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RELATIONSHIPS AMONG COMMUNITIES, IDENTITIES, AND ACADEMIC PERFORMANCE OF AFRICAN AMERICAN ENGINEERING UNDERGRADUATES

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RELATIONSHIPS AMONG COMMUNITIES, IDENTITIES, AND ACADEMIC PERFORMANCE OF AFRICAN AMERICAN ENGINEERING UNDERGRADUATES

A DISSERTATION APPROVED FOR THE
SCHOOL OF INDUSTRIAL ENGINEERING

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DEDICATION

This is dedicated to future minority STEM undergraduates. For you there are no ceilings.

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Abstract

A potential barrier to increasing diversity in engineering may be the failure of engineering colleges within predominantly White institutions (PWI's) to understand, acknowledge, and/or accommodate the unique perspectives of its under-represented minority students. Numerous studies have shown us that the success of many under-represented minority students at PWI's may be impacted by lack of community, feelings of isolation from their culture, and disidentification within their field (Foor, Walden, & Trytten, 2007; Seymour & Hewitt, 1997; Shehab et al., 2007; Shehab, Murphy, & Foor, 2011; Walden & Shehab, 2009).

This study represents a phenomenological analysis of data collected by the Research Institute for STEM Education (RISE), who conducted a study seeking to identify factors contributing to the success of under-represented and under-served minority engineering students at a predominantly White research institution. Minority undergraduate engineering students participated in face-to-face interviews designed to engage them in reflection and discussion of their experiences as engineering students. The interview data for 19 successful African American undergraduate engineering students were selected from three academic performance groups: excellers, persisters, and strugglers. Their interview data were analyzed to address the question of how community and identity contribute to the academic achievement of successful African American engineering undergraduates of a predominantly White institution.

To answer this question, student experiential narratives were interpreted through the lenses of community, Black identity, and engineering identity to better understand how

these constructs influence the student academic performances. Results suggest that community, Black identity, engineering identity, and academic performance may moderate each other. Students found community in different places based on their academic grouping. Excellers found community in a wider range of places and were most likely to find community in engineering organizations with majority White membership. Persisters and strugglers were more limited in the places they found community and mostly participated in more ethnocentric organizations. Persisters and Strugglers were more reliant on Black reference groups for community than were excellers, indicating stronger reliance on same race communities. Engineering discursive identity increased as academic performance increased. Surprisingly, several students from each grouping held negative images of engineers which often clashed with their own identities, perhaps suggesting a potential friction between Black and Engineering identities.

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CHAPTER ONE: INTRODUCTION

Rationale

In 2008 Mathieu Bouville questioned the "good" of engineering diversity. He philosophically argued that the way diversity is defined in contemporary engineering education literature is somewhat flawed:

> *"one must be careful when invoking diversity not to ring a homonym. This is of the utmost importance since some of these views are mistaken and cannot justify any policy."…most authors use 'diversity' as a buzzword (Sullivan, 2006) rather than as a concept—using this sacred cow as a large shield against refutation. Most authors mention 'diversity' without ever explaining in what it is supposed to be good and why one should try to promote it (the exception being the argument of improved designs). It does not seem that they genuinely try to justify the policies they advocate: they provide rationalizations rather than genuine justifications." (Bouville, 2008)*

He also reiterated that diversity cannot be argued as an intrinsic good because it cannot be empirically tested as such. However, he points out that the argument of diversity as instrumental good can be tested, and therefore can be proven.

Why STEM Diversity?

Global powers such as China and India are progressively advancing their technological capabilities at a substantial rate, quickly closing the hi-tech gap and leaving the United States' position as the sole super power of technological advancements susceptible to being overtaken (National Academy of Engineering, 2005). Several researchers and scholars have suggested that one potential reason for the US technological demise is the consistent shrinking of its STEM workforce (National

Academy of Engineering, 2005, 2007; National Action Council for Minorities in Engineering, 2006; National Science Foundation, 2003, 2007a, 2008).

Research suggests that the inclusion of untapped resources in STEM such as women and underrepresented people of color may be the answer to this critical problem. According to the National Science Foundation's *Science & Engineering Indicators* report (2010), under-represented minorities (other than Asians/Pacific Islanders) are substantially under-represented in the science and engineering workforce:

> *"With the exception of Asians/Pacific Islanders, racial and ethnic minorities represent only a small proportion of those employed in S&E occupations in the United States. Collectively, Blacks, Hispanics, and other ethnic groups (the latter category includes American Indians/Alaska Natives) constitute 24% of the total U.S. population, 13% of college graduates, and 10% of college-educated individuals employed in S&E occupations"(National Science Board, 2010b p. 3-34)*

In 2006 only 4.7% of the engineers in the US were African American or Hispanic Americans, which is underwhelming considering the fact that they represented 28% of the US population. William A. Wulf, president of the National Academy of Engineers (NAE) called for diversity in the STEM workforce, citing the creative potential brought on by what he called "individual diversity" (Wulf, 2001).

With that said, I argue for diversity not solely on the pretense of "doing diversity" by increasing the overall number of women and under-represented people of color in the STEM workforce, but also based on the great potential of unparalleled creativity, flexibility, and competence within the increasingly complex and diverse global economy.

STEM Attrition and People of Color

National attention to STEM diversity has encouraged US colleges and universities to increase focus on enhancing their female and underrepresented minority (URM) participation. But are they really prepared to support diverse growth? Unfortunately, statistics say otherwise. URM students enrolled in STEM majors at predominantly white colleges and universities are among the lowest academic performers, least persistent, and fewest graduated (National Science Foundation, 2007b).

In the book, *Talking About Leaving: Why undergraduates leave the sciences* (1997), Elaine Seymour and Nancy Hewitt discuss their research in which they investigated reasons for low persistence among URM undergraduate students pursuing STEM majors. Their study employed a qualitative methodology involving face-to-face interviews that allowed in-depth understandings of the struggles that inhibited the persistence of undergraduate students majoring in STEM fields. These interviews also allowed URM students in the study to discuss their experiences at predominantly white campuses and revealed that some of their experiences were often different from their majority counterparts (Seymour & Hewitt, 1997).

Findings suggested that URMs experienced the hardships of majority student persistence as well as additional issues such as over confidence, poor high school preparation, feelings of isolation, poor student-faculty relationships, and internalization of blame for poor academic performance. While the Seymour & Hewitt study has informed and influenced many STEM education studies and interventions, attrition and retention rates have changed little as a result. Additional qualitative research examining the differences among and within ethnic groups is needed.

STEM Persistence and people of color

The Research Institute for STEM Education (RISE) utilized qualitative methodology to study undergraduate minority engineering students at a division one, south-central institution. The RISE study conducted face-to-face interviews with undergraduate engineering students of color disaggregated into four ethnic groups (American Indian, African American, Asian American, and Hispanic American), allowing for the identification of similarities across URM as well as in depth understanding of students within each ethnic group.

Shehab et al. (2007) analyzed RISE data to understand similarities and differences between the disaggregated groups and found that while successful undergraduate students of color shared some similar struggles and strategies, student interviews revealed differences in experiences between the individual ethnic groups (Shehab et al., 2007). Corresponding analyses of RISE data from students from three of the four disaggregated ethnic groups have yielded studies that have provided powerful insights in regard to American Indian, Asian American, and Hispanic American engineering students (Foor & Shehab, 2009; Foor, Walden, & Trytten, 2007; Trytten, Wong Lowe, & Walden, 2009; Walden & Shehab, 2009). However, prior to the current study, data from successful African American undergraduate engineering students had yet to be the sole focus of an analysis.

Purpose of study

Black Americans are poorly represented in the engineering workforce: According to the U.S. census, Blacks accounted for 12.6% of the national population (U.S. Census Bureau, 2011), however they represent 3.2% of employed engineers. Black Americans are poorly represented among engineering graduates. Between 2000 and 2006 the percentage of engineering bachelor's degrees earned by Black Americans has declined from 5.6% to 5.1% (National Science Board, 2010a). Finally, Black Americans are poorly represented among engineering undergraduates. Between 1995 and 2006, the percentage of undergraduate engineering students that were Black Americans steadily declined from 7% to 5.8%. In pre-college educational settings, African American students are among the lowest academic performers and highest in remediation, behavioral problems, truancy, and dropout rates. Black students who avoid negative outcomes and pursue higher education at predominantly White institutions (PWI's) potentially face issues due to isolation, tokenism, the threat of being stereotyped (Steele, 1997), and a smaller likelihood of success than their White counterparts. Success in engineering has been particularly difficult for Black American undergraduates, and while reasons for unsuccessful outcomes among Black American students are well documented, reasons for success are somewhat less understood.

African American students who succeed in engineering have managed to avoid the types of negative pre-college outcomes that de-rail many Black American high school students. These students have also overcome the potential isolation, lack of relatable

external community, less approachable faculty relationships, the threat of being held accountable for fulfilling negative stereotypes, and the rigor of the advanced STEM courses at engineering institutions (Seymour & Hewitt 1997). These students have succeeded through a gauntlet of potential challenges, and their stories should be of extraordinary importance to future students who seek similar paths.

Definition of Terms

Before proceeding it is important to first define terms central to this study:

Black **-** General term for people with naturally dark skin and with African ancestry. This term can be inclusive of American born people or immigrants from Africa and Caribbean countries.

African American **-** American born, non-immigrant Black Americans.

Success **-** Having earned an engineering degree. Therefore a student needs only to graduate with an engineering bachelor's degree in order to be considered successful within the context of this study.

Due to the interchangeable use of the terms "Black" and "African American" in US Census data as well as contemporary literature, the current interpretation of background information does not delineate between these two terms, and therefore they will appear to be used interchangeably here. However the current study's methodology does delineate these terms and focuses primarily on successful African American undergraduate engineering students.

Research Questions

This study utilizes qualitative research methods to explore the undergraduate experiences of successful African American engineering students to better understand their success. While this study seeks to understand students who succeed, it also aims to differentiate between students who excel, persist, and struggle academically during their undergraduate engineering experience. More specifically, the research question to be explored is how do community and identity contribute to the academic achievement of successful African American engineering undergraduates of a predominantly White institution. To respond to this question, successful African American engineering students will be differentiated by academic performance, and their experiential narratives of life at the PWI will be interpreted through intersecting lenses to develop the necessary implicit answers to the questions:

1. Where do these students find community?
2. How do these students identify with being Black?
3. How do these students identify as engineers?

Researcher identity

Although inclusion of these factors or lenses is supported by literature, the investigative motivation for these research questions is substantially influenced by the researcher's own experiences. In qualitative research it is essential to communicate subjectivities that may bias, unbalance, or limit your research.

As an African American engineering alumnus who has amassed experience as a student, mentor, director, and teacher in STEM, I have a keen interest in success among African American students in STEM. It is my personal belief that among other things, there is much to learn from the experiences of successful students. While I consider the insights that my own race/ethnicity and experiences bring to the interpretation of student narratives as strengths, some readers might see those same strengths as biases. Purposefully built into the qualitative research process is a system of reviews by an advisory committee who do not share my background, as well as a solid literature foundation to guide data interpretation, which serve to check and reduce potential bias.

CHAPTER TWO: LITERATURE REVIEW

This section will discuss contemporary research and literature related to undergraduate communities, engineering identity, and Black identity among successful African American undergraduate engineering students.

Community

Community, according to Gerard Delanty (2003), can be defined in different ways and seen from different perspectives. In his book, *Community*, Delanty (2003) examines community from a historical standpoint, revealing his own reasoning for the differing opinions on community. Historically, community was attached to society; the two were almost synonymous but were separated from the state. He writes:

> *"(Community) referred to the more immediate world of meaning, belonging and everyday life…Civil Society could also be expressed in terms of the common bond, or community…Community thus did not mean merely tradition but simply social relations, such as those that were in fact emerging around a market-based society and bourgeois culture." (Delanty, 2003 p.2)*

Later, there was a separation of community from society, partially due to Hebrew and Christian thinking, which saw society as unjust and un-pure. In society as we know it, Delanty describes community as "natural" and society as "mechanical". In his theory community has a double meaning:

> *"On the one side, it expresses locality and particularity-the domain of immediate social relations, the familiar, proximity-and, on the other, it refers to the universal community in which all human beings participate,"(Delanty, 2003 p. 4)*

Delanty has provided an appropriate lens for understanding community in both senses. This lens enables identification of the different communities students find, whether they are as broad as the general African American community, or as narrow as an engineering study group.

Critical to both universal and local community is the role of social interaction. Social learning theory provides an additional lens for viewing community(Bandura, 1969). Bandura (1969) introduced the "social-learning theory," which proposes the idea that people learn several norms and behaviors from interaction with and observation of other people or "models".

Vygotsky (1978) highlighted the role of social interaction in learning and development and proposed a negotiation of socio-cultural factors key to the learning of students. Social interaction among students enables social transmission of knowledge between lesser and more advanced students (e.g., a mentorship relationship). This in turn increases the capabilities of the less advanced students in completing complex tasks more so than they would accomplish independent of the social interaction (Vygotsky, 1978). However, though dependent on the socio-cultural environment, the students construct their own meanings and hence their own knowledge.

From this theory follows the practice of discussion among students with a goal toward skill building and construction of authentic knowledge by students themselves. Theorists such as Bourdieu (1986) draw attention to student's natural opportunities to forming the social networks and relationships that contribute to learning. Bourdieu proposes that learned behaviors from others, as well as the social networks and resources available to an individual, comprises their "social capital" (Bourdieu, 1986).

Brown et al. (2006) considers community (or social networks) an important element of social capital that is lacking among people of color in both engineering education and professional environments. Brown regards social capital as a means for enhanced learning among engineering students of color via collaboration with other students and teachers (Brown, Flick, & Williamson, 2006). Research supporting the importance of social capital was conducted by Sanders (2010), who conducted a qualitative study of eight successful sophomore and junior-level male, African American engineering students, and found that participation in academic and social networks, as well as institutional programing and organizational support had a pivotal impact on their success (Sanders, 2010).Conversly, Seymour & Hewitt's (1997) findings describe outcomes from a lack of social capital. In their study of students of color who did not persist as STEM undergraduates, they found that highly culturally identified students had difficulty transitioning into predominantly white institutions where they felt their community and cultural lifestyles were not valued (Seymour & Hewitt, 1997).

Ethnic organizations as communities

Ethnic organizations such as minority student associations, Greek letter organizations (GLOs), and minority professional engineering societies have been found as sources of community for Hispanic American (Walden & Shehab, 2009) and American Indian (Foor & Shehab, 2009) engineering students as well as African American non-engineers (McClure, 2006; Trenor, Grant, & Archer, 2010).

Walden & Shehab's investigation (2009) focused on understanding how Hispanic-American students' personal backgrounds influenced their sense of belonging and

ability to find community within their institution. Thirty-seven successful Hispanic-American undergraduate engineering students attending a mid-sized south-western PWI were interviewed about the communities they participated in. The communities students found were described as either College of Engineering organizations such as the engineering club (E-club), the Society of Hispanic Engineers (SHPE), or the Society of Women (SWE) Engineers or organizations external to the College of Engineering, such as the Hispanic American Student Association (HASA), the Pan-American Student Association (PANAM), or Greek letter organizations (GLOs).

Findings indicated that the majority of the students found at least one community, nearly half the students were or had been active in more than one community, and in general female students were more involved than male students. Also, over half the students participated in SHPE; however the majority of those students were 2ndgeneration or 2.5 generation students. Engineering technical societies (E-club and SWE) were more likely to be joined by English-native, 2.5 generations or above, or unemployed students. First generation and/or Spanish-speaking students were more likely to find community in ethno-centric organizations outside of the College of Engineering such as HASA and GLOs (Walden & Shehab, 2009).

