

The Experiences of African-American Males on Multiracial Student Teams in
Engineering

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Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State
University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Engineering Education

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4 May 2015
Blacksburg, VA

Keywords: intergroup contact, multiracial student teams, multiple identities

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ABSTRACT

Team projects in engineering are critical sites for professional and personal development as students interact with peers and faculty on projects designed to simulate engineering work. These projects allow students to try on professional roles and establish a sense of identity within their field, which in turn influences their retention through college and into engineering careers. However, team projects can present challenges specific to students from underrepresented populations. While research on women's team experiences is strong, few researchers have studied African-Americans. To fill this gap, the current study explores the experiences of African-American males on multiracial student teams and the impact of those teams on these students' identities.

This qualitative study employed a phenomenological approach, using a three-interview sequence with eight African-American male engineering students as they worked on team projects at a predominantly white institution (PWI). The interviews gathered background information about each participant, explored the team functionality during the project, and enabled participants to reflect on the team experience. Two theoretical frameworks were considered during the study design: 1) intergroup contact theory provided a lens to explore interracial interactions, and 2) multiple identities provided a lens to analyze the impact of team dynamics on students' intersecting identities.

The findings provide a rich understanding of the team experiences of African-American male students that can enhance project-based teaching within engineering to more explicitly attend to team dynamics, including interracial interactions for students of color. Both positive and negative impacts on African-American males in engineering emerged from the intergroup contact within the team environment. Specifically, the results indicate that these participants enjoyed their multiracial student teaming experiences, supported by informal social interactions among team members and generally positive professional interactions. However, the study participants also entered their team experiences fully aware of the negative stereotypes about African-Americans in engineering and proactively worked to dispel those stereotypes.

Dedication

I dedicate this work to my parents, Pastor Israel L. and Earnice Cross,
to the young African- American males who aspire to be engineers,
and to all those who have supported me over the years.

“Men who have come into a consciousness of who they are in terms of their true identity,
in terms of their true capacities for knowledge and consciousness,
are able to move and change the world” Na'im Akbar

Acknowledgements

First, all praises to The Creator and sustainer of all life.

Next, thanks to my adviser, Dr. Marie Paretti, for your support through this process. I am grateful for your time, energy, encouragement, and guidance that made it possible to get my dissertation completed. I know it was not easy.

Thank you to my participants, who let me into their lives and graciously shared their stories with me.

Thanks to my committee: Dr. Marie C. Paretti, Dr. Bevlee Watford, Dr. Holly M. Matusovich, Dr. Paula M. Seniors, and Dr. Mya Poe. It was my pleasure to work with you and learn from your insight over the course of this dissertation. Your contributions throughout this process were truly character building.

Special thanks to Dr. Carson Byrd, who introduced me to intergroup contact theory, and to Dr. Claire Robbins for discussing multiple identities with me. Your generosity and discussions were essential to my dissertation.

Thanks to my research group and ENGE family. Your support during my PhD program is greatly appreciated and your friendships are truly irreplaceable. Thanks to Dr. Walter Lee for your assistance with intercoder agreement and ALL the things you brought to my life. Thanks to Dr. Jay Pembridge, Dr. Stephanie Cutler, Dr. Rachel McCord, Cory Hixson, Courtney Smith, Ben Lutz, Mike Ekoniak, Deirdre Hunter, Dr. Cheryl Carrico, Cassandra Groen, Monica Motley, Allison Randall, Kevin Sevilla and many others who helped me get through this process.

Thank you to Charlotte Amenkhienan for your counsel and support to help me get through a very difficult process.

Thanks to my “Entourage for Success”: Dr. LaVonne Neal, Dr. Regina Lewis, Dr. Karsonya (Kaye) Whitehead, Dr. Conra Gist, Dr. Alicia Moore, and the NIU Cadets for pushing me to respond to my challenge with strength and integrity.

Thank you to my academic family: Dr. Mike Harris, Dr. Pamela Shaw, Dr. Stephanie G. Adams, Ken Simonson, and Dr. Rachelle Brunn.

