benefit of your participation includes identifying potential strategies for increasing science participation among African-American students at Arizona State University. To be

considerate of your time, a $25 American Express gift card will be awarded as compensation for your participation.

If you have any questions concerning the research study or your participation in the study, before or after consent, you can contact me at 602.350.0489 or quintin.boyce@asu.edu. Additionally, you can contact the professor that I am working under at: Dr. Kimberly Scott, Kimberly.a.scott@asu.edu, 480.965.5380.

Sincerely,

Quintin Boyce

With my signature, I give consent to participate in the above study.

Name (printed) _____

Signature _____ Date _____

If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, at (480) 965- 6788.

APPENDIX B

INTERVIEW PROTOCOL

Interview Question Matrix

Questions related to Barriers

1. Are you familiar with the idea of tracking (ability grouping), and if so, was that something that was practiced in the schools that you attended while growing up?

2. What have been some of your biggest obstacles during your academic career?

3. How were you as a high school student? How did you perform on the college entrance exams that your took before enrolling at Arizona State University?

4. What type of relationships did you have with your teachers growing up?

5. What are some obstacles that your have faced/currently face as a student at Arizona State University?

6. How are you financing your education?

7. What are some barriers that you have encountered while attending Arizona State University?

8. What do you believe are some of the issues that prevent African American students from being adequately represented in science fields/education?

Questions related to Affordances

1. What roles have your parents played in your education?

2. What are your relationships like with your professors at Arizona State University?

3. What are your relationships like with your peers at Arizona State University?

4. What have been some elements that have encouraged your success as a student at Arizona State University?

5. Have you had any African American science professors? If so, have you established a relationship with them?

6. Do you belong to any organizations…. On or off campus? If so, which ones?

7. How frequently do you meet with your professors?

8. What sorts of things have your encountered that have supported you during your academic journey here at Arizona State University?

9. What type of role models and/or mentors have you developed as an undergraduate student at Arizona State University?

10. What has been the role of your family while you have been enrolled at Arizona State University?

11. What are some strategies that you have used that have allowed you to be successful in science education?

Uncategorized Questions

1. Tell me as much information about yourself in regards to your educational journey from as far back as you can remember, up until today.

2. What has life been like for you before enrolling in college?

3. What have been some of your major accomplishments during your academic career?

4. Tell me about your educational background growing up, please share specific experiences that you can recall?

5. How did you decided to select a science major?

6. What were some influential events that you believed shaped your outlook on education?

7. Do you have family members that have attended college and have pursued a science major?

8. How was science apart of your childhood growing up?

9. What was your first exposure to science that you can remember?

10. How would you describe your science education while in middle school, while in high school?

11. What do you believe is the role of science in today's society?

12. How has your high school science experience influenced your choice of college major?

13. Reconstruct for me a typical day for you as a college student. Explain all details of what normally happens to your through out the course of any given day.

14. Given what you have stated about your life before being a college student, and considering what you have shared regarding your current life as a college student, how do you explain the accomplishments your have secured thus far?

15. Given what you have reconstructed in these interviews, where do you see yourself going in the future?

16. What do you see yourself doing with your science degree?

17. How do you think more African Americans could be encouraged to purse science education?

Individual Interview Protocol

First interview

1. Tell me as much information about yourself in regards to your educational journey from as far back as you can remember, up until today.

2. Are you familiar with the idea of tracking (ability grouping), and if so, was that something that was practiced in the schools that you attended while growing up?

3. What has life been like for you before enrolling in college?

4. What have been some of your major accomplishments during your academic career?

5. What have been some of your biggest obstacles during your academic career?

6. Tell me about your educational background growing up, please share specific experiences that you can recall?

7. How did you decided to select a science major?

8. What were some influential events that you believed shaped your outlook on education?

9. What roles have your parents played in your education?

10. Do you have family members that have attended college and have pursued a science major?

11. How was science apart of your childhood growing up?

12. What was your first exposure to science that you can remember?

13. How would you describe your science education while in middle school, while in high school?

14. What do you believe is the role of science in today's society?

15. How has your high school science experience influenced your choice of college major?

16. How were you as a high school student? How did you perform on the college entrance exams that your took before enrolling at Arizona State University?

17. What type of relationships did you have with your teachers growing up?

Second Interview Part 1

1. What are your relationships like with your professors at Arizona State University?

2. What are your relationships like with your peers at Arizona State University?

3. Reconstruct for me a typical day for you as a college student. Explain all details of what normally happens to your through out the course of any given day.

4. What have been some elements that have encouraged your success as a student at Arizona State University?

5. What are some obstacles that your have faced/currently face as a student at Arizona State University?

6. Have you had any African American science professors? If so, have you established a relationship with them?

7. Do you belong to any organizations…. On or off campus? If so, which ones?

8. How frequently do you meet with your professors?

9. How are you financing your education?

10. What sorts of things have your encountered that have supported you during your academic journey here at Arizona State University?

11. What are some barriers that you have encountered while attending Arizona State University?

12. What type of role models and/or mentors have you developed as an undergraduate student at Arizona State University?

13. What has been the role of your family while you have been enrolled at Arizona State University?

Second Interview Part 2

1. Given what you have stated about your life before being a college student, and considering what you have shared regarding your current life as a college student, how do you explain the accomplishments your have secured thus far?

2. Given what you have reconstructed in these interviews, where do you see yourself going in the future?

3. What do you see yourself doing with your science degree?

4. What are some strategies that you have used that have allowed you to be successful in science education?

5. What do you believe are some of the issues that prevent African American students from being adequately represented in science fields/education?

6. How do you think more African Americans could be encouraged to purse science education?