Similarly, Foor & Shehab (2009) investigated where successful undergraduate mixed-race "Native American" students found community and how their communities contributed to their persistence. As with Walden & Shehab (2009), student involvement in the engineering societies, such as the American Indian Science and Engineering Society (AISES), and non-engineering organization, such as the American Indian Student Association (AISA), were analyzed along with the vastly varying backgrounds

of the students. Student community involvement was seemingly predicated on ethno-centricity and level of acculturation. However in the case of several Native American students the darkness of their skin predicted their level of acculturation.

> *"Boundaries around the social spaces of AISA and AISES are understood along color lines. Darker skinned, more 'authentic' Native American students occupied the social space of AISA. Students who 'looked white' gravitated to the social space in AISES." (Foor & Shehab, 2009)*

These findings have guided the analysis of the current study to aid in the identification of similar organizations aimed toward support of African American students. Similar to HASA and AISA, the Black Student Association (BSA) provides support for all campus students from its respective ethnicity. Much like SHPE and AISES, the National Society of Black Engineers (NSBE) supports Black engineering students. The two studies described above suggest that lighter skinned and/or more acculturated students may find community in the ethnic professional engineering societies, while darker skinned and/or less acculturated students may gravitate more toward ethno-centric student organizations.

Greek letter organizations (GLOs) were also places Hispanic American engineering students found community (Walden & Shehab, 2009). Historically, many African American students of all majors have participated in Black Greek letter organizations (BGLOs or BGOs). BGOs were modeled after White Greek letter organizations (WGOs), however they have historically served a different purpose (McClure, 2006).

> *"According to the history of the NPHC [National Pan-Hellenic Council], racism had prevented Blacks from joining already existing White fraternal organizations. Black students on both historically Black campuses and predominantly White campuses founded fraternal*

> *organizations to enhance their college experiences and to deal with political and social issues facing the Black community (Rodriguez, 1995 as quoted by McClure, 2006 p.1039).”*

BGOs remain as entities on campuses across the nation, serving as centers of communal and social life for millions of African American students. According to McClure (2006), White students at PWIs can find support “through their participation in mainstream organizations that are predominantly White by default”. However there is a greater need for BGOs at PWIs due to the need for minority students to have their own same-race support groups. In her qualitative study seeking to understand how membership in BGOs impact Black men at PWIs, McClure (2006) found that membership in BGOs provides networks of social support that help students integrate into the larger campus, opportunities to connect with the history and culture of the larger Black community, and a network of alumni in the workforce.

BGOs have been found to benefit African American engineering students as well. A qualitative study by Trenor et al. (2010) sought to understand the potential role of BGOs in the lives of African American engineering students. After interviewing 10 undergraduate engineering students who were also members of BGLOs, several positive themes emerged:

- *Family-like bond/trust fosters network of academic and social support*
- *Access to career information and professional network through BGO*
- *Accountability to BGO chapter for academic performance*
- *Confidence gains in skills learned through BGOs applied to engineering schoolwork*
- *Time management skills*

(Trenor, Grant & Archer, 2010 p. 5)

Trenor's findings suggest several advantages for African American engineering students participating in BGOs.

> *"In fact, membership in a Black Greek-letter organization has the potential to provide unique contributions to African American engineering students' persistence, academic achievement and career paths." (Trenor, Grant, & Archer, 2010)*

The theories and research described above imply an importance of community for undergraduate STEM students of color, as well as a lens for identifying the communities they find, which may be instrumental in understanding their degree of success.

Identity

This study will focus on understanding both racial identity and engineering identity and the role they play in the success level and the communities of successful African American engineering students. The following sections will discuss available literature addressing these forms of identities among undergraduate engineering students.

Black Identity

The term "Black identity" came to prominence in the late 1960's during the Black power phase. This political label represented the solidarity and mass movement activity of African Americans in the wake of the assassination of Dr. Martin Luther King, Jr. In the book *Shades of Black*, William E. Cross (1991) discusses human identity. He considers identity to be a combination of personal identity (PI) and reference group orientation (RGO). According to Cross (1991, p. 43), "PI variables are thought to be the

building blocks of personality." These are general personality variables common to all humans such as anxiety, self-esteem, introversion-extroversion, depression-happiness, etc… These variables are then mediated by innate factors such as gender, culture, class, race, and ethnicity (Cross, 1991). Reference group orientation (RGO) represents the values, perspectives, group identities, lifestyles and worldviews of reference groups. Cross also wrote "In a sense, RGO represents the ethnographic dimension of the self-concept." (Cross, 1991) RGO includes racial identity, group identity, race awareness, racial ideology, race evaluation, race esteem, race image, and racial self-identification.

Research indicates a historically lower Black identification among African Americans prior to 1960, with a shift towards stronger Black identity during the Civil Rights Era. This transition in Black identity was considered a period of nigrescence (Cross, 1991). Cross introduced the psychology of nigrescence, a theory describing five stages of an individual's Black identification that symbolically represents a transition from being a negro (externally applied label based on appearance) to being Black (self-applied source of pride and connection to others, owning the label). Below are Cross's five stages of nigrescence:

Pre-encounter

This represents the stage of a person's life where they have yet to be confronted with their racial identity or forced to be aware of their race or racial implications.

Encounter

The encounter is an experience where a person is forced to confront their racial identity and become aware of their race (i.e. the first time a person his treated differently because of their ethnicity).

Immersion

During this stage a person (often in response to an encounter) takes an exaggerated plunge into their own ethnic heritage, often embracing behaviors, beliefs, and relationships with others that are seen to represent their culture, while rejecting those that do not.

Emersion

Emersion represents the transition from the often exaggerated embrace and rejection of the immersion stage to a gradual acceptance and recognized value of previously rejected behaviors, beliefs, and relationships with those of other cultures.

Internalization

This stage represents a synthesis between embracing a person's own racial identity, as well as those of other cultures. During this stage, a person not only embraces their own cultural behaviors, beliefs, traits, and relationships, but they also recognize the value of those same aspects in other cultures and are comfortable with them.

Demo & Hughes (1990) examined Black identity in terms of social structural processes and arrangements among a national sample of Black American adults. Findings indicated that childhood parental messages, adult relations with family and

friends, and community are important in cultivating group identity. Findings also suggest that integration into mainstream society, as reflected in interracial contact and adult socioeconomic attainment, is associated with less in-group attachment but more positive Black group evaluation. Demo & Hughes's findings indicate a "multidimensional conceptualization of Black identity" which suggests that Black identity may vary based on content of parental socialization, age, and socio-economic status. (Demo & Hughes, 1990).

To understand how the academic achievement of successful African American undergraduate engineering students may have been influenced by their Black identity, their narratives were viewed through the lens of the nigrescence model. This allowed the researcher to interpret the stages of Black identity development of the students, and differentiate by the academic achievement of students who excelled, persisted, or struggled academically.

All interviews were viewed through one research lens at time, meaning, all 19 student interviews were first coded via a community framework, then Black identity, and lastly engineering identity.

Engineering Identity as Discursive Identity

Utilizing Gee's lens of discursive identity (Gee, 2000), engineering education researchers have defined and studied engineering identity(Allie et al., 2007; Allie et al., 2009; Capobianco, 2006). Discourse Identity involves an ability to interact with and understand the tools, symbols, and rhetoric of a specific community with which one seeks to identify. It also implies the ability to communicate with others who identify

within that community. Therefore, engineering discourse identity involves a desire to be a member of the engineering community, as well as a capacity for understanding the language, behaviors, symbols, and interactions common to members of the engineering community. Engineering identity can be expressed through a student's willingness and confidence in "talking the talk" as they learn to "walk the walk." The following research describes challenges with reconciling engineering identity with Black identity for African American engineering students.

In Denson et al.'s *Critical Inquiry into Urban African-American Students' Perceptions of Engineering* (2010), a qualitative research methodology was used to understand how African American high school students perceive engineering. The study found that the lack of school exposure to the field of engineering indicates "perpetuation of stereotyping for a field that is predominantly occupied by white, middle-age males," and implicates a lack of early development of engineering identity. In their interpretation of the findings, they described the greater issue of poor math and science ability as an issue of lesser opportunity for quality instruction coupled with culturally irrelevant curriculum content (Denson, Avery, & Schell, 2010).

Malone and Barabino (2008) studied identity formations in STEM among African American graduate students in laboratory environments and found that students were challenged by feelings of "invisibility/lack of recognition", not being "in the loop", racialization (or feeling as though they represent all African Americans), and the integration of their African American and STEM identities. Here, the researchers describe the challenges of identity integration within the university setting:

> *"Previous research and our own study suggest that laboratory and educational interactions can lead to and/or provide the conditions for forming an identity as researcher, professor, and scientist; yet many times we find that underrepresented minorities face identity impasses rather than opportunities to deepen and integrate identities within a university setting. These difficulties in identity integration are one facet of being the "only one," meaning that a person is "one" rather than brought into a community of practice where one is automatically part of 'we.'"(Malone &Barbino 2008, p. 505)*

These studies exemplify discouraging factors in relation to African American engineering identities; however, it may be useful to understand engineering identities and the extent to which they are reconciled with the Black identities of successful engineering students as potential contributors to their success and differentiators between persistence and excellence. The discursive engineering identity lens was used for interpreting engineering identity, as well as the perspectives brought on by previous engineering and STEM identity research on African Americans.

CHAPTER THREE: METHODOLOGY

The analyses performed here are a part of the study "Portraying Success Among URM Engineering Majors," a broader multidisciplinary qualitative study of factors contributing to undergraduate URM engineering success conducted by the Research Institute for STEM Education (RISE). This chapter will discuss the rationale behind the choice of using qualitative methodology, as well as describe the procedures used to analyze data.

Rationale for Research Design

Though traditional quantitative data has great utility within the field of engineering education, qualitative studies have proliferated over the last decade. Qualitative methods traditionally have been reserved for social science and psychological research, however deeper, richer, and more robust data can be accessed from individual lived experiences of participants. Qualitative methods were chosen because of their power to transform the experiences of those with traditionally unheard voices (i.e. African American engineering students) into meaningful data. Creswell (2007) states:

> *"We conduct qualitative research because a problem or issue needs to be explored. This exploration is needed, in turn, because of a need to study a group or population, identify variables that can then be measured, or hear silenced voices. These are all good reasons to explore a problem rather than to use predetermined information from the literature or rely on results from other research studies. We also conduct qualitative research because we need a complex, detailed understanding of the issue [,]...we want to empower individuals to share their stories, hear their voices…we want to understand the contexts or settings in which participants in a study address a problem or issue...We use qualitative research and help explain the mechanisms or linkages in causal theories or models...[,] develop theories when partial or inadequate theories exist for certain populations and samples or existing*

> *theories do not adequately capture the complexity of the problem we are examining...[,]because quantitative measures and statistical analyses simply do not fit the problem...To level all individuals to a statistical mean overlooks the uniqueness of individuals in our studies." (Creswell 2007, p. 55)*

Qualitative Method

The research paradigm that best fits this research project is that of phenomenology. Phenomenology provides a framework for understanding factors contributing to differential success emerging from the common themes and unique experiences of a group of African American engineering students.

Phenomenology is a qualitative method used to understand a shared experience from the varied perspectives of multiple participants in the experience. Phenomenological methodology allows individuals who have experienced a similar phenomenon to reveal their experiences in order to gain a deeper understanding of the phenomenon experienced. Creswell (2007) describes the basic purpose of phenomenology below:

> *"The basic purpose of phenomenology is to reduce individual experiences with a phenomenon to a description of the universal essence...It would be important to understand these common experiences in order to develop practices or policies, or to develop a deeper understanding about the features of the phenomenon."(Creswell 2007, p. 73)*

Context for the Study

This study took place at a major research university located in the south central region of the US. At the time, the total undergraduate enrollment of this institution neared 19,000, with an engineering student population of around 2,000. The ethnic

breakdown for the university during this time is shown in Table 1. Note that the College of Engineering (COE) was slightly more diverse than the university as a whole.

Table 1. Fall 2007 Engineering Enrollment by Ethnicity

Ethnicity	University	COE
White	74.05%	68.52%
Black	5.70%	6.16%
Asian	5.65%	8.04%
Hispanic	4.15%	5.67%
American Indian	7.40%	6.93%
Totals	100.00%	100.00%

Though the percentage of African American undergraduates enrolled in COE is greater than the university, their numbers and percentages at COE have steadily declined over the time of this data collection. Figure 1 shows the decline in both overall number and percentages of Black undergraduate engineering students enrolled from 2000-2006. Over this time span, the percentage of Black engineering undergraduates was nearly cut in half, while that of whites increased by nearly thirty-percent. Black undergraduate engineering enrollment may have been negatively impacted by a major transition within the Multi-cultural Engineering Program (MEP), during which leadership fluctuated and coincidentally so did perceptions of the program. Additionally, political forces impacted race-based recruiting admissions, and financial aid.

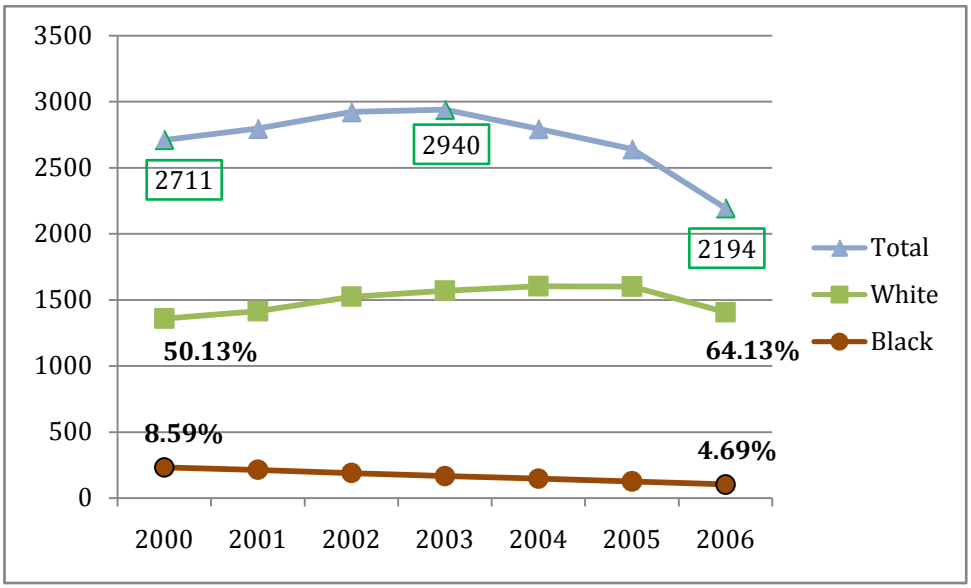

Figure 1. 2000-2006 Fall Undergraduate Engineering enrollments

COE retention rates also reflect the poor persistence of African American engineering undergraduates. The six-year graduation rate for the entire university's 2000 cohort of first-time full-time freshmen was 59.5%, while the six-year graduation rate for COE students was only 34.8%.White engineering students within the 2000 cohort graduated at nearly 32%. African American students within the 2000 cohort graduated at the lowest percentage of all groups, a mere 28%. Decreasing enrollment, coupled with the lowest graduation rates in the college, seem to paint a poor picture for the future of African American engineers at this institution.