Thank you to my parents, Pastor Israel L. and Earnice Cross, my brother Tony O’Kain, my sister Tracy and brother Israel, my aunt Sandra Walker and my uncle Tamara Walker, my grandma Perlene O’Kain, all my cousins, and the rest of my biological family for your love and support.

Thank you to my Indiana and extended family, including my God-children, Beth, and friends. Thanks to my “mother board”: Schuanita, Adrian Thomas (AT), CJ, Lisha Tucker, and Tracey Collins for watching me grow.

Thank you to my Cincinnati family, including Pastors Lesley E. and Noni Jones, Sheila D, Deacon Gay, Minister Terri, and my church family at Truth and Destiny Covenant Ministries.

This work is based on research supported by the National Science Foundation under Grant No. EEC-1025189. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation

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Chapter 1 Introduction

1.1 Overview

Team projects in engineering are critical sites for professional and personal development as students interact with peers and faculty around projects that are often designed to simulate professional engineering work (Cross & Paretto, 2015). Team projects allow students to try out professional roles and to establish a sense of identity within their chosen field (McNair, Paretto, & Kakar, 2008) . These opportunities are particularly useful in helping students construct professional identities that are central to retention and career plans. Within team activities students learn disciplinary norms, expectations, standards of work, and communication requirements in addition to content knowledge (Dannels, 2000), which all contribute to identity construction.

However, team projects can also be a source of conflict for students from underrepresented populations such as women (Tonso, 2007a) and ethnic minorities (Foor, Walden, & Trytten, 2007), and previous research highlights the consequences of ignoring racial and gender issues in undergraduate group activities (Rosser, 1998). Because, team projects are places where racism, sexism, and other prejudices can become evident through peer and mentor interactions (Tonso, 2006; Wolfe & Powell, 2009), understanding the social experiences occurring within team learning environments is an important area of research. A better understanding of these experiences can enhance our pedagogical practices as we start to establish how demographic characteristics affect team dynamics (Bell, Villado, Lukasik, Belau, & Briggs, 2011). While several researchers have explored the experiences of women in engineering teams (e.g. Ingram & Parker, 2002; Tonso, 1996), few have explored the experiences of African-American students. To fill this gap in the research, I explored the team experiences of a group of

male African-American engineering students, including their perceptions of peer and faculty interactions within multiracial student teams in engineering, where multiracial refers to members of different races (e.g. African-American, Caucasian, and Asian). . Note: In this dissertation, I use the term African-American; however, I use the authors' language (e.g. students of color or Black) when I refer to previous studies, and the participants in the study were permitted to self-identify their race.

1.2 Need for Research

Teams are important in professional engineering practice, and effective teamwork skills are highly desired by engineering employers. According to Bellamy et al., team based pedagogies were prompted in part by companies that desired better product quality (Bellamy, Evans, Linder, McNeill, & Raupp, 1994). Industry leaders began to emphasize the use of teamwork when research demonstrated that when used effectively, teams reduced production costs while increasing employee intellectual contributions and productivity (Adams, 2003). At the same time, researchers found that team projects in school provide students with the opportunity to interact in groups and practice these professional teaming skills.

As a result, the use of team projects has increased in engineering courses, and teamwork is now a central accreditation outcome in the U.S. (Technology), 2010). For example, most engineering courses that include a design project utilize student teams (Howe, 2010; Pembridge, 2011; Whitman et al., 2005). However, the approaches to forming, developing, and mentoring teams in engineering courses, as well as the processes by which student teams become effective, remain unsettled (Paretti, Layton, Laguette, & Speegle, 2011). Overall, research on engineering student teams focuses on implementation and assessment, but does not extensively explore student experiences. For example, less than a fourth of the articles regarding engineering student

teams included in my review of the literature discussed the student experience in any way. Moreover, many of the studies that addressed student experiences were published ten or more years ago (e.g. Richardson & Montemuro, 1999; Tate & Linn, 2005). As a result, our current understanding of students' experiences on engineering teams may be outdated as both students and curriculum have shifted.

The research gap is even more pronounced for underrepresented minorities, who have significantly different experiences than majority students in engineering. In this context, underrepresented engineering students are defined as student groups historically marginalized within STEM fields, where the student population does not mirror the national racial composition (e.g. African-Americans are 12% of US population but only 5% undergraduate engineering population) (Gibbons, 2010). Engineering culture is predominately Caucasian and male, with small pockets of diversity, and student teams are a microcosm of that culture. That is, students teams will mimic the social norms established by the larger community of practice within the engineering culture (Tonso, 2006). As a result, teams can negatively affect underrepresented populations, and several studies have highlighted such affects for women. For example, the negative impacts of student teams on women in engineering explored in-depth by Tonso (2006) included "tacit tolerance of sexist behaviors" (pg. 193) that inhibited women's sense of belonging within engineering. Other authors have investigated differences in communication styles between male and female students (Wolfe & Powell, 2009), and the effect of social anxiety during team activities with peers and mentors (Ingram & Parker, 2002). The negative impact of differing communication styles can lead to women doing all the work to avoid holding team members accountable, or it can limit their team involvement such that they

are relegated to administrative tasks that do not require technical expertise or engineering knowledge (Ingram & Parker, 2002).

Far less work has been done considering the experiences of African-American students, yet from a critical race theory perspective, race is always influencing organizational behaviors, and inconsistent practices based on race can lead to different learning experiences for majority and underrepresented engineering students (Delgado & Stefancic, 2012). Furthermore, we know that students' sense of belonging is critical to their matriculation through an engineering program (B. D. Jones, Paretti, Hein, & Knott, 2010), and it is even more so for African-American students (Strayhorn & Terrell 2010). When students of color are able to find social support and to connect with their peers, for example through teams, they are more likely to be academically successful (Reynolds, Sneva, & Beehler, 2010). Conversely, group work can be negative or lead to undesirable academic outcomes for African-American students when that social support is lacking, which makes it important to understand the dynamics of student teams (Pauli, Mohiyeddini, Bray, Michie, & Street, 2008). These dynamics are particularly important for interracial teams where both implicit and explicit racial attitudes can impact the effectiveness of the team (Dovidio, Gaertner, Kawakami, & Hodson, 2002). Moreover, there is minimal understanding regarding pathways for students of color to successfully navigate arguably racist or unwelcoming educational environments (Harper, 2013).

1.3 Purpose of the Study

Because so little is known about underrepresented students' team experiences, the purpose of this phenomenological study is to understand the experience of African-American engineering students on multiracial project teams at a predominantly white institution (PWI). Moreover, given the documented impact of gender (Tonso, 2007a) and the complexity of

multiple identities, this study focuses specifically on African-American men. Given the low number of African-American males in engineering, researchers advocate investigating how African-American males successfully navigate college despite known stereotyped and raced social norms that exist at PWIs (Harper, 2013). To that end, the study aims to identify salient features of the structure or context of the phenomenon in terms of participants' thoughts, feelings, examples, and ideas about the experience (Moustakas, 1994). Importantly, as an initial exploratory investigation, the study focuses on describing the experiences of the participants, and is not intended to develop theory or an intervention; this focus is consistent with the assumptions of phenomenological research. The study addresses the following research questions:

Research Questions:

Overall RQ: How do African-American males experience multiracial student teams in engineering?

RQ1: How do male African-American engineering students describe their experience on multiracial teams?

RQ2: What patterns or themes emerge in the way male African-American engineering students describe and interpret their experiences on multiracial teams?

RQ3: How do the experiences of male African-American engineering students on multiracial teams relate to their sense of identity?

Together these research questions represent steps toward a better understanding of the team experiences of African-American men that can in turn lead to effective pedagogies to support multiracial student engineering teams.

1.4 Approach

To systematically describe the meaning of the lived experience for several African-American men working on multiracial teams, I applied a phenomenological approach.