Table 2. COE 2000 cohort's six-year graduate rate

Ethnicity	Graduates	Graduation Rate
White	274	32%
Black	50	28%
Asian	46	41%
Hispanic	34	32%
American Indian	31	36%

Participants and Setting

Participants for the broader study were selected using both criterion and convenience sampling techniques. The criteria were that students:

- self-identify their ethnicity as African American,
- be enrolled as undergraduate engineering students, and
- eventually graduate from the institution with a bachelor's degree in an engineering discipline

The study participants were recruited from throughout the College of Engineering and were offered a modest participation stipend, however, the sample ultimately arose from those self-selecting individuals who volunteered to be interviewed. A total of 37 students meeting the above criteria volunteered to participate in the broader study. While the broader study may potentially yield more generalizable results, the current study does not seek to generalize. Phenomenological studies typically use between 5 and 25 participants (Creswell, 2007), and for this reason a subsample of 19 (11 male and 8 female) students was selected from the original 37 participants using additional selection criteria. The selection criteria for this subset were based on the following collegiate characteristics: cumulative grade point average (GPA), number of course re-takes, gender, and academic major.

GPA is often used by many institutions as an indicator of a students' academic excellence. The institution of focus in the current study uses GPA to distinguish students when recruiting, recommending scholarships and internships, and finally when considering special distinctions for graduation. The initial intent of this study was to

understand differences between two groups (students who excel academically vs. students who do not); however, an analysis of student academic transcripts revealed a hierarchy of three distinct categories: high, mid, and low-level academic achievers. As a result, the intent was shifted to understand differences between three student categories; excellers, persisters, and strugglers. Therefore, cumulative GPA was used as a primary factor to determine academic excellence and differentiate categories.

GPA cannot always tell the whole story of student academic performance. Another factor that was considered is how often students were forced to regress in order to preserve or maintain their progress toward a degree. The institution of focus employed a grade forgiveness policy allowing students to replace grades for up to four courses in the event that their grades in those courses were unsatisfactory. Course re-takes can substantially impact cumulative GPA in a positive manner, and therefore are the second major criterion used to determine academic excellence. For example, an individual who earns a 3.6 cumulative GPA after re-taking two failed courses is not considered as high an academic performer as a student who has earned the same GPA without re-taking courses. The table below displays the overall subsample of students differentiated by their respective academic grouping, gender, GPA (mean and range, and number of course re-takes.

Table 3.Academic Grouping

Academic Grouping	Total Students	Female	Male	Average GPA	GPA Range	Retake Range
Excellers	6	2	4	3.7	3.44-3.9	0-2
Persisters	5	3	2	3.062	2.9-3.28	1-3
Strugglers	8	3	5	2.635	2.0-2.89	6 or more

Based on the academic grouping criteria, the total study participants fell into comparable subsamples of six excellers and eight strugglers. Persisters were initially over represented and were reduced based on overall sample size, gender, and major distribution. Overall these students earned GPA's ranging between 2.26 (struggler) and 3.9 (exceller) and re-took between 0 and 14 courses over again. Nineteen students completed 32 interviews with 11of them interviewing multiple times (two completed three interviews and nine others interviewed twice). The following section will elaborate on the students from each academic grouping.

Excellers

Excellers were the highest academic achievers. Students from the exceller group earned at least a 3.44 cumulative GPA while having to re-take 0-2 courses. Table 4 displays pertinent exceller background characteristics.

Table 4. Exceller Characteristics

Students	Parental Education level	High School		College	
		Comm. Type	Class Size	GPA	Retakes
Male Civil Exceller 1	Some College	Urban, major metro area	201-500	3.90	0
Male Petroleum Exceller	Post graduate	Urban, major metro area	201-500	3.89	0
Female Mechanical Exceller	Post graduate	Mainly rural community	51-200	3.69	2
Male Mechanical Exceller	Post graduate	Suburban, mainly commuter for large city	more than 500	3.44	0
Male Civil Exceller 2	Some College	Mainly rural community	51-200	3.82	1
Female	High	Small town	201-500	3.46	1

Chemical Exceller	School				

All but one exceller received an academic scholarship to attend the institution. Half of the exceller's parents earned a degree beyond bachelors', and only one had parents who hadn't attended college. Excellers high school communities varied; two students attended schools in urban, major metro areas, two in mainly rural communities, and two in suburban, mainly commuter cities or small towns. Exceller high school graduating class sizes varied as well; three students graduated with classes of between 201-500 students, two students graduated with a class of 200 students or less, and one student graduated with a class of more than 500 students.

Persisters

Persisters were mid-level academic achievers. Students in the persister group earned cumulative GPA's between 2.9 and 3.28, while re-taking 1-3 courses. Table 5 shows the characteristics of the five students in the persister group.

Table 5. Persister Characteristics

Students	Parental Education level	High School		College	
		Comm. Type	Class Size	GPA	Retakes
Male Mechanical Persister	Some College	urban, large city	51-200	3.28	3
Male Electrical Persister	4 year degree	urban, major metro area	51-200	3.08	2
Female Mechanical Persister	4 year degree	suburban, medium city	more than 500	3.07	2

Female Chemical Persister 1	4 year degree	small town	51-200	2.98	1
Female Chemical Persister 2	Post graduate	suburban, mainly commuter for large city	more than 500	2.90	1

Three persisters received academic scholarships, while two did not report scholarship information. All persisters had a parent who attended college; only one persister did not have a parent who earned a four-year college degree. Persister high school communities varied as two were from urban high school communities, two were from suburban high school communities, and the remaining persister attended school in a small town. Three persisters belonged to high school graduating classes of 51-200 students, while the remaining two graduated with classes of 500 or more students.

Strugglers

Strugglers were the lowest academic achievers. Students in the struggler group earned cumulative GPA's ranging between 2.26 and 2.83, while having re-taken six or more courses. Table 6 represents pertinent background characteristics.

Table 6. Struggler Characteristics

Students	Parental Education level	High School		College	
		Comm. Type	Class Size	GPA	Retakes
Female Electrical Struggler	Some College	Suburban, medium city	More than 500	2.79	14
Female Civil Struggler	Some College	Suburban, medium city	More than 500	2.73	7

Male Chemical Struggler	Some College	Urban, major metro area	51-200	2.70	7
Female Computer Struggler	4 year degree	Urban, large city	51-200	2.26	11
Male Electrical Struggler	2 year degree	Urban, large city	201-500	2.69	11
Male Industrial Struggler	4 year degree	Urban, major metro area	Less than 25	2.38	14
Male Civil Struggler	Some College	Suburban, medium city	201-500	2.70	6
Male Mechanical Struggler	Post graduate	Urban, major metro area	201-500	2.83	8

Five strugglers received academic scholarships, while three were supported through Pell grants and student loans. All but one student interviewed twice, with their final interviews falling between fall 2005 and spring 2007. All strugglers had at least one parent attend college; however only three had a parent earn a four-year college degrees or higher. Five strugglers attended high schools in urban communities, while the other three attended suburban high schools. Struggler high school graduating classes varied more than any other grouping with three students from classes between 201-500, two had classes of 51-200 students, two from large classes of 500 or more, and one reported less than 25.

Data Collection

This study utilizes data sets previously collected by the broader RISE study (Shehab et al., 2007). Survey and academic transcript data were used to generate the criteria for the selection of the subsample of 19 successful African American undergraduate engineering students. Interview data were used to investigate the undergraduate lived experiences of the 11 male and 8 female engineering students, who provided 32 interviews over five semesters.

A detailed description of the full interview protocol can be found in Appendix A. In brief, face-to-face interviews were utilized as the method for capturing the lived experiences of the participants in regards to their strategies for success in engineering. All interviews were audio recorded and later transcribed verbatim. Participant identities were kept confidential by removing all names from the data set and replacing them with coded identifiers. The researcher was provided data from the current study, free from participant identities, and also cleaned of any names mentioned during the interviews.

The current study focused on utilizing responses to interview questions that align with the research lenses as well as the research questions. Responses to the numbered protocol questions listed in Table 7 comprised the bulk of data used for analysis (see Appendix A for protocol questions).

Table 7. Protocol Question Mapping

Protocol Questions		
Black Identity	**Engineering Identity**	**Community**
17, 19, 24, 25, 26, 27, 29, 35, 36, 37, 39, 55	2, 3, 4, 12, 17, 31, 33, 50, 56	10, 12, 13, 14, 17, 25, 26, 30, 31, 32, 35, 36, 39

Data Analysis

Due to the vast amount of transcript data, NVivo 8 © (QSR) qualitative analysis software was utilized. NVivo's robust combination of digital features and tools allow for more efficient coding, storage, and analysis of interview data. In NVivo, each interview transcript was subjected to a "coding" process in which significant statements or quotes providing understanding within the interview content was categorizing, labeled, and saved or "coded".

The initial coding structure was generated from original interview protocol questions used during the RISE study, research literature, and emergent codes from an eight-student pilot analysis seeking to understand how successful African American undergraduate engineering students define success (Hughes, Shehab, & Walden, 2011) (Student interviews from the pilot study were also used in the current study). This structure was then modified based on the current study's research questions and consultation of relevant literature, then used as the initial coding structure. This initial structure, while remaining subject to more modification throughout the coding process, was used to re-code the pilot study interviews as well as interviews from the remaining 11 students.

All interviews were viewed through one research lens at time, meaning, all 19 student interviews were first coded via a community framework, then Black identity, and lastly engineering identity. Therefore each interview was coded at least three times independently using each research lens as a framework for analysis and interpretation. While coding each transcript through each research lens, descriptive and interpretive notes were taken using NVivo's memo feature. Notes taken from students who

completed multiple interviews were consolidated at the completion of their final interview coding.

Once coding of all interviews was completed, an analysis spreadsheet was generated to help organize and more easily view student descriptive summaries across the overall group. Using Microsoft Excel ®, the descriptive notes saved in NVivo were copied to this spreadsheet, which was initially organized in a 4 x 20 table/matrix displaying the interpretive notes of each student's experiences by research lenses and student/academic grouping.

Once interpretive notes were viewable across academic groupings, they were used to generate composite descriptions/summaries of each academic group (excellers, persisters, and strugglers) via each interpretive lens (community, Black identity, and engineering identity), representing the "essence" of each lens as experienced by each academic group. Table 8 provides a condensed visual example of this matrix.

Table 8. Persister Analysis Spreadsheet Example

Research Lens	Male Mechanical Persister	Male Electrical Persister	Female Mechanical Persister	Female Chemical Persister 1	Female Chemical Persister 2	Consolidated Summary
Community	Notes	Notes	Notes	Notes	Notes	Composite Persister Community Summary
Black Identity	Notes	Notes	Notes	Notes	Notes	Composite Persister Black Identity Summary
Engineering Identity	Notes	Notes	Notes	Notes	Notes	Composite Persister Engineering Identity Summary

Those academic group composite descriptions/summaries were later consolidated to

generate complete composite descriptions/summaries of each research lens, which represented the overall “essence” of each lens as experienced by the entire sample. The essence of student experiences, as seen through each research lens (both by academic grouping and overall sample), were then cross referenced with demographic data, coding, and literature to understand potential relationships and connections.

These consolidated interpretations represent the researchers understanding of the phenomenon and are explained in the results section. NVivo was later used to perform queries that searched coded content for relevant and robust quotes exemplifying the researcher’s subjective interpretations. Many of these quotes were copied and organized in the analysis spreadsheet and are offered in the results section.

CHAPTER FOUR: RESULTS & DISCUSSION

Using the phenomenological process described in the preceding chapter, student interviews were analyzed via each research lens (community, Black identity, and engineering identity) to identify common themes within and across each academic sub-group. Analysis revealed the emergence of community as an overarching lens, which permeated through the lenses of both Black identity and engineering identity. Therefore the results section is presented and organized in terms of the community analysis results, their relation to academic performance and their interrelationships with the analysis results of the Black identity and engineering identity lenses. The section is broken into three subsections, two of which use Delanty's (2003) duality of community as the framework representing community in its two senses; universal and local. The third section describes a specific, strategic, and more personal type of local community, the social/learning communities that students find and relate their success to (Bandura, 1969; Brown, Flick, & Williamson, 2006; Vygotsky, 1978; Wenger, 2000).

Delanty (2003) calls one sense of community the "universal community" and defines it in terms of general humanity and how an individual feels connected to the human race. Membership in a universal community is often established by one's identification with the physical and mental traits, behaviors, and characteristics of the universal community. For the African American engineering students included in this study, the corresponding universal communities were defined as the engineering profession, the broader African American community, and overall community of this particular PWI. The engineering professional community refers to that of practicing engineers and engineering students across the world. The African American community

refers to the U.S. population of African Americans, and the PWI community refers to the overall population of students, faculty, and staff of the specific institution the students attend.

Another sense of community Delanty described was that of "locality and particularness." Local communities are formed from members who share similar interests and experiences and who engage with one another in some meaningful way. One category of local community experienced by students in this study comprises institutional organizations such as the College of Engineering (COE) and Engineering Club (E-Club), whose membership includes all students enrolled in an engineering major. Campus-wide social communities such as the Black Student Association (BSA) and Black Greek Organizations (BGOs) are local and specific to Black students and offer a space for the engineering African American students to interact with other Black students on campus. The National Society of Black Engineers (NSBE) represents an intersection of local communities defined both by major and by race and its mission serves as a bridge to the Universal communities of the engineering profession and the African American community.

Contemporary engineering education literature highlights the potential impact of establishing learning communities (or social learning communities) on student success due to their stimulation of social learning (Bandura, 1969; Vygotsky, 1978) and engineering discursive identity development (Allie et al., 2007; Allie et al., 2009), as well as their enhancement of social capital (Bourdieu, 1986; Brown, Flick, & Williamson, 2006). Social learning communities can also be recognized under the broader "local communities" term; however, they have been given a special distinction

due to their emphasis on learning. Social learning communities are places where common bonds and experiences locally intersect with technical learning. These communities can be further disaggregated to voluntary and required settings where engineering students interact with each other and/or faculty members in regard to technical learning. Understanding the interaction between the students in social learning communities can provide insight into engineering peer relationships, potential feelings of isolation due to race/ethnicity, and student engineering discursive identities.

Specific engineering courses discussed by students were identified as required social learning communities because in engineering classroom settings students and faculty are scheduled to meet in a space to discuss material related to a specific engineering subject or topic for a predetermined time period, often one semester. Each course offers a unique experience for students and faculty to interact in relation to technical course material. Course team projects were also identified as required social learning communities due to the requirement of students to complete projects with a smaller group of their classmates.

Students also found their own voluntary (non-required) social learning communities where the students have the power to choose who they interact with. Study groups and technical societies are two examples of non-required social learning communities that were identified. Study groups enabled students to choose who they study with and when. Technical societies, such as the American Society of Civil Engineers (ASCE), encouraged engineering students to attend meetings with other co-disciplinary engineering students and learn more about technical aspects of their profession.

Universal Communities

Universal communities represent places where students feel connected to much more generic groups. The universal communities identified here are those of the engineering profession, the broader African American community, and the community of the PWI of focus. This section describes the exceller, persister, and struggler universal community experiences as well as an interpretation of how the communities relate to both Black identity and engineering identity. At the universal level, Black identity is interpreted in terms of environment of upbringing and sense of belonging in the African American community, while engineering identity refers to student's perceived fit with engineering image.