Phenomenology is a qualitative method that focuses on understanding the essence of a lived

experience based upon the shared or common factors that all participants experience during the phenomenon (Creswell, 2007). Phenomenology is a method to describe a complex experience that is not well understood--in this case, how African-American men experience engineering student teams. There are two broad categories of phenomenology; *hermeneutical* emphasizes the researcher's interpretation of "text," while *psychological* or *transcendental* emphasizes participants' description of the experience. I took the latter approach, and focused on my participants' description and interpretation of their team experience.

Several philosophical assumptions underlie phenomenology as a research method (Creswell, 2007). First, the goal is to understand the essence of a lived experience rather than a desired state. Second, participants are aware that they are experiencing the phenomenon being studied. In my study, the second assumption meant that the participants had to self-identify as African-American and had to be participating on a multiracial team during the data collection. The last assumption of a phenomenological study is that the outcome produced by the work is a description of the essence of the experience, but not an explanation for the experience. The last assumption is critical in my study because I am only collecting data from individual participants, not from team members, mentors, or other observers of the team dynamics who might have different perceptions. However, by exploring how African-American men experience engineering teams, my dissertation provides useful information for faculty and academic staff managing multiracial teams in engineering courses to enhance the experiences of both students of color and majority students.

Following Moustakas (1994) and Hycner (1985), my data collection focused on the perceptions of the participants as they reflected on their experience. To begin, I recruited participants by direct solicitation at meetings of key campus groups such as the National Society

of Black Engineers (NSBE), followed by emails to those groups inviting participants to complete a demographic screening survey. Based on the survey responses, I interviewed eight African-American males in engineering who were working on project teams at the time of the study. Sample size was sufficient to achieve saturation. I applied a phenomenological three-interview sequence to collect data. I developed interview protocols for this interview sequence, which guided the African-American participants through the reflexive process to describe their experience on a multiracial student engineering teams. The three interviews 1) gathered background information about the participants, 2) explored team functionality during the project, and 3) enabled participants to reflect on their team experiences. I used verbatim transcripts to create a list of significant statements from the participants, which were then grouped into clusters of meaning to identify themes.

Multiple steps were included in the study design to ensure reliability and trustworthiness. For example, I had a peer researcher review my data analysis at multiple points during the systematic procedure (Hycner, 1985). Also, I maintained a detailed audit trail throughout the study to track my analytic memos. Finally, I sent each participant their summary profile as a member check.

1.5 Theoretical Frameworks

Two theoretical frameworks, intergroup contact theory and multiple identities, informed the study design and guided the data collection instruments. Those theories were essential to the development of my research questions and the selected strategy of inquiry. However, the frameworks were not part of the phenomenological analysis (which relied on emergent rather than *a priori* themes); instead they provided explanatory power and helped situate my results within literature. Specifically, in Chapter 5 I discuss the emergent themes in the context of these

guiding frameworks. By doing so, I expand the use of these theories into the context of engineering, and particularly to the experiences of a marginalized group within this social structure. At the same time, by focusing on the perspectives of the marginalized group, my study also critiques components of each theory as they are enacted within the social structure of engineering. Finally, these frameworks serve as an advocacy lens that leads to a call for action or change in socially accepted behaviors (Creswell, 2009) based on insights into the experience of African-American male engineering students.

1.5.1 Theory 1 (Intergroup Contact)

While focusing on the perspective of African-American men, the study took a deeper look into the experiences among students from different races on engineering teams. Since the study investigates the experiences of individuals in mixed-race contexts, intergroup contact theory is a viable theoretical framework to help situate the results. Intergroup contact theory is a promising and complex social psychology theory that originated from Allport's contact hypothesis (Dovidio, Gaertner, & Kawakami, 2003; Pettigrew, Tropp, Wagner, & Christ, 2011). Intergroup contact is the direct physical or face-to-face interaction between members of different groups (racial, political, or sexual orientation) and the emotional and psychological responses experienced due that social contact. The contact hypothesis suggests that when intergroup contact is intentional and supported by authority (e.g. faculty mentor), bias and prejudice can be reduced (Dovidio et al., 2003). To my knowledge, the theory has not yet been applied in the context of engineering or engineering education. However, it has been applied in a significant number of social science studies to reduce social anxiety, prejudice, and hostility. Given its usefulness in other contexts, another impetus for the current study is to explore whether intergroup contact is applicable to multiracial student engineering teams.

Social science researchers have described both positive and negative outcomes of intergroup contact as well as the essential mediating factors. Positive outcomes include a reduction in anxiety (Binder et al., 2009; Jackman & Muha, 1984), increased trust (Dovidio et al., 2002), effective communication (Ely, Padavic, & Thomas, 2012), and the sharing of resources. Negative outcomes include poor communication (Dovidio, Kawakami, Johnson, Johnson, & Howard, 1997), violence (Hewstone, Rubin, & Willis, 2002), resentment (Tuch & Hughes, 2011), and distrust or anxiety (Stephan & Stephan, 1985). Through multiple meta-analyses, social science research has identified six mediating conditions to achieve positive intergroup contact (discussed in detail in Chapter 2), with authority support as the most critical (Pettigrew, 2008). Other factors that can impact the contact situation are personal or individual characteristics. Personal characteristics addressed in the literature include sensitivity to racism (Pearson, Dovidio, & Gaertner, 2009; Sellers & Shelton, 2003), threat level (i.e. group vs. individual) (Tausch, Hewstone, Kenworthy, Cairns, & Christ, 2007), group identification (i.e. group membership and value) (Pettigrew, 1998), and stereotypes (Czopp, 2008) or attitudes (Jackman & Muha, 1984).

1.5.2 Theory 2 (Multiple Identities)

Multiple Identities is a conceptual framework that provides a way to examine how individuals' demographic (e.g. race, class, gender, ethnicity, and age), cultural, social, and personal identities intersect. This approach emphasizes that a person's experience is not simply an additive sum of individual identities (e.g. African-American + male + engineering); instead all identity dimensions impact an experience simultaneously in ways that are more complex. In addition, the salience of any one dimension of identity can vary greatly by context. The initial conceptual Model of Multiple Dimensions of Identity (MMDI) was developed to address

multiple traditionally oppressed identity dimensions such as race and gender (S. R. Jones & McEwen, 2000). However, the investigation of additional student characteristics led to the re-conceptualization of the model to account for the complexity of context, meaning-making, and identity perceptions (Abes, Jones, & McEwen, 2007). Various studies applied multiple identities theory to African-American college students (Stewart, 2008, 2009; Tate & Linn, 2005), as detailed in Chapter 2. Key in this research is that college students are continually experiencing intersections of their various identities (e.g. racial, gender, professional), while simultaneously exploring and developing those identities. Furthermore, the relative salience of any dimension of a college student's identity, particularly students of color, varies by context (Tate & Linn, 2005), and in some context, multiple identities may be in conflict with each other, leading to negative outcomes (Settles, 2004). For example, some studies on the multiple identities of Black college students, found that females tend to separate their social and professional groups (Tate & Linn, 2005). Other studies found that Black college students were able to integrate the multiple dimensions of their identity and grew less reliant on external validation (Stewart, 2008). Multiple identities are thus a useful conceptual framework to explain how different dimensions of male African-American engineering students' identities intersect during multiracial student team experience.

1.6 Significance of the study

This study contributes to the knowledge base regarding underrepresented students' experiences in engineering and provides some insight into the complexities of diversifying the STEM workforce. Specifically, the results of the my study

- demonstrate how phenomenological studies can be useful in engineering education research;

- provide a detailed description of how a group of African-American males experience multiracial teams;
- provide evidence of the ways in which peer relationships are critical to African-American males' team experiences;
- describe the challenges male African-American males face during team experiences in engineering, particularly in terms of stereotype awareness;
- enhance our understanding of how African-American men experience being stereotyped;
- suggest coping mechanisms for African-American men to navigate negative experiences in engineering and the absence of faculty of color to teach them;
- demonstrates the applicability of intergroup contact as a viable theoretical lens to qualitatively investigate the experiences of students on multiracial engineering teams.