Excellers

Excellers displayed varying connections to universal communities. Several of their interview responses displayed an identification with either an initial or growing comfort with the norms and customs of majority White culture. The following passages help to illustrate this. This male petroleum engineering exceller describes growing accustomed to being "the one Black student", as he was raised in a majority White environment. Here he discusses his upbringing and how it relates to his comfort level at this PWI:

> *I: How do you feel about being a minority in that environment?*
> *P: Um I feel fine with it because I grew up that way and I've always been in that environment. I grew up in the suburbs and was the one Black student or whatever. So it's kind of like the environment I've become used to, so it really doesn't bother me.*
>
> *–Male Petroleum Exceller*

Some Black students became so acclimated to majority White environments that they were unfamiliar with more diverse environments. The male electrical engineering exceller speaking in the passage below was actually surprised by what he perceived as an unexpected abundance of diversity when he first arrived on campus:

> *I: Did anything surprise you when you first got here?*
> *P: Probably the diversity of the campus, as far as ethnic groups.*
> *I: It surprised you that it was so diverse or?*
> *P: It was so diverse, yeah.*
>
> *–Male Civil Exceller 2*

The comments above indicate that these excellers developed a high-level of comfort in predominantly White environments prior to their arrival on campus. The exceller providing the first comment mentioned previous experience in a majority White neighborhood and high school, which prepared him for the majority White environment at the PWI. The surprising reaction to the overall campus diversity expressed by the next exceller indicates that his expectation was to see even fewer minority students than were present at an institution with low minority enrollment. His low expectations for minority presence implies a higher expectation of White students and suggests either a previously developed willingness to adjust or a high-level sense of comfort in majority White environments.

While these passages suggest that some excellers' comfort with majority culture developed prior to their arrival on the campus, not all excellers shared the same sentiments about the diversity of the institution, nor did they arrive with the same level of comfort or experience in majority white environments. Excellers raised in predominantly Black environments needed to overcome initial feelings of isolation. In a

response to a question regarding his daily experiences as an African American male in the College of Engineering, the male civil engineering exceller speaking in the passage below describes his initial acclimation:

> *When I first got here it was eye-opening because I came from a school that's probably 90% African American. So the first year it was kind of different, but I just became accustomed to it and now I don't even realize it because the classes are so small. There's like 10 to 12 people now and so I probably am the only African American in that class...So later in my college career, it really hasn't affected me at all. I haven't noticed it.*
>
> *–Male Civil Exceller 1*

The passage above indicates that the student previously had little experience in majority White environments and was forced to adjust as a student. He later discussed the need for social relationships between African American students and "Caucasians", as a means of enhancing achievement:

> *Once you say [School Name], it draws back a lot of African Americans, but they don't know. Once you get here and get the experiences, this college is like a microscope of the world. The world is mostly Caucasian, so you have to learn how to work…Caucasians are who you are going to work with if you want to get to higher positions in your life, so learn how to deal with all types of people. Don't just be focused on one group of people. Come here and learn as many things as you can, there are going to be a lot of experiences. There is so much to do, so much to learn, and so much opportunity that you have to succeed…Step outside of the box*
>
> *–Male Civil Exceller 1*

This exceller seems to have recognized the value in adjusting to majority culture and embracing an attitude of acceptance that enabled him to overcome his initial transition from a majority Black to majority White environment. While an upbringing in majority Black environment suggests the presence of a Black reference group orientation and

overall Black identity, his attitudes seemed to allow him to more easily connect to the general PWI community. These passages not only provide insight to the student's attitude toward transitioning from a high school environment where Black students were more prevalent, to a PWI, but also a world view that recognizes the importance of developing connections with other cultures outside of traditional African American culture to achieve professional success.

In addition to an overall sense of belonging to the universal PWI community, some excellers also expressed identification with the professional engineering community. When asked to describe their image of an engineer, excellers responded with expressions of their sense of belonging to the broader professional engineering community. In the passage below, the civil engineering exceller describes his narrow vision of an engineer as "A man's man" and tells us whether or not he "fit" with his image.

> *I: What do you think is the image of an engineer?*
> *P: Smart and business-oriented. A man's man. If you think about the profession, you think that it's a man's profession, so I think they're smart, and real manly. It has a lot of history and lot of integrity behind it. A lot of people respect engineers.*
> *I: Do you fit that image?*
> *P: I think so.*
>
> *–Male Civil Exceller 1*

Another exceller provides an alternative image of engineers while maintaining "smart" as a key characteristic:

> *I: What do you think is the image of an engineer?*
> *P: Really smart people, really smart, they know what they're doing. They can design stuff, problem solver.*
> *I: Do you fit this image?*

P: Yeah…All of my other friends that aren't in Engineering give me crap all the time, saying "You're really smart, you know? You're an engineer. Oh wow, you're really a smart guy over here." And I'm pretty good at solving problems, Engineering-related. I love to design things. I'm pretty good at designing stuff and having ideas.

–Male Mechanical Exceller

The use of characteristics such as "smart" and "problem solver" by the excellers above signify some stereotypical views of engineers; however the student's perceived fit with their own engineering images suggests the presence of self-efficacious attitudes toward their intelligence. This perceived fit as an engineer indicates a sense of belonging to the professional engineering community.

Not all excellers expressed the same connection. The response by the male civil engineering exceller below expresses his image of engineers as that of a person lacking personality and exemplifies a mismatch with his identity:

I: What do you think is the image of an engineer?
P: I think it's more of a, you know, professional, white-collar type of job… It's kind of mostly a straightforward person. Not much of a personality probably.
I: And do you feel like you fit this image?
P: no not really.
I: Because you've got personality?
P: Yes, I've got personality and I don't wear a tie.

–Male Civil Exceller 2

Unlike the excellers before, this description of an engineer as a "white-collar type" and "straight forward person" that leaves something to be desired in terms of personality seems to have a negative connotation behind it. His lack of perceived fit with his image of engineers suggests a disconnect between himself and engineers,

therefore also implying a feeling of not belonging to the universal professional engineering community.

While excellers varied quite a bit in regard to both the PWI and professional engineering communities, they were most uniform in their connection to the general African American community. The following passages provide insight into a few excellers' connection to the African American community while also discussing the intersection between Black identity and engineering identity.

> *I: Engineering has historically been a white male profession, so how do you feel about being a minority in that environment?*
> *P:It feels good [to overcome] those stereotypes that African Americans can't do it or are not smart enough… it's kind of lonely at times though*
> *I: How do you get past the loneliness?*
> *P:I guess you just kind of get use to it. I guess when you do have events or things that go on, you kind of represent those that don't go into the field and, I mean, different fields and kind of break the stereotype a little bit. When you have an opportunity, you do hang around other African Americans that are in your field.*
>
> *–Male Civil Exceller 2*

In the passage above the student acknowledges being a part the African American community, as well as an understanding of common stereotypes that face Blacks in the engineering profession. The stereotypes he mentioned, "that African Americans can't do it" or that they are not "smart enough" suggests an awareness of American society's view of African Americans not being intelligent enough to become engineers. While he recognizes that he will be one of few who are able to pursue the field, he embraces the opportunity to blaze the trail for future Black engineers, as well as any opportunity to "hang" with other African Americans in the field.

A strong connection to the African American community is also expressed in the

advice of this petroleum engineering exceller to future African American students at the PWI of focus, he encourages them to embrace their culture while not being afraid to "step outside of the box":

> *Don't let them define you. You define yourself. If you're classified as an African-American, don't let that define you. Go talk to anybody. Don't let race be a boundary. If you come in here and say well I'm African-American, you're already half way defeated if you ask me. You have to come here thinking I'm a student just like all the rest of these kids... Just go talk to whoever you want, because they're people just like you... Be proud that you're an African-American, and know where you came from, but don't come here thinking that you're behind or you can't do as well as them because you can do well just like everyone else.*
>
> *–Male Petroleum Exceller*

The passage above suggests a connection to the African American community by placing the term "them" on the White majority and focusing attention on keeping them from classifying African Americans. Like the civil engineering student speaking in the passage before, this student also displays an awareness of society's views of African Americans and seeks to challenge their acceptance among other African Americans. His proposed strategy appears to be a rejection of stereotypes that view African Americans as lesser people, and willingness to communicate with people who are not African American. His statements not only suggest a connection to the exceller's own African American culture, but also an attitude of acceptance toward those from majority and other cultures.

When asked to describe what role being an African American played in his choice of friends, this male civil engineering exceller responds with an allusion to a strengthening connection to his roots:

> *P: I don't know. I think it just keeps me back to my roots, my background. I don't know how I would act if I had predominantly white friends or my attitude about the African American community would change. I am not going to just assume that it would change, but it probably would. But I just always had African American friends, pretty much.*
>
> *–Male Civil Exceller 1*

In mentioning that surrounding himself with African American friends keeps him to his "roots", and alluding to the possibility of change in the event that his friends were not African Americans, the student suggests a deliberate choice. This passage not only indicates a strong Black reference group orientation, but also suggests that there may be concerns with losing ethnic culture by establishing friendships primarily with those outside of that culture.

Though most excellers expressed their identification with the African American community, not all of them did. Other excellers may have shared the distinction of being African American, but didn't share a connection with the African American community. In the passages below a mechanical engineering exceller overtly displays this disconnect, starting with the reference group orientation of the group he surrounds himself with, and ending with an admission of the need to appear "Black" on his resume:

> *I: What is the racial ethnic makeup of your primary, core group of friends?*
> *P: All White...My dad put us in an environment where he knew my mom would not have problems living. With my mom being White, he's not going to put my mom in a predominantly Black neighborhood where she's going to feel uncomfortable, or make it like she may have a little problem.*
>
> *–Male Mechanical Exceller*

Later he further distances himself from the African American community when he seemingly embraces his contrasting physical appearance from that of "average" African American males:

> *I: Can you speak more about your daily experience as an African American male in the College of Engineering? Does it like affect you any?*
> *P: No because I guess a lot of people don't portray me like that because I don't dress like your average African American male. I dress a little bit different, and everybody says I just look different. So like I guess I'm my own person, my own thing.*
> *I: So, do people think you're African American, or do they think you're something else?*
> *P: I've been mistaken for Puerto Rican before. When girls talk to me they think I'm something else or they don't know what I am.*
>
> *–Male Mechanical Exceller*

Finally, he acknowledges this disconnect, in expressing his desire to show that he is Black:

> *I: Why did you just become involved in NSBE?*
> *P: Well basically because the honest truth is I wanted to somehow show on my resume that I was Black.*
>
> *–Male Mechanical Exceller*

Though certainly not the norm, the White reference group orientation, willingness to disidentify with African Americans and their culture, and the expressed need to appear Black for professional reasons indicate an overt disconnect between the student and the general African American community. However, they also suggest an advanced adjustment to majority White environments as well. The lack of connection to personal Black identity as well as Black reference groups suggests a low level Black identity and

lack of connection to the general African American community.

Overall, excellers displayed a Black reference group orientation, an awareness of Black issues, and a desire to advance the Black community. Excellers also demonstrated an advanced adjustment or a strong willingness to adjust to the predominantly White campus environment, suggesting a sense of "belonging" to the universal community of the PWI campus. The ability of excellers to recognize the value of other cultures, coupled with their apparent internalization of African American culture, places the overall group closest to the internalization stage of nigrescence.

Excellers were divided in terms of students who felt they fit their image of an engineer vs. those who did not. According to Allie (2007), a sense of belonging to the engineering community is a key element of the engineering discursive identity development. Variability in perceived fit with the engineering image indicates an average group connection to the universal engineering professional community, suggesting an average contribution of perceived image as an engineer to overall engineering discourse identity.

Persisters

Like excellers, persisters varied in terms of their connection to the universal professional engineering community. When asked to describe their own images of engineers and whether or not they fit, persisters were divided. This mechanical engineering student says he fits his image of an engineer but seems unsure:

> *I: What do you think is the image of an engineer?*
> *P: We're looked at as nerdy and smart. We have no life. We're looked at as smarter, more analytical. We won't say twelve o'clock, we'll say like eleven fifty nine. We're more precise.*
> *I: Do you fit the image?*

P: Yeah I guess so...

–Male Mechanical Persister

Below, a female persister indicates that she is transitioning into her image of an engineer:

I: Do you feel (P), what do you think is the image of an engineer?
P: Someone who's knowledgeable in technical matters, and who understands why things do the things that they do. Actually, it's just basically somebody who can look at a situation and have an open mind to think of ways to make it better, solve problems, and make things more efficient in companies.
I: Do you fit the image?
P: More and more. (Laughs) It's a growing process.

–Female Chemical Persister 2

The persisters above used similar terms such as "nerdy" and "knowledgeable" to symbolize intelligence when describing their images of engineers. Also, their perceived fit with their engineering images suggests a growing, but not confident sense of belonging to the professional engineering community, and hence an adequate engineering identity. While their descriptions were somewhat uniform, not all persisters felt they fit their own engineering image. This inconsistency is exemplified by the female chemical engineering persister speaking in the passage below:

I: What do you think is the image of an Engineer?
P: Glasses, real smart and states this random stuff off the wall whatever and always into books, no social life, nerdy.
I: Do you think that you fit that image?
P: No... It's really hard for me to catch on something quickly whereas, most people just say, "Oh you're in Engineering, you must be really smart." And, I don't view myself as really smart. I just view myself as smart because I had to sit down and think and apply myself versus someone else who is just innately smart.

–Female Chemical Persister 1

In the response above, she shares the view that engineers are smart; however, she expresses her image with phrases that emphasize negative stereotypes about engineers. She did not identify with her image of an engineer, in her case indicating a disconnect from the professional engineering community.

While several persisters acknowledged the intelligence of engineers, they did not all liken themselves to engineers. The group's divided responses suggested an average group connection to the professional engineering community, and therefore an average contribution to group engineering discursive identity

Persisters exhibited a strong identification with the African American community. This trend is exemplified in several of their responses: In the passage below, a female chemical engineering persister explains what being "brown" not Black, means to her:

> *I: What does your ethnicity mean to you?*
> *P: First of all I'm not Black because I'm brown; my mom taught me that. It's a culture that through the beginning years struggled and can still be seen as struggling to actually be seen equally in the sights of others in America… African American culture to me represents pride of yourself, [and] for your people… it's like your identity, it's like a badge of honor to be African American because you've prevailed over so many things in the past and still do even now in today's society... It's just like saying "Hey, I'm African American. I'm still living; I'm struggling but I'm making it through and I'm surviving." It's about community; it's about family, about how each generation provides a stepping-stone for the one to come afterward.*
>
> *–Female Chemical Persister*

In the passage above, the persister acknowledges the historic challenges of African Americans while also expressing pride in the group's ability to overcome those

challenges. Her words indicate a strong sense of belonging in the universal African American community an intense Black reference group orientation. While the persister above views being African American as a badge of honor, the male mechanical engineering persister viewed his ethnicity as a responsibility:

> *I: So what does being a Black male mean to you?*
> *P: To me I feel like I have to, not prove myself, but be like be a good role model for my siblings. I need to show a good perception so that people won't look down on Black males. Don't lolli-gag in class...Get your work done so that later on whenever people see a Black male in the College of Engineering, it won't be as a big of a deal. Probably before me, ten years ago, somebody, a Black male was there. It was probably even more of a big deal than it is now, but they did their job and I feel like I need to do mine too.*
>
> *–Male Mechanical Persister*

In recognizing the historic challenges of African Americans, the current issues presented, as well as their own sense of duty to give back to the Black community, the students symbolize the persisters' strong connection to the universal African American community.

While their sense of belonging to the universal African American community was strong, some persisters also recognized the need for adjusting to the majority White campus community. In the passage below, a male chemical engineering persister explains his tendency to "tone down":

> *I: Have you had to hide or abandon any of your cultural beliefs or practices?*
> *P: I wouldn't call it abandon or hide, but I would say tone down ...I always refer to what W.E. B. Dubois used to call "double consciousness"…you have to exist in one way in say corporate America and exist another way at home. For example, you know I am very capable of talking in the proper manner with proper mannerisms, but if I go home I revert back to more colloquial or more common language. It*

> *might not be proper English and I am aware that it is not proper, but that is how I speak in a comfortable setting. I wouldn't call it hide, but you have to present yourself differently, because the way I act with my friends and family is not what is perceived as being intelligent and professional in corporate and academic [settings]…if you were to see me at home not knowing me at all or with my friends, you would assume that I am not an intelligent person and I am not a proper person and I don't know how to express myself in an intelligent manner. You can't give them ammunition against you. You can't give professors or potential employers that type of opportunity to count more against you. It is not necessarily hiding my culture and what I believe is important in my culture, it is just a different way of presenting myself so as not to come off as what is perceived as ignorant.*
>
> *–Male Chemical Persister*

In the above passage, the male chemical engineering persister not only implies his participation in African American, campus, and professional community, but also seems to imply a distinction between his own cultural behaviors and those prominent on campus and in the professional environment. In this view he combines the acceptable norms and practices of "academic" (understood as campus community) and "corporate" (understood as professional) communities and relates them to society's positive valuation of intellectual judgment. In the same view, he separates the language and behaviors of African Americans from the others and relates them to society's negative intellectual judgment. Below, another persister implies use of bicultural behavior or "role playing" as a means to an end:

> *Maybe there is a little bit of role-playing just to get you in the door. Where I'm going to pretend that I am like you but I'm going to keep my identity because that's who I am.*
>
> *–Female Chemical Persister*

Although more simply put, the female chemical engineering persister makes similar

implications. While her words indicate bicultural behaviors, they also reveal an underlying separatist perspective that implies a differentiation of behaviors and language from the predominantly White majority. These students recognize the necessity of adjusting to the PWI environment as well as the importance of subscribing to shared African American language, beliefs, and practices.

The persister group exhibited a strong identification with the greater African American community, and a somewhat strategic identification with both the campus and professional predominantly White communities. While they seemed to recognize the necessity of navigating in the campus and professional worlds, they also sought to maintain their African American language and behavioral traits which were often expressed in contradiction to that of the majority White population encompassing the campus and professional communities. This behavior shifting indicates an internalized connection with the African American community as well as an understood value of relationships with other cultures at the PWI of focus. In terms of nigrescence, the combination of Black identity and the valuation of non-African American cultures suggests that the persister group falls within the emersion stage of Black identity development.

In relation to engineering identity, persisters provided varied insights to their sense of belonging to the universal professional engineering community and engineering identity. The distanced and uncertain persister responses suggest a weak overall engineering identity.

Strugglers

Most strugglers expressed a strong sense of belonging to the African American community. In the passage below a chemical engineering struggler describes his view of the plight of young African American males:

> *P: I feel like as a male who has come from where I come from and is about to graduate next year, I feel like I have a responsibility to educate other Black males because I mean the Black male as an entity is in a lot of trouble right now. We have a lot of different issues affecting our community specifically. It's whether the different things that you see on TV; you know guys thinking the only way you can make money is rapping or playing ball or something. I feel it is part of my purpose not only to get a degree and make life comfortable for my family, but also bring others along with me and show them that they can do it too. It is not against the law and it is not a crime to live comfortably. You don't always have to be rich. When I mentor a lot of young kids, they almost see it as unacceptable to work 9am-5pm and go home and raise a family. They want their life to be like what's on TV... I feel it is part of my responsibility to educate. I think I am a Black male for a reason and that is part of the reason...*
> *I: So have you always felt this responsibility?*
> *P: I felt it more so when I got to college, because I realize (what comes) once you get to school, and so I think it has gelled in me even more, especially when I am in more of a position to be a mentor, age-wise. It has really hit me more I guess as I grew up intellectually as well as into manhood.*
>
> *–Male Chemical Struggler*

In the passage above, the struggler acknowledges the plight of Black males as well as

a sense of responsibility to give back to the African American community by helping to mentor other young Black men. His awareness of African American issues and desire to give back indicate a strong connection to the universal African American community as

well as an intense Black reference group orientation. This perspective permeated throughout the struggler group, implying a strong overall Black Identity among the group.

Strugglers also varied in their responses related to the universal engineering professional community, suggesting a weakened group sense of belonging as well as an average engineering identity. Here a chemical engineering struggler explains his feeling as though engineering is his only option:

> *P: I would say just sometimes you get overwhelmed and you just get burned out on being an engineer. I know every engineer has that crossroads where they say do I really want to do this? Is this what I want to do? I seriously thought about changing my major last year, like seriously considered it. But when I thought about it I was like there is nothing else that I really want to do. There is nothing else I can see myself doing. I ended up deciding to stick with it. I think that is the hardest thing, just asking yourself and getting through it and deciding that this is what you really want to do.*
>
> *–Male Chemical Struggler*

This passage not only provides some insight about the challenge faced by several students, but more importantly indicates this student's connection to the professional engineering community as well as their engineering identity. Alternatively the electrical engineering struggler speaking in the passage below strongly expressed the desire not to be an engineer:

> *P: I've never seen myself as an engineer. Whenever I've had experiences to see what engineers do, I don't see myself doing that. I've never seen myself actually doing what engineers do. But I thought it was cool at first and now I'm seeing what actually occurs in the fields and I don't really like it... during my internship I really saw what they were doing and I didn't want to be in a cubical for the rest of my life. That's what they are pretty much, they're not really in a team or environment...*

> *ninety percent of your time you're in a cubicle and that's not what I saw myself doing... I want to do something more creative than crunching numbers.*
> *I've always seen myself in a suit at a company meeting and giving a presentation and things of that sort. And well, you do that kind of stuff, but it's on boring stuff, and I'm not interested*
>
> *–Female Electrical Struggler*

This passage represents the straight forward perspective of a struggler who had come to dislike the engineering profession. This passage indicates a weakened engineering identity.

Overall strugglers demonstrated a strong sense of belonging to the universal African American community, suggesting an intense Black reference group orientation. Struggler interviews failed to consistently address the universal PWI community. As the next section will show, strugglers were less likely to feel comfortable in the majority environment, indicating a weak group valuation of majority White culture. The combination of intense Black reference group orientation, yet weak adjustment to predominantly White culture suggests the struggler group falls within the immersion stage of Black identity development. Struggler responses also indicated a weak sense of belonging to the professional engineering community, suggesting a weak engineering identity.

Local Communities

Local communities are places where people who share similar interests and experiences, and who engage with one another in some meaningful way find community. The types of local communities identified in this study are institutional

organizations and campus-wide social communities. This section describes the exceller, persister, and struggler local community experiences. Interpretations of how these communities relate to both Black identity and engineering identity are also included here. Confidence in the ability to use course terminology and discuss engineering material is an element of the engineering discursive identity. Responses that indicate this type of confidence were used as indicators of engineering identity at the local level. Black identity refers to student interaction with ethnocentric communities within the institution.

Excellers

Several excellers revealed a strong initial sense of belonging to the College of Engineering because they felt well prepared for studying engineering prior to their college experience. This perception is exemplified below by a male civil engineering exceller:

> *P: I would say I was very well prepared. I feel like I challenged myself in high school. I took calculus, two years of chemistry, pre AP Physics, and AP English. I came into OU with 18 hours so I felt really prepared. I wasn't able to clep out of chemistry class but it was so easy; the same with Chemistry II, I thought both of those were really easy classes. I actually felt like I was ahead compared to most people.*
>
> *–Male Civil Exceller 1*

In the passage above the term "clep" means to be exempt from a college course due to high school examination. In his response, the student displays a strong engineering efficacy as he describes the high school coursework that prepared him for engineering discourse at the collegiate level. This initial confidence in his preparation for authentic

engineering discourse indicates a strong initial sense of belonging to the college of engineering and therefore suggests a strong engineering identity.

Not all students were prepared by a traditional high school. The exceller speaking in the passage below had a unique background of home schooling; however her transition to the state school for Science and Math helped prepare her:

> *P: I was home schooled and then I took classes at the [State Name] School for Science and Math business center...The [State Name] School for Science and Math really helped me realize that college isn't like high school. If I wouldn't have had that, I don't think I would have succeeded nearly as far.*
>
> *–Female Mechanical Exceller*

The passages above indicate a strong sense of perceived engineering competence at the outset of their collegiate careers. This confidence in exceller preparation indicates a comfort level with the rigor, vocabulary, and discourse found within engineering course work and therefore suggests strong engineering identity.

Several excellers expressed the desire to have a strong African American community at college. This was often revealed during responses that discuss their desires to increase the population of the school's minority community. When asked if it made a difference whether or not other students of color were in her classes, this female mechanical engineer replied:

> *P: I am not sure. I think it does make a difference. It makes you feel like you know if they can do it, then you can. I mean, if it wasn't that many I would still do it because I have been in classes like English and all that stuff where I was the only African American in there. I guess in engineering, you just want to have people who are like you in all different types of ways, so you will relate to them more. It is not like I am the only girl here, or I am the only Black girl here. I am the only*

> *Indian girl here. I mean I would like to have people around me who are like me. I am female; I am in engineering; I am Indian; I am Black; and I like mechanical. I want to have people around me who fit all those different types of things so that I can relate more to them and so that I know that I am not the only one who is going through it.*
>
> *–Female Mechanical Exceller*

In the passage above, the student reveals her wish for more students who look like her; however, because she is multi-racial she suggests increases from a more multi-cultural perspective than just African American.

The need for more minority students was echoed by several other students across academic groupings, indicating a collective awareness of isolation and longing for stronger Black oriented communities within engineering classrooms. When asked about his daily experiences as an African American, this male civil engineering exceller describes his feelings of isolation:

> *P: Um, at first it was tough. If I think about it I think there are only maybe two of us in the entire department. But, it's different definitely from just normal hanging out like even if it comes down to like doing homework and different things. You're the only one in your group. You're the only African American. You're in a minority altogether…It's not a bad experience; It's just different when you look around and you kind of realize the opportunity that you have.*
> *I: Do you see this as a barrier like the lack of minorities, maybe?*
> *P: I think it could be a barrier, but I think I have kind of turned around to be kind of a positive thing... I should take advantage of the opportunity that I have.*
>
> *–Male Civil Exceller 2*

In this passage the exceller addresses the lack of African American students in the college of engineering, and the sense of isolation that comes from being one of very few students who looked like him. This desire to be around more African American students

indicates a Black reference group orientation.

This Black reference group orientation among excellers was prevalent both academically and socially. However, not all students spoke positively about their interactions with engineering students who share the same ethnicity. Students with more experience with majority culture were more likely to be ridiculed by other African American students. When asked had she ever been treated negatively because of her racial or ethnic background, this female mechanical engineering exceller described some alarming behaviors:

> *P: Some students from my racial background have a preconceived notion of how you are going to act and I don't fit into all of their requirements. Some people say I am too [much] like this other group of people. I don't know, I guess they expect me maybe to dress differently or to dress up a lot, because there are not a lot of them (Black students) who dress up. I mean, I really don't have the time for that... I just know that some people are going to think that, so really it doesn't bother me. I have a lot of other things that I have to focus on…*
> *I: So preconceived notions about how you should talk or dress or something like that?*
> *P: Yes, or act this or act white. I just think I act like me.*
>
> *–Female Mechanical Exceller*

The passage above represents an unfortunate, but real scenario where students that are more adjusted to majority White environments may be confronted within the African American community at the institution by less adjusted students who feel that physical appearance and other behaviors must match their own imposed cultural stereotypes.

Due to their comfort level with non-Black communities, excellers were likely to participate in technical societies and non-ethnic engineering organizations, providing them a more diverse range of communities. Here, the same female mechanical

engineering exceller who was treated negatively by her Black peers talks about the organizations she participated in:

> *I am in the American Indian Science and Engineering Society. Actually in March I am planning to be the vice president. I am pre-college initiate to the National Society of Black Engineers… As for the Society of Women Engineers, I actually plan to get a position in March for SWE… I am also a finance chair for the Engineer's Club E-Week.*
>
> *–Female Mechanical Exceller*

While some excellers found community primarily in non-ethnocentric organizations, others participated in both technical societies and ethnocentric organizations. They maintained involvement in all organizations, but with stronger attachments to the more ethnocentric spaces. For example, this male civil engineering major was involved in a wide array of local communities:

> *I: Are you involved in any technical societies?*
> *P: I'm involved in the American Society of Civil Engineers, the National Society of Black Engineers and those are my technical society's right there.*
> *I: OK. Are you involved in any social groups?*
> *P: I'm a part of the Top Ten Senior Honor Society…*
> *I: Are you a part of any church groups?*
> *P: I attend church at Fifth Street Baptist Church but I'm not part of the group. I am a part of the congregation, but I'm a visiting member. I do have a church back home, but I do attend church every Sunday.*
> *I: Do you participate in BSA?*
> *P: I do because I have a little [brother].*
> *P: I mean I have other ethnic groups… I'm the vice-president for programming for my fraternity.*
>
> *–Male Civil Exceller1*

Excellers had both Black reference group and engineering group orientations. They participated in both technical and non-technical engineering societies which allowed

them to be a part of more communities where technical knowledge and professional skills could be shared and discussed. These opportunities suggest a strong connection to the engineering community and strong engineering identities among the group. Excellers were also likely to gravitate toward Black friends, have an awareness of isolation and desire to increase the local Black population. This again suggests a Black group orientation among excellers. This Black reference group orientation combined with the excellers' comfort with predominantly White technical organizations lends further support to their placement as a group in the more advanced stages of Black identity development.

Persisters

Persisters consistently spoke about feelings of disconnect from the College of Engineering. An example of this is shown here as a female chemical engineering persister speaks about how her feelings of belonging change with her ability to discuss course material:

> *I: OK. Do you feel you belong in the College of Engineering?*
> *P: At times I do. At times I don't.*
> *I: What are some of those times that you don't?*
> *P: When I don't is when I think I'm not understanding, when I think that everyone else knows what's going and I think I don't know what's going on?*
> *P: Those are times that I don't feel like I belong. The times when I do feel like I belong [are] when I can discuss ideas and concepts and know what I'm talking about and know what the other person's talking about.*
>
> *–Female Chemical Persister1*

Her statements indicate a wavering sense of engineering identity when viewed through the discursive identity framework of Allie et. al (Allie et al., 2009). They also

mentioned feelings of isolation within their classes. The same student discusses feeling intimidated to ask questions by her classmates at times:

> *P: Well, you go to class and you see maybe one or two people that look like you. There are a fair amount of females in the class. It's just that they are all majority. So, sometimes you feel a little intimidated to ask the question. Because, you are wondering well, like, "Oh That's a stupid question. Duh! You should know that." I feel intimidated sometimes.*
>
> *–Female Chemical Persister1*

Similar sentiments were shared in this male mechanical engineering persisters' response to a question about his daily experiences as an African American male. He indicates a continuing sense that his abilities are in question by his peers:

> *P: Sometimes you feel like you have to prove yourself sometimes in your classes, not to your teachers but to the people around you. Because a lot of times they won't like if I answer a question like it just seems like people don't think I am saying the right thing. In a group, it seems like if I answer something they will ask somebody else. So it just seems like I have to prove myself a lot. Now is not as bad because I am a junior and I have been around the people, but it seemed like at first that's how it was. I had to prove myself.*
>
> *–Male Mechanical Persister*

These types of perceptions show us how minority students are impacted by the majority enrollment in the College of Engineering and its resulting classroom culture. These students felt so isolated and defensive that they were intimidated to ask questions for fear of being misunderstood or ostracized. Feeling consistently questioned and intimidated by majority engineering peers maybe a potential reason for limited social relationships with non-Black engineering peers and limited participation in majority-dominated engineering organizations.