1.7 Limitations

Despite the efforts to ensure the quality of the proposed study, there are always limitations. First, the design of the study included a single research site and looked across years and majors; future work may look at replicating these efforts in a broader multi-institutional research endeavor with focused attention on specific variables of interest. The sample includes only a self-selected portion of the African-American men in engineering at the study site. More specifically, these participants were willing to participate in a study of the experiences of African-American students on multiracial teams; the sample may not represent all African-American men, and may particularly exclude those who did not wish to discuss multiracial interactions in engineering. Third, the time scale for study did not capture identity development or change in the students over an extended time; future work could be longitudinal to enhance our understanding. Fourth, the amount of previous team experience or previous interracial

contact was not part of the participant selection process, although previous experiences may heighten participants' sensitivity to multiracial team issues (Ely et al., 2012). Fifth, given the range of academic levels, participants had varying levels of understanding regarding their own identity dimensions. That is, some participants had not explored their personal identity or found it difficult to articulate their current personal identity status. Finally, neither actual team performance nor student outcomes were part of the data collection. Consistent with phenomenology, the study data focuses only on student perceptions of their experience, and does not include any team performance metrics (i.e., project or team grades). Future work could incorporate observation and/or assessment data to consider how these experiences enhance or interfere with the overall team process.

1.8 Chapters Overview

In this introduction, I have briefly described some key concepts regarding multiracial student engineering teams, stated the purpose of my study, articulated the research questions that guided my study, and identified several intellectual contributions my study makes to research on race in engineering and student teams. Chapter 2, the review of literature, expands on the concepts introduced in Chapter 1 and summarizes pertinent previous work. The literature review emphasizes the current state of our understanding of student teams, interracial interactions, and uses of multiple identities theory to study students of color. Chapter 3 describes the phenomenological qualitative method and the full study design, including a detailed description of participants, data collection, and analysis. Chapter 4 provides an organized presentation of the results and operationalized definitions of the final themes. Chapter 5 situates the results in prior literature and summarizes major conclusions. Finally, Chapter 6 articulates the implications of the research, recommendations for specific stakeholders, and future work to build on this study.

1.9 Definitions

African-American, Black or students of color: the participants for the study were asked to self-identify their race, but I use the term African-American unless specified by the literature or the participant.

Cooperative Interdependence: Mutual cooperation among team members where goal attainment requires intergroup collaboration (not only individual efforts) (Johnson, Johnson, & Smith, 1998; Johnson, Johnson, & Smith, 2007).

Intergroup Contact: the direct physical or face-to-face interaction between members of different groups (racial, political, or sexual orientation) and the emotional psychological responses people experience due that social contact. Positive intergroup contact is interaction between individuals from different races or ethnicities, that leads to positive outcomes such as reduced anxiety, prejudice, or hostility. Negative intergroup contact is interaction between individuals from different races or ethnicities that leads to negative outcomes such as increased anxiety, prejudice, or hostility (Pettigrew, 1998).

In-group: a group of people sharing similar demographic characteristics, interests or attitudes, which produce feelings of solidarity, community, and exclusivity (Tajfel & Turner, 2004).

Mixed-race, cross-race, or multiracial teams: an engineering student team that has members from more than one racial or ethnic classification (e.g. two white students, one African-American student, and one Asian student is multiracial).

Out-group: people outside one's own demographic or interest group, especially as considered to be inferior or alien; a group perceived as other than one's own (Tajfel & Turner, 2004).

Recategorization: redefining in-groups and out-groups. This redefinition can be done in a various ways. According to social science researchers (Dovidio et al., 2003), recategorization can be achieved when individuals rearrange peers into one superordinate group such that "they" and "us" become "we." The former intergroup boundaries are replaced with a single, inclusive boundary, such as when “our” engineering or team identity becomes more salient than “my” and “your” racial identity. Another way to recategorize individuals is to see them as separate individuals instead of members of an out-group. These newly formed mental representations of group membership are strategies to reduce intergroup bias and leads to greater cooperation or the potential for friendship opportunities.

Self-disclosure: a process of communication through which one person reveals himself or herself to another (Turner, Hewstone, & Voci, 2007). Specifically, it refers to statements made by the participant to express opinions, personal identities, and/or values, and it is a mechanism to mediate friendship opportunities and support positive intergroup contact or personal interactions.

Underrepresented: Instances in which a group’s representation within a field (e.g. engineering) is below its representation in the United States population. For example, African-Americans represent 13% of national population (Rastogi, Johnson, Hoeffel, & Drewery, 2011), but represent only 5% of engineering students at the undergraduate level (Gibbons, 2010). Thus, in the case of engineering, women, African-American, Latino, and Native-Americans are underrepresented.

Chapter 2: Review of Literature

2.1. Introduction

Teams are important in professional engineering practice, and effective teamwork skills are highly desired by engineering employers. Based on their critical role in industry, team projects are increasingly prominent in engineering curricula, but little research to date explores how these projects affect students, particularly those from underrepresented groups. Underrepresented students' experiences are important to study because team projects can expose social anxieties associated with racism, sexism, or other prejudices (Wolfe & Powell, 2009). Rosser (1998) warned STEM educators about the consequences of ignoring racial and gender issues in undergraduate group activities and emphasized the importance of the team development process. However, most research on engineering teams focuses on team effectiveness or performance and assessment of student learning (e.g. Bellamy et al., 1994; Lent, Schmidt, & Schmidt, 2006), but rarely considered student experiences. The research that does exist tends to focus on the impact of gender on teams (e.g. Tonso, 2007; Faulkner, 2007; Faulkner, 2009; Malone et al., 2005; Ingram, 2002). Few studies articulate how race affects engineering student teams. Yet the benefits and conflicts that impact women in engineering are not only relevant to underrepresented African-American students, but may be more pronounced. Therefore, more work is needed to understand how team interactions affect students from underrepresented populations.

Toward that end, this chapter reviews pertinent issues in multiracial engineering student teams and provides an overview the theoretical perspectives structuring the study: Intergroup Contact Theory (ICT) and Multiple Identities (MI). It begins with a description of research on student teams, including the incorporation of teams into the education of engineers, a summary

of studies considering multiracial teams in group learning activities, research on gender and engineering teams, and the role of faculty on students' team experiences. The review then provides a synthesis of studies that illustrate the key concepts of the two theories that informed my dissertation, intergroup contact and multiple identities.

2.2 Teamwork in Engineering

2.2.1. Teamwork Important in Industry

Teamwork is a highly desired skill by engineering employers (Matusovich, Paretti, Motto, & Cross, 2012; Paretti, Pembridge, Brozina, Lutz, & Phanthanousy, 2013) as industrial processes and engineering problems become more complex and teams rather than individuals are the working unit. In other words, teamwork is prevalent in industry as the nature of industrial work often requires a team of engineers (R. Martin, Maytham, Case, & Fraser, 2005). The ability to work in a group effectively and efficiently is mandatory for success in the contemporary workplace (Chapman, Meuter, Toy, & Wright, 2010) and is an essential outcome as defined by ABET, Inc, the agency responsible for accrediting engineering programs (ABET, 2010)

The desire of engineering employers for professional teaming skills in the workplace to enhance quality and performance led to pedagogical shifts to incorporate these skills into the curriculum (Bellamy et al., 1994). Practicing engineers, educators, and scholars all now recognize teamwork skills as essential to workplace success (Lingard, 2010). For example, according to Seat & Lord, performance skills such as interpersonal communication and teaming skills are a concern for STEM employers and engineering educators alike because these professional competencies must be taught, practiced, and then evaluated (Seat & Lord, 1999). As a result, Seat and Lord (1999) proposed a systematic approach to infusing teamwork into the engineering classroom that provides a common language and structure for teaching these skills

as a part of traditional engineering curriculum. Similarly, Smith et al. introduced multiple pedagogical approaches to better teach teamwork skills to engineering students by increasing student engagement in the classroom (Smith, Sheppard, Johnson, & Johnson, 2005). Engineering educators have also offered best practices for incorporating teamwork into engineering classroom based upon a series of studies designed to identify optimal conditions for teamwork in an academic setting (Oakley, Hanna, Kuzmyn, & Felder, 2007). In fact, both employers and educational researchers view teaming and collaborative learning methods as valuable experiences in engineering classrooms (Johnson et al., 2007). Thus, the desire for engineers with highly developed teamwork skills and the addition of more design experiences has led to increased presence of teaming skills in engineering curricula.