Persisters, however, were able to find community in the more ethnocentric organizations such as NSBE, minority serving fraternities/sororities, and the previously mentioned Multi-cultural Engineering Program (MEP). This female mechanical engineering persister describes her perception of the community of MEP before and after the restructuring of the program (Shehab, Murphy, & Foor, 2011):

> *P: I miss the closeness. Like all Black engineers could count on the other Black engineers. Now that it is gone, everybody is just going every which way and it is unorganized… before, the resources were right there. Now you actually have to do your research and find it, which sometimes is very time consuming and you don't have the time. It was just a home away from home. {Prominent administrator} would have like little get together at [her] home because a lot of people would be homesick. It was just a place to call home whenever you were homesick. Now, there is really nothing. You can really tell with the minorities coming in now.*
>
> *–Female Mechanical Persister*

Not only did she find community in MEP, but also in NSBE:

> *P: As soon as I joined NSBE, I started hanging around with a lot of Black people and realizing that oh, they have a lot in common with me. Why didn't I do this earlier? In the school I went to in high school, I really didn't have that choice and now I do and there are people with the same interests and the same major.*
>
> *–Female Mechanical Persister*

Although data is not shown, most persisters also found community in BGLO's. This finding coupled with the passages above, highlight ethnocentric organizations not only as safe-havens where persisters can find people who look like them and communicate safely, but also they represent a place where Black identity can safely develop among other Black students. Persister interview data also indicated a perception of adequate

high school preparation for the initial rigor and discourse of their engineering courses; this data is also not shown.

While persisters did not find community in the College of Engineering, field-specific technical societies, or non-ethnocentric organizations, they found it in ethnocentric engineering organizations such as MEP and NSBE, and non-engineering organizations such as BGLO's. These findings indicate an average engineering discursive identity and a strong Black reference group orientation.

Strugglers

Strugglers found community within ethnocentric engineering organizations such as MEP and NSBE. MEP was revealed as an important multifaceted support structure for students that provided an institutionalized community. Among other things, MEP was used as a recruiting tool to help convince this student to attend the institution:

> *I: So the reason you came to [the institution] is pretty much just financial?*
> *P: I mean that's a big part of it but another part was that the MEP program made me feel like I wouldn't just be on my own up here and not just kind of thrown into the fire. I feel like I have a support section and the finances as well. I mean those were the two big things that you know I felt would make me want to come up here.*
>
> *–Female Chemical Struggler*

The passage above is just one example of how the community-oriented program helped students feel like they belonged at the institution. One student felt that MEP was more like a family, and its director was like a mother figure who went above and beyond:

P: No. {Prominent Administrator} is awesome. She was, like our mom. At least she was for MEP.. So, she really helped. I mean, even though she wasn't my technical advisor, I would still go in there and say "Okay, this is what University College told me. Is it right?" And she would double check it to make sure that they weren't trying to kill me and mess up my schedule.

–Female Civil Struggler

While the program was lauded by several strugglers for its positive impact, several strugglers discussed some of the negative outcomes brought on by changes made to the program during their academic careers:

P: When I came in as a freshman the program was much larger. There were a lot more opportunities for scholarships and a lot more opportunities for a minority to come here. Since the original program director and {Prominent Administrator}, since both of those people aren't here anymore, we've kind of seen the program kind of get scaled back. It used to be its own program but it was moved into the [Engineering Student Services Center], and you can see the minority enrollment kind of drop every year. I mean it is still there as far as the support structure if you need to talk to somebody. There are still people you can go talk to, but it is not as much of a force on campus as it was when I got here. When I got here, the Black population was larger because MEP was responsible for getting a lot of kids up here by offering scholarships. About 50-60% of people up here whether they were in engineering or not were up here through the MEP program. You could kind of see those numbers drop gradually every year. It is as not as much of a force as it used to me.

–Female Chemical Struggler

The above passage exemplifies what many students perceived about the MEP program during its transition. It also indicates the importance of MEP not only as a community, but also as the source of enrollment for the institution's Black population. Strugglers who entered the COE during the MEP transition saw MEP in a different light:

> *P: It is not really as communal or anything. I think the National Society of Black Engineers, which I am a part of, is really more communal in that aspect. My experience with them hasn't really been a good one; it hasn't been a bad one. It is really just a class, but I think it was a waste of time …The only thing they really have is like a banquet. Well, that I know of. Maybe I am oblivious to all MEP activities. All I know they have is their class that you complete when you first get here to get your scholarship and the banquet and tutorials. I never go to the banquet, but I go to the tutorials. I'm always going to need the tutorials until I graduate, so I guess in that aspect I will be using it.*
>
> *–Female Electrical Struggler*

The passage above is a stark contrast from the previous statements about MEP. The statement represents what several students who attended the institution during the MEP transition felt, which was a weak sense community through that program. In this passage, the student also revealed NSBE as an important organization where students found community. Several strugglers were heavily involved in the NSBE organizations events and activities. These events and activities were described by the male chemical engineering struggler (then NSBE president) speaking in the passage below:

> *P: We have a lot of different events. We have social event and we do a lot of community service. One of our big community service projects that we do every year is called a Walk for Education. We go into a lower income community and we have bags with us, and each bag has like college applications, FAFSA applications, and trade school applications. They just have different information about going to school and going to college that a lot of people in that community aren't aware of. A lot of people see the only way out of their situation as sports, being an entertainer, or maybe illegal means. We just go to that community. We go door to door and we talk to these people. This is what we have. This is what you can do. There are some things in here if you want to look at it. We usually leave some type of contact number if they have questions. We try to educate people as far as their opportunities and being able to go to school other than what the media portrays as your only way of being able to go to school, or what they are mostly exposed to, like college athletes and stuff like that.*

I: Do you think being involved with your organizations, do you think that influenced or affected your school experience in any way?
P: I think it definitely did. It just gave me an opportunity, especially with NSBE, to see that you can do it and kind of the support structure of seeing other Black engineers excel at being engineers in a predominantly white male dominated environment.

–Female Chemical Struggler

The passage above describes some of NSBE's social and community service events, but goes in depth on one of their service endeavors in low income communities. The passage indicates NSBE's organizational awareness of Black issues, as well as its focus on the betterment of the Black community. This organizational focus promotes a strong Black reference group orientation. This orientation is further supported by the male mechanical engineering struggler below when asked what organizations he participated in:

P: I'm a member of NSBE, National Engineering Society of Black Engineers.
I: Anything else?
P: No, not really.
P: I mean I want to be, but I feel that there are not enough Black Engineers.
I: How involved are you in NSBE?
P: NSBE? Well, my freshman and sophomore year I was pretty active. But, now that I'm in my junior year and, well, I joined a fraternity so more of my time is geared towards that. Not that I don't want to be active in NSBE. It's just it's always conflicting, but I'm still an officer, Academic Excellence Chair.

–Male Mechanical Struggler

This student's statements indicate a sense of loyalty to NSBE and suggest a strong Black group orientation due to his motivation from the lack of Black engineers. The student also briefly discusses membership within a fraternal organization. Strugglers

also found community in ethnocentric non-engineering organizations such as Black Greek Letter Organizations (BGLO's). Below a female electrical engineering struggler discusses the types of activities she pursues within her sorority:

> *I: Okay. You said you were involved with a sorority. What activities were you involved in with these groups?*
> *P: Planning of events and seeing them come through. I just help plan; I am the chair for the committee that schedules speakers. I like the fact that I can have something outside of engineering; something more fun. I needed help to become well-rounded and learn how to solicit money to host different things.*
> *I: So in those organizations, do you pretty much take on leadership roles?*
> *P: Yes*

BGLO's were not only communities that enabled student members to develop into well-rounded leaders, but they also provided mentors for younger students. In the passage below, the electrical engineering struggler explains how he mentored younger engineering students within his fraternity:

> *A guy in my Fraternity now, I'm kind of mentoring he's an EE major too. I kind of guide him, tell him how teachers are and give him workbooks and notes. If I have an incoming person or something like that; you know, I just tell them they should, really study early and often and understand the concept, also bug the teacher until you understand it. They may not like it, but that's their job, so, that's mainly what I tell them.*
>
> *–Male Electrical Struggler*

Strugglers also found community with either the Black Student Association (BSA) or their African American peers. Several strugglers expressed that the Black Student Association (BSA) was an unspoken community that all African American students were naturally a part of but were not required to participate in. The same electrical

engineering struggler from the passage above exemplifies this attitude when asked if he participated in any ethnic organizations:

> *P: [Yes] As far as like NSBE, and NPHC (National Pan-Hellenic Council), and BSA…But, I mean everybody's involved in BSA…as far as being active in BSA, I mean, I go to their events but, I'm not on the Executive Boards. And in my Fraternity that I'm on the Executive Board*
>
> *–Male Electrical Struggler*

In the passage above, the student acknowledges the all-inclusive role of the BSA as a Black community; however, he indicates its lower prominence among Black engineering students. Outside of institutional communities, strugglers often found community among other Black students. When asked about his level of comfort at the PWI, the mechanical engineering struggler speaking in the passage below quickly relates his comfort level to the local Black community:

> *I: Is [the institution] a comfortable environment for you?*
> *P: Yeah, it's pretty comfortable. A lot of the Black community is pretty much friendly and helpful. You know, I don't feel worried or fear for my life around here so.*
>
> *–Male Mechanical Struggler*

In another instance, an electrical engineering struggler attempts to explain why she primarily hangs out with other Black students:

> *P: The majority of my friends are Black and they have been since I came to the {Institution of focus}… I think more so here, it is more standoffish because people have their own racial group, their own divisions. It is like having a small town inside of a large town. So like there is the Black town and then here is the white town and then they just really stay together because all of the amenities that you need [are] there in that town and there is not really a need to branch off into the next town.*
>
> *–Female Electrical Struggler*

This struggler exemplifies the lack of comfort with the predominantly White environment and organizations that is common within the struggler group. The struggler passages highlight the perceived racial lines dividing the institution where each race was “standoffish” towards the other, preventing the crossing of racial boundaries. This separation encourages the formation of uniform racial groups, therefore institutionally limiting social interactions between students from other races.

Strugglers found community in several ethnocentric organizations and societies including MEP, NSBE, BSA, fraternities and sororities, and the institution’s Black population. Ethnocentric non-engineering organizations like the BSA and fraternities and sororities provided outlets from the engineering environment and opportunities for leadership. Some students revealed the BSA to be an all-inclusive club where engineering strugglers felt included, but were not very active.

Ethnocentric engineering communities such as MEP and NSBE were important for several strugglers; together they provided financial, personal, academic, and professional support. However, transition within MEP lead to varied impact on students from the struggler group and NSBE participation seemed to diminish as students grew older or became members of fraternities or sororities.

Finally, outside of the ethnocentric engineering and non-engineering communities that strugglers found, they often found community with African American peers. The tendency for strugglers to find community in ethnocentric communities appeared to confine them to communication with other Black students. This suggests a strong Black group orientation, yet a lack of value placed in building relationships outside of African American culture. In terms of nigrescence, strugglers fall between the immersion and

emersion stages. While the ethnocentric engineering organizations provided community and services that would help strengthen student engineering identity, they focused more in support roles and professional development than developing technical knowledge and discourse. The lack of participation in organizations developing appropriate engineering knowledge and discourse suggests weak engineering discourse identity among the struggler group.

Social/Learning Communities

Social/Learning communities are local communities that intersect with a technical learning environment. The types of social/learning communities identified were both voluntary and non-voluntary. Involuntary communities are places where students and or faculty are required to interact and include specific engineering courses and course team projects. Voluntary communities are places where the students had the power to choose for themselves and included study groups and technical societies.

Excellers

Excellers participated in both voluntary and involuntary social/learning communities. Technical societies represent voluntary communities because of the member student's choice to join. Here two male excellers mention their participation in the technical societies for their perspective fields:

> *I: Are you involved in technical societies?*
> *P: Yeah in ASCE.*
>
> *–Male Civil Exceller 2*

ASCE is an acronym for the field-specific civil engineering organization named the American Society of Civil Engineers. Likewise, the male petroleum engineering exceller below participated in the field-specific technical society for petroleum engineers:

> *I: Okay. Are you in any technical society?*
> *P: Yeah... the Society of Petroleum Engineers*
>
> *–Male Petroleum Exceller*

While some students merely mentioned their participation in tech societies, others spoke in more depth, like the female chemical engineering exceller below:

> *I: Are you involved in group organizations, professional organizations at this time?*
> *P: Yeah like I'm in AIChE.*
> *I: Do you think it's important having those, being involved in those organizations?*
> *P: I really think it's good. You get to know the chemical engineers. Since I'm a fifth year, in the first couple of classes that I took in chemical engineering, I was with the class above us, and then I fell back with this class after I had my son because I didn't want to take 19 hours. I was doing 12. So I fell back with class and actually, that's when I got involved with AIChE and I got to know this class a lot better. We'll go out and hang out together or go to lunch together, and definitely, I think that this class has helped me with schoolwork more like study groups. So I definitely think that is good.*
>
> *–Female Chemical Exceller*

The passage above exemplifies the potentially positive impact of finding communities in field-specific technical societies. Here, the student speaks about her positive experience with the American Institute of Chemical Engineers (AIChe). For her, AIChe became a community that linked her to her chemical engineering cohort, as

well as important voluntary study groups that were helpful to her success. Voluntary study groups were also important communities for excellers. In the passage below, this same female chemical engineering exceller advises other Black female engineers to find a study group:

> *I: What advice would you give to another African-American female or another biracial female who wants to come to the College of Engineering and be an engineer?*
> *P: I would definitely say you know to find that support group. Find, like, a group of friends you can study with because it's better you know. Like whenever you're studying with people you can understand their way of thinking and you know maybe you don't understand something but they can understand you know like a certain subject better and you understand another subject and you guys help each other out.*
>
> *–Female Chemical Exceller*

The above passage exemplifies what several excellers felt about the importance of finding an effective study group community. She indicates that study groups help to understand the thinking of fellow engineering peers. Her words seem to suggest that group members should share similar fields and courses. Several excellers discussed the importance of study groups to their success as well as other benefits. The male civil engineering exceller below discusses some of those benefits, in the context of his early collegiate survival:

> *I: Who or what has helped you learn how to survive in engineering?*
> *P: Survive? Um, I think the big part was study groups...*
> *I: How did the study groups get used? How'd they contribute?*
> *P: Um, really getting through the early classes, some of the weed out classes... So at times, when you go through big hall lectures like physics or chemistry it's a little bit tougher to get one on one help, so in study groups it's a lot better because you can work at your own pace and with people that are your peers.*

–Male Civil Exceller 2

Some excellers were comfortable participating in multiple study groups. In the passage below, this male petroleum engineering exceller speaks about his multi-study group experiences:

> *I: Have you kept the same study group throughout or has it changed with all of your classes?*
> *P: Yeah, it's interesting because I noticed, like, a lot of them in my class, like, a lot of, you start seeing certain people that always study together, and it hasn't really been like that for me. I'm kind of, like, I kind of move around. I'll be like, I'll stay with these people for a while and then I'll start studying with these people for a while. I just go around in different groups and no one seems to, it doesn't seem to bother anybody. It's just like, especially with Petroleum, there only seems like to be three or four groups just in there studying. I just kind of have gone to each one to study.*
> *I: And is this your choice or you just?*
> *P: Yeah, it's just my choice. I mean, it's just like, my thing was it kind of goes back to what I said. I've been busy all the time, and whoever was in there working that's where I sat down. And if they're doing work, I sat down and did work with them and it didn't seem to bother anybody.*
>
> *–Male Petroleum Exceller*

In his description, this student emphasizes the voluntary nature of study groups. The student's tendency to join which ever group he pleased indicates a high comfort level in interacting with the different study groups and a sense of acceptance by the majority students.