2.2.2. Teams Experiences in Engineering: Cooperative Learning and Project Teams

These team experiences typically take one of two forms: cooperative learning or team projects (e.g. freshman or capstone design). Cooperative learning is a classroom technique where students work on learning activities in small groups and receive rewards or recognition based on their group's performance (Slavin, 1980). The focus is on students building knowledge together by teaching each other (Johnson et al., 2007). Cooperative learning has been labeled as the most common form of active learning (Adams, 2003), and has been shown to produce positive outcomes, including significant individual learning gains and positive interpersonal relationships (Johnson et al., 1998; McWey, Henderson, & Piercy, 2006). Team projects also rely on group work, but focus on having students produce some type of product or artifact and emphasize a task or process such as engineering design (Kolmos & de Graaff, 2014). Despite the popularity of these methods, and the potential gains in teamwork skills for students, engineering faculty should also be intentional about implementing these group learning methods into engineering

courses because not addressing gender and race dynamics can diminish gains and hinder the development of women and students of color (Rosser, 1998).

Research on implementing cooperative learning as classroom technique suggests both positive and negative effects on individual student development. For example, initially researchers found relatively consistent effects on intergroup relations and achievement of individual minority and majority students (Slavin, 1985). Generally, when used with multiracial teams, interracial friendship is the most striking and consistent outcome of various cooperative learning techniques. In one case, experimental research on cooperative learning methods in desegregated elementary and secondary schools found relatively consistent positive effects on intergroup relations and the achievement of minority and majority students (Slavin, 1985).

Conversely, researchers have identified aspects of both cooperative learning and team projects that can have more mixed or negative outcomes. For example, group conflict can be either productive or inhibiting to student learning (Webb, 1982). Whether conflict is productive or inhibiting depends on individual student characteristics such as attitude or acceptance. Group work can also have a large impact on negative emotions and experiences of students (Pauli et al., 2008), particularly when students perceive diversity issues (i.e. gender and race) as a challenge to team productivity (Pauli et al., 2008). For this reason, the students in Pauli et al.'s study desired training to learn how to handle diversity challenges within their student team project.

Another potentially negative concern for team projects and cooperative learning is the unequal status of team members. Unequal status within a team can influence students' challenge-oriented communication styles and conflict resolution strategies (Purzer, 2009, 2011). For example, students with lower self-efficacy communicated in a different style than high self-efficacy students in engineering teams. Students with lower self-efficacy or a diminished sense

of belonging may avoid challenging the ideas or decisions of high self-efficacy team members. Such avoidance of verbal conflict can limit student learning because if challenge-oriented discourse is restricted, it could reduce opportunities to correct misconceptions.

Finally, these group learning pedagogies have the potential to elicit negative classroom experiences around interracial student interactions. For example, social anxiety and cultural characteristics are cognitive and psychological factors that can mediate negative perceptions of teamwork (Pauli et al., 2008). To put it another way, cooperative learning classroom activities can lead to the perception of a negative experience if students do not feel comfortable and confident in handling the interpersonal communication that occurs in cross-race contact situations. In light of the potential negative outcomes for team projects and cooperative learning, it is not hard to imagine that these negative effects are often more pronounced for women and underrepresented minorities.

2.2.3. Teams Experiences in Engineering: Impact of Gender

Within engineering, group learning typically takes the form of team projects, which are infused throughout the engineering curriculum but are most prominent in design courses. Capstone design courses are a critical milestone within the engineering curriculum and have garnered significant attention for engineering education researchers (Paretti et