While most excellers found community within voluntary study groups, they were also required to participate in involuntary course-related groups where they were asked to complete course assignments and projects with their peers. This "group work" is described by the male civil engineering exceller in the response below:

I: Do you guys have to do a lot of group work?
P: Yeah, in some classes. Not as much now, but especially the last few semesters. There was a lot of team work where we have to meet up and work on projects and things like that.

–Male Civil Exceller 2

The female chemical engineering exceller speaking in the passage below further describes group work, its frequency, its grading, and its contribution to her success:

I: What do you think about team work or group work?
P: We do a lot of group work, especially this past year. In a couple of our classes a lot of it was group work. We had a design class, and my group was of six people, and basically all of our grade, or I think like 40% of our grade, was all group projects and stuff. And then this semester, since I'm in Capstone it's just me and one partner, and we're designing a flame retardant. So it's all about us two working together to get this done.
I: Do you think groups are a key to your success?
P:Yeah and I think that it's a good indication of what it's going to be like in industry because you're not really going to be doing anything by yourself. You're going to have to learn with people, so.

–Female Chemical Exceller

In the passage above, the student indicates that group work/team projects are often used within engineering courses and are expected to be prevalent in the engineering workforce as well. She discusses the substantial portion of course grades that are steeped in group projects, indicating a strong need to develop the skills necessary to function in a cohesive group. In the passage below, the male mechanical engineering exceller describes a voluntary group work scenario that relieved stress:

I: Okay. How do you feel about group work and team work?
P: I like it. It takes the stress off of me... like today for example, in my Dynamics class we had team quizzes. Me and my buddy have to take a quiz together, so I depend on him a lot. He's like one of my real good buddies and I like to study with him. I know I can count on him, and I

> *know he's just as smart as me. We can put our heads together and figure the problem out…So I don't have a problem.*
>
> *–Male Mechanical Exceller*

The passage above not only describes a voluntary group/team work scenario, but also highlights the exceller's attitude toward fellow group mates. In the statement, he implies that he embraces group work when paired with students of a similar caliber, perhaps insinuating that he might have a problem with group work if he were paired with whom he perceives as a lower caliber peer.

Excellers often found community within their field-specific technical societies, study groups, and project teams within their engineering courses. Tech societies offered them an opportunity to connect with other students in their field, and more specifically their academic cohort to form study groups and participate in authentic engineering discourse. Study groups were revealed to be important to the success of several excellers. These represented small learning communities that helped students avoid failing weed out courses by allowing them to learn from their peers at their own pace. Team projects were also embraced by excellers as opportunities to learn from and with their peers, but also as simulations of their future work environments. These represented significant chunks of their course grades, but as long as their group members were of the same caliber, they enjoyed participating in team projects. Technical societies, study groups, and team projects each represent opportunities for social learning and authentic engineering discourse (Allie et al., 2007; Allie et al., 2009; Bandura, 1969; Vygotsky, 1978). The embrace of these social/learning communities suggests strong engineering discourse identity among the exceller group.

Persisters

While their participation in field-specific technical organizations was limited, persisters found social/learning communities in study groups and course specific project teams. These social/learning communities were often ingrained in the daily lives of persisters. This is discussed by the male mechanical engineering persister speaking in the passage below:

> *I: If you would give me an example of a typical day for you?*
> *P: Um, classes normally start later for me… And then after class, usually we'll have work in groups. Probably about eight hours a week, we do the group work. Um, now it's becoming more this year, because we have stuff to design.*
>
> *–Male Mechanical Persister*

Since group work was a part of their daily lives, students came to identify the benefits and drawbacks of such social learning communities. In the passage below, a female chemical engineering persister discusses the good and bad:

> *I: What do you like or dislike about projects and group work?*
> *P: I don't like the fact that I have to depend on someone else for my grade. I'm kind of a self-motivated person and even when I'm not being self-motivated and lazy, I know when it's time to light the fire and step it up. I just don't like, I just don't like depending on someone whose or group work when maybe the team's like "it's not due until April, we can start in March" no, we need to get it done so I don't have to think about this. I might have something else to do in March or something else to do in April. So just things like that, but I like group work because it gives you a chance if you don't necessarily know the problem it gives you another perspective on it. And then you can think of it another way; it can get you to a conclusion or to the answer, not necessarily quicker or faster but it might be easier. And you might accidentally learn something as you're teaching it or you're showing it to someone else, and you might learn something from them also.*

–Female Chemical Persister 1

The student indicates that group work can be a challenge for students who don't like to depend on the work of others, however it can also be helpful when attacking course concepts and assignments, allowing an opportunity to view problems from a different angle. In the passage below, a female mechanical engineering persister discusses another challenging aspect of group work:

> *I: Okay. What do you like or dislike about the projects or group work?*
> *P: Sometimes some people don't pull their own weight, which is normal. I really myself prefer group work at a point, if you get a good group. Other than that, if the person doesn't pull their own weight, that is the only thing.*
> *I: And does that go the same way for the project?*
> *P: Yes.*
>
> *–Female Mechanical Persister*

Having group members who do not contribute the same effort and ability level is a negative possibility when working in groups; however like this one, several persisters still preferred working in groups. Not only did persisters participate in involuntary course-related groups, but they also found community and help in voluntary study groups. This is exemplified in the female chemical engineering persisters response below:

> *I: Okay. Do your peers contribute to your success, your peers in the College of Engineering?*
> *P: Yes. Um, I feel like that's something I got on to pretty late, but I finally recognized that I should have been doing that a long time ago. I don't feel as if it's something you can do by yourself. I know it's something I can't do by myself. It's like, you have to have groups because some of the concepts are like "What did he say". So, yeah, definitely I have regular study groups that I can go to now and we'll*

work on assignments together, study for exams together. I wasn't doing so much of that my sophomore year which is why it was a lot more difficult. But, yeah, I think basically everyone in my classes are starting to realize more and more that we need each other to get through this degree.
I: What happened to make you realize that you needed to do the group work? Did someone tell you?
P: No, we have homework assignments that keep you on top of what's going on in the class. And I would always get to some point with homework assignments where I would know so much material, and after that it's like I would need an extra push or an extra hint. I just, I couldn't think of anything else, until I started going to them... TA's help for a little while until you get deeper into the actual classes where they couldn't help as much. And, so, at that point I started getting together with people other students in the class because we all had to do it and know it anyway. So you might as well talk it out and try to figure it out together rather than sit there and do it by yourself or somebody who took the class two years ago and doesn't really remember.

–Female Chemical Persister 2

The passage above displays the unique positioning of voluntary study groups when compared to attending the office hours of teaching assistants or tutoring with upper classmen who are further removed from the actual student experience within the specific course or concept of interest.

Like with the exceller group, both voluntary and involuntary social/learning communities were heavily utilized by persisters and often became an aspect of their daily life as an engineering student. Study groups were often discussed in a positive light, and were seen as opportunities to learn from each other by viewing assignments from different angles. Though persisters also embraced group work, some were challenged by its dependent nature, as well as the occasional slacking member who didn't pull their weight. Persisters often mentioned the opportunity that these social/learning communities afforded them to discuss their assignments. The desire and

ability effectively to discuss courses and to complete course assignments among peers indicate adequate engineering discourse skills. However, unlike excellers, persisters did not participate in field-specific technical societies where engineering discourse was often prevalent, suggesting moderate engineering discourse identity.

Strugglers

Like excellers and persisters, both voluntary and involuntary social/learning communities were important to the success of most strugglers. Several strugglers found course groups to be very helpful to their learning and eventual success in engineering. These male engineering strugglers discuss study groups in a positive light. Here an electrical engineering struggler says study groups helped him survive:

> *I: How did you learn how to make it in the College of Engineering?*
> *P: Uhh, working in groups; studying with others.*
>
> *–Male Electrical Struggler*

The male industrial engineering struggler below agrees:

> *It's just like team work is the best way to learn, because when you teach it you learn it. You're getting a better understanding of it. You're clearing out my wall, and helping to build your wall at the time. So I think that's excellent, on both parts, but most people don't see it that way, they see it as a waste of time, teaching (.). Like a lot of times when I get it I can't wait to show it, because I've been there and I really want to build my wall even stronger. I guess solidify it in my brain, as well as open it up to yours.* (SIE117M)

In the passage above the student describes his learning as a building of a wall and suggests that group work allows peers to reciprocate the building of their walls in either

the role of the teacher or the learner. In the passage below, a male civil engineering struggler describes his general positive experience working in groups:

> *I: Okay. Let's see. Uh, in your classes how do you feel about team work and group work? What is that experience been like for you?*
> *P: It's a good experience. Most of the guys I work with are pretty cool and easy to get along with. They're willing to work, I guess, just as hard as I am so, it's a good experience.*
>
> *–Male Civil Struggler*

This male chemical engineering struggler found it challenging to think of any negatives associated with group work, however he does find something:

> *I: So what do you like or dislike about group work?*
> *P: Really there is not much that I dislike about group work, other than there may be sometimes some people get to adamant about and idea that they have and don't want, if the group is not favoring that idea, sometimes they get too, you know they don't want to let it go. Other than that, I really enjoy group work because that is pretty much what has gotten me to where I am right now, just being able to work with each other to solve a lot of problems we have.*
>
> *–Male Chemical Struggler*

While the student speaking above felt that head-strong group members could be a slight issue when approaching group work, he later elaborated on the benefits of group work which seemed to more than compensate for the negative aspects:

> *I: Do you still feel the same way about group work?*
> *P: I do. Everything we do in my class is pretty much group work. So, I think it gives; things probably get solved easier in groups, because there are some things that somebody else might think about that you've never thought about and vice versa. So, that way, you get different viewpoints than mine when working on the same problem.*
>
> *–Male Chemical Struggler*

Like some persisters, the struggler speaking in the passage above discussed the opportunity that working in groups provide for students to view problems from different perspectives.

Strugglers also embraced study groups as pivotal social/learning communities that helped them to survive engineering. In the passage below, a female civil engineering struggler talks about the benefits of study groups:

> *I: Do you see your study groups as beneficial?*
> *P: Yeah, they preach to us all the time that we're going to have to study in groups anyway. I know, I like we have it where we do the homework ourselves, like, the night before, or two nights before and then the night before it's due, or before it's due, go over it together as a group. You've already done your work. It's not just cheating. It's, "I really need to understand this. Did you get it? Okay." And then we can just fill in the last few blanks rather than everyone just trying to do their homework, because that never works and we've learned that quickly. So, we usually have it done. If it's due Thursday, have it done by Tuesday and we'll meet up…*
> *I: That's good. And so the people in your study groups, you basically have all your classes together, or?*
> *P: Either we've had them all together or "I've taken that class and you haven't", but we're all on the same plan. We might be in different years. But eventually we'll all end up taking the same thing. So, I've taken a couple of classes that people haven't had yet, and they've taken classes that I haven't had yet.*
> *I: So you can still help each other?*
> *P: Yeah, it still works.*
>
> *–Female Civil Struggler*

The student discusses the beneficence of study groups and reveals aspects of the homework completion process.

While several strugglers felt study groups were crucial to their success, that didn't mean that they were without challenges. In the statement below, a male industrial

engineering struggler talks about his struggles communicating with his study group:

> *P: I mean it was hard, because there are certain things that you do, in Black culture that are not similar to them. And sometimes we both speak English, but for some reason they weren't understanding what I was saying. I'll be trying to explain myself, and they just straight miss it every time. And it affects group studies and stuff like that, because I didn't want to study with them because half the time we are like "Huh?, Huh?" trying to figure out what each other is saying.*
>
> *–Male Industrial Struggler*

The above passage indicates a communication barrier between him and his group mates that kept him from joining certain study groups. This scenario suggests a cultural difference that was challenging to overcome for both parties.

In some cases, students formed their primary study groups with other Black students regardless of their engineering field so that they would feel more comfortable. The male mechanical engineering struggler discusses this:

> *P: I know the people that I've came into college with from high school, and that's basically the group of people that I study with. And now that, you know, we're kind of going our separate ways, because I know {Participant's friend}is Petroleum, so he's getting into his Petroleum classes. I think that {Participant's friend} switched and {Participant's friend} is a little bit behind, as far as the classes. So, it's starting to get a little more difficult, because I don't have that group of people to go study with you know. If I don't understand it myself, it's a little bit of a hassle to just ask for help, you know?*
>
> *–Male Mechanical Struggler*

In the passage above the student indicates that the student limited his study group members to other Black peers who graduated from the same high school. This may imply that the student failed to participate in study groups with non-Black students and

therefore limited his opportunities for engineering discourse with his major cohort and other students in his major courses.

Much like the excellers and persisters, strugglers participated in both voluntary and involuntary social learning communities. Required group assignments and voluntary study groups allowed strugglers to communicate with students from both inside and outside of their majors and participate in engineering discourse to arrive at conclusions. While mostly positive discussion in regard to social/learning communities was generated, there were some instances where challenges were mentioned. Overbearing team members, difficulty communicating, and limited ethnic diversity were among those challenges; however the paired teaching and learning experiences that peer work/study groups provided over compensated for the challenges. Again, group work and study groups provide communities where students can participate in engineering discourse and therefore strengthen their engineering discourse identities. While strugglers embraced their social learning communities, overall they described more challenges communicating with their White classmates and were likely to place detrimental limitations on the groups they joined. As a result, not only did they elude participation in field-specific technical societies where informal opportunities for authentic engineering discourse may have been prevalent, but they primarily participated in ethnocentric social/learning communities where comfort level outweighed ability level of members. This indicates an inhibited engineering discourse and suggests a weakened engineering discourse identity.

Summary of Results

Excellers felt they were initially prepared for engineering courses, and participated in both voluntary and required social learning communities that provided opportunities for authentic engineering discourse. However, they varied when describing an image of an engineer that included their own physical and/or psychological characteristics, suggesting considerable, but not complete, development of engineering discursive identity. Excellers found community in more places than the other two groups of students and displayed strong adjustment to majority-White culture across the group. The exceller group also displayed the weakest intensity of Black reference group orientation; however, due to their internalized Black identity and strong valuation of other culture, they fell mostly within the internalization stage of nigrescence, indicating the most advanced Black identity.

Persisters exhibited good perceptions of their high school preparation, strong participation in both voluntary and required social learning communities, and varying agreement between their self-images and their perceived images of engineers, indicating a moderately developed engineering discourse identity. While excellers found community in technical societies, persisters did not; they found community in more ethnocentric organizations. Persisters' level of comfort in majority environments appeared weaker than that of excellers, but they often exhibited strategic alignments with majority culture that aided their academic achievement. However, they displayed an intense Black reference group orientation and sense of internalized personal Black

identity, indicating an overall group Black identity falling in the emersion stage of nigrecescence.

Strugglers, like persisters, found community solely in ethnocentric organizations such as NSBE, BSA, or MEP. They appeared to have the weakest level of adjustment of all groups to the predominantly White environment; however, they described the most intense Black reference group orientation. In terms of nigrescence, struggler group identity appeared to fall close to the immersion stage. The places students found community correlates to their academic achievement group and can be explained using lenses of Black and engineering identity development.

CHAPTER FIVE: CONCLUSIONS & IMPLICATIONS

This phenomenological study sought to understand the unique experiences of successful African American undergraduate engineering students to learn how the factors community, Black identity, and engineering identity differentiate their degrees of success. Using qualitative interview data from a study conducted by the Research Institute for STEM Education (RISE), 19 students were first differentiated by academic performance and then their experiential narratives of life at a PWI were interpreted via the intersecting research lenses of community, Black identity, and engineering identity to understand how community and identity contribute to the academic achievement of successful African American engineering undergraduates of a predominantly White institution..A review of the literature on topics surrounding persistence, community, Black identity, and engineering identity not only sharpened understanding, but also

focused the gaze of each lens, facilitating the subjective interpretations leading to the study's results. Student transcripts and demographic information were used to select an appropriate sample and differentiate by academic performance. A modified phenomenological analysis approach was used to analyze each unique student's experiences, and then synthesize those experiences across each academic group as well as the overall sample.

This section will interpret the findings related to each lens and describe how these findings contribute to answering the research question of how community and identity impact differential academic success. The section is organized by each major research lens and its corresponding research question.

Community

1. Where do successful African American undergraduate engineering students find community, and are the communities different for students who struggle, persist, or excel academically?

Students found community in a plethora of places ranging from the universal African American community to the rugby team. Overall, the most prominent places community was found were within ethnocentric communities - with their Black engineering peers/friends, MEP, NSBE, and BGLO's. These places effectively served as safe havens, places of support, involvement, and socialization for all students (more specifically those less adjusted to majority White environments). However, differences were identified based on academic performance. Students who excelled were more likely to also participate in non-ethnocentric communities such as field-specific technical societies, majority White fraternities, and the engineering club (e-club) than

students who persisted or struggled academically. Students who persisted or struggled were more likely to have solely participated in ethnocentric organizations such as Black Greek Letter Organizations (BGLO's), the National Society of Black engineers (NSBE), or the Multi-cultural Engineering Program (MEP).

Whether within majority White or ethnocentric organizations, engineering peers, friends or family, students across the sample found community in at least one place, suggesting that finding a campus community may be correlated with persistence for African American undergraduate engineering students. This finding echoes that of Tinto () and many others since his seminal publication. However, this study reveals a new perspective on community: Students who excelled participated in diverse communities, highlighted by their participation in majority White field-specific technical societies and their strong social relationships with White engineering peers. Persisters and strugglers were less likely to develop social relationships with their White engineering peers or participate in field-specific technical societies. **Conclusion 1: These findings suggest a potential connection between comfort within a predominantly-White engineering environment and academic performance**. This finding is consistent with Tinto's social integration theory (Tinto, 1975, 1987) which suggests that students who better integrate to the social environment of their institution have a high likelihood of academic success at PWI's.The ability to effectively join the discourse within ethno and non-ethnocentric communities may be a distinct advantage of excellers, enabling them to stay connected to both worlds.

Black Identity

2. How do successful African American undergraduate engineering students identify as Black and are there differences among students who struggle, persist, or excel academically?

In terms of nigrescence, students who excelled fell between the encounter and internalization stages; displaying the widest variance in Black identity. While some excellers exhibited an internalized personal Black identity, strong Black reference group orientation, and a valuation of non-Black cultural relationships; others displayed a lack of personal Black identity and/or Black reference group orientation. However, the majority of those students were in the internalization stage, indicating that excellers exhibited the most advanced Black identity of all academic groupings. Persisters consistently combined intense Black reference group orientation with a strategic valuation of non-Black cultural relationships, behaviors and practices. These students fell between the emersion and the beginnings of internalization stages of nigrescence, indicating an advanced Black identity. Students who struggled varied least in terms of nigrescence, falling closest to the immersion stage. Strugglers exhibited strong personal Black identity and Black reference group orientations, gravitating solely toward Black reference groups and not displaying the valuation of other cultures that students who excelled or persisted did. **Conclusion 2: This finding suggests a negative relationship between intensity of Black reference group orientation and academic performance.** In terms of nigrescence, students who excelled displayed the most advanced Black identities and were more prone to embrace majority culture than students who persisted

or students who struggled. Students who persisted appeared to strategically embrace and/or adjust to majority culture and displayed more advanced stages of nigrescence than strugglers. Strugglers represented the least advanced group in terms of nigrescence and appeared to have the least comfort interacting with majority students. **Conclusion 3: These finding suggest a positive relationship between Black identity (via the nigrescence model) and academic achievement at a PWI.**

Engineering Identity

3. How do successful African American undergraduate engineering students identify as engineers and are there differences among students who struggle, persist, or excel academically?

Across all groups, some students described stereotypical images of engineers that were contrary to perceptions of their own images. This finding suggests a potential perceived disconnection between engineering identity and personal identity for many successful African American engineering students. Differences in engineering identity accumulated via perceptions of high school preparation, participation in discursive engineering communities, and match with perceived image of an engineer. Students who excelled exhibited highly perceived high school preparation and an initial ability to participate in the authentic engineering discourse of their early engineering courses. They also reported positive experiences within social/learning communities, and were most likely to participate in field-specific technical societies which also offered authentic engineering discourse opportunities. Students who persisted were also high on their high school preparation. Persisters had strong initial perceptions of ability to

participate in the discourse of their engineering courses, as well as positive experiences within social/learning communities; however, they did not benefit from the engineering discursive opportunities provided by field-specific technical societies. Like persisters, strugglers were not likely to participate in field-specific technical societies. As academic performance increased, so too did engineering self-efficacy and the tendency to find communities and opportunities where authentic engineering discourse was prevalent. This finding supports that of Allie et. al (2007, 2009). **Conclusions 5 & 6:These findings suggest: a) a positive relationship between academic performance, opportunities for authentic engineering discourse, and engineering discursive identity. and b) a positive relationship between authentic engineering discourse and engineering identity.** This is consistent with Bourdieu's (1986) theory of social capitol (Bourdieu, 1986)(Bourdieu, 1986)(Bourdieu, 1986)(Bourdieu, 1986), in that students with higher engineering efficacy and engineering discursive identity upon their college arrival were more prepared to participate in authentic engineering discursive experiences which supported and advanced their engineering discursive identity. This progression is an example of accumulated advantage via the advanced social capitol of the predominantly-White technical societies. Because these students were high academic achievers, they were able to find comfort in both required and voluntary social/learning communities among other high-achieving students, further enhancing their social capitol via these communities (Bourdieu, 1986).

Academic Portraits

Thorough investigation of student background characteristics and intense exploration of student lived experiences has enabled the identification of common traits for each academic grouping. The synthesis of these traits allowed the development of loose profiles of "typical" students from each academic group. These profiles do not represent all students within each group; however they do embody a collection of common traits pieced into three composite portraits. The following sections describe portraits of a "typical" exceller, persister, and struggler.

Portrait of an Exceller

The "typical" exceller is raised in a predominantly White environment by parents with substantial college experience. This student develops an early interest in STEM and attends a high quality college preparatory high school. High school preparation and experiences in environments heavily populated by Whites well prepares them for successful navigation through PWI's, therefore easing their transition.

In college, the exceller finds community in a myriad of places; from ethnocentric organizations such as BGLO's and NSBE, to organizations with majority White membership such as the engineering-club and ASCE. The exceller feels comfortable as a member of both the College of Engineering and the overall institution. Perceived high school preparation and ability to participate in engineering discourse with engineering peers and faculty materialize into a strong engineering discourse identity. Internship

experience and participation within field-specific technical societies have also contributed to an above average engineering identity.

The exceller's strong adjustment to majority culture, combined with his Black reference group orientation and an internalized Black identity, gives him an advanced Black identity. With this sense of self, he takes on a more multicultural perspective and an ability to embrace cultures different from his own.

Portrait of a Persister

The persister is raised by parents with substantial college experience. This student develops an early interest in STEM and attends a quality college preparatory high school.

In college, the persister finds community in ethnocentric organizations such as BGLO's, NSBE, and MEP. This student does not always feel comfortable as a member of either the College of Engineering or the overall institution. The persister is not likely to socialize with her non-Black engineering peers outside of the classroom, instead choosing to keep her interactions academic/business oriented. Perceived high school preparation and limited ability to participate in engineering discourse with engineering peers and faculty materialize into an emerging engineering discourse identity.

While her adequate adjustment to White culture and valuation of relationships with and behaviors of Whites enables her to survive at a PWI, she tends to gravitate toward ethnocentric organizations. This student has an advancing Black identity, bolstered by her ability to forefront different personas for different situations.

Portrait of a Struggler

The struggler is raised in predominantly Black environments by parents with some college experience. This student develops later interest in STEM and attended a lower quality college preparatory high school. High school preparation and previous experience with Whites does not adequately prepare him for his PWI transition.

In college, the struggler finds community in ethnocentric organizations such as BGLO's, NSBE, and MEP. This student does not always feel comfortable as a member of either the College of Engineering or the overall institution. The struggler is not likely to socialize with his non-Black engineering peers outside of coursework or studies. Perceived high school preparation, poor ability to participate in engineering discourse with engineering peers and faculty, and lack of practical internship experience materialize into less than adequate engineering identity.

The struggler's less than adequate adjustment to White culture challenges his survival at a PWI; however, his heavy participation in ethnocentric communities helps him to overcome those challenges. This student has an advanced Black reference group orientation and awareness of Black issues, yet exhibits a low valuation of relationships and behaviors of majority culture, and therefore according to nigrescence, has not progressed as far as other groups in his overall Black identity development.

Implications

While one aim of this research was to understand the potential influence of community, Black identity, and engineering identity on academic achievement, another

aim is to apply the findings to elevate student achievement. Though ideally the researcher would like for institutions to utilize these findings to produce excellence among all engineering students, realistically, they would be fortunate to see an upward shift from one academic grouping to the next. This section will identify the gaps between each academic grouping and suggest potential strategies for filling those gaps and inducing those shifts.

Though not perfect nor uniform in terms of the research lenses, excellers exhibited the most advanced achievement, community participation, Black identity, and engineering identity. Perhaps their ability to integrate both the dominant and minority cultures have enabled them to find comfort in a diverse range of communities that span from non-ethnocentric engineering organizations to ethnocentric non-engineering organizations. Participation in these communities provides ample opportunity for enhanced social capital, which in turn, promotes their discursive engineering identity and academic development.

In comparison to excellers, persisters exhibited a lesser ability to integrate into majority White communities, instead displaying a strategic shifting from one set of cultural behaviors to the other. This parallel existence may have prevented persisters from feeling a more natural comfort within non-ethnocentric communities, and therefore inhibited their participation in predominantly White communities where authentic engineering discourse may have taken place. Perhaps if majority-dominated engineering communities focused more on establishing an inclusive atmosphere that not only embraces ethnic diversity, but also promotes multi-cultural communication, and welcomes students of intense reference group orientation, both persisters and strugglers

would feel more comfortable adjusting to the predominately-White engineering environment. In turn, their valuation of other cultures and opportunities for authentic engineering discourse would be enhanced, resulting in elevated Black identity, engineering discourse identity, and academic achievement.

An engineering institutional culture that embraces diversity, and cultivates positive engineering discursive and cultural identity development among ethnocentric and non-ethnocentric communities will be essential for these upward shifts to take place. Institutional programming and policy will be important for inducing that cultural shift. Below are recommended ways engineering institutions can influence these shifts.

Recommendations

1. Strongly encourage participation in ethnocentric engineering support organizations such as MEP and NSBE, and majority-White field-specific organizations.
2. Establish partnerships between ethnocentric and non-ethnocentric engineering communities that aim to connect organizations and cultivate cross-cultural relationships between Black and non-Black engineering peers.
3. Increase and strongly encourage opportunities for authentic engineering discourse within ethnocentric engineering organizations.
4. Provide early opportunities and strong encouragement for students to form course project teams and study groups with majority students, as well as students from the same major cohort.

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APPENDIX A

Interview Protocol

PREAMBLE

The University of Oklahoma attracts a substantial population of students from underrepresented minority populations, including an unusually high proportion of Native American students (7%). As is common across the country, OU as a whole, and the College of Engineering (COE) in particular, have achieved differential levels of success in graduating students from these populations. This project will study these patterns of success, focusing on the questions (1) What systemic factors contribute to the success of URM students in engineering at large, predominantly white universities? and (2) What systemic factors contribute to differential
success among URM populations?

You are here today to tell us your story about being a student of color at OU and in the College of Engineering. We want you to understand that we will protect your identity. Please feel free to discuss all issues that you feel are relevant. However, if you are uncomfortable with the conversation, let me know and we can continue with a different question. Do you understand that I will be taping this interview? Do you have any questions before we begin? Do you mind if I take a few notes during the interview?

BACKGROUND

1. Now I see you are a ---- and your major is ---- when do you expect to graduate?

2. How did you come to pick ---- engineering as a major? (expectations of the discipline;)

3. Were there any people like friends/ high school teachers that influenced your decision to come to OU or to select ---- engineering? (if so, ask for details) What role did your family play in your decision? (how strong was their influence?) Did your family member's education levels / careers influence your decision?

4. Can you remember if you participated in any science projects or competitions when you were in middle school or high school? How would you evaluate how your high school prepared you for studying engineering at the college level?

5. Did you apply to any other university? (if so, ask for details) Do you like OU? If so, what do you like best about it? Are there things you don't like about OU? If so, what? Are you glad you came to OU?

EXPERIENCES IN ENGINEERING

6. Can you describe what your first two months were like in the College of Engineering? What met with your expectations? What surprised you? At OU? Compare the environment of your home town to what you found here?

7. You represent a success story in that you made it into the College of Engineering and that you have continued to progress towards an engineering degree. Can you talk to me about your perception of this success? Describe what success in the College of Engineering means to you.

8. How are you doing in your engineering studies? (ask for detail) Do you anticipate graduating without a problem? Is there anything that could get in the way of your graduating? How do you plan to overcome these potential obstacles?

9. Where do you go when you need help with an academic matter (courses, grades)? What people/services are available in the COE? What people/services are available on the OU campus? (show grid and ask if they are aware of these offices/services and if they have used and what their experience was?) Have these people/services helped you be successful?

10. Where else can you seek help on the campus? What kind of help have you needed? Who/what helped, and how?

11. What do you like/dislike about your engineering classes? (ask for explanations) What do you like/dislike about projects? Group work?

12. How would you describe your relationships with students in your engineering classes? Inside the classroom? Outside the classroom? Do you meet outside of class by choice or because you have assignments? Do your relationships with others students help you achieve success?

13. What words would you use to describe the environment in your engineering classes? Is it friendly? Competitive? Supportive? Encouraging? Hostile? Inviting? (How so? Specifics: examples)

14. What is your best experience with a professor in engineering? Is that typical? Do your relationships with professors help you achieve success?

DIVERSITY – Remember to probe on COPING MECHANISMS / STRATEGIES

15. Have you lived in the dorms? How long were you a resident? Describe the racial/ethnic composition in your dorm…on your floor. Were you ever treated differently? How did you cope? What resources did you use?

16. What is the racial/ethnic composition of the student body in your engineering classes? Does it make a difference to you if there are other students of color in the class or other--(e.g., African American)--people in the class? (Insert appropriate group) Do you think race/ethnicity influences your relationships with students in your class? What strategies have you used to help you be successful working with classmates from other ethnicities?

17. Describe the racial/ethnic background of the engineering professors you've had. Do you think race/ethnicity influences your relationships with teachers in COE? Across the University?

I want you to think about your experiences in the College of Engineering, at OU, and in the local community for the context of these next questions.

18. Do you think you've ever been treated differently because of your race/ethnicity? Can you describe what happened? How did you respond? (Probe for thoughts, feelings, behaviors . . . What did you think? How did your feel? Did you feel like there was anything you could do? What?) How did the teacher(s)/students respond? With whom did you discuss the event(s)?

19. During this experience did anyone/or anything help you/or give you support? Did anyone/anything make things worse? What helped you overcome this experience?

20. Do you think you've ever been treated differently because of your gender? (Same probes as above)

21. During this experience did anyone/anything help you/or give you support? Did anyone/anything make things worse? What helped you overcome this experience?

22. Do you think gender influences your relationships with (1) students in your class, (2) teachers, (3) other people in the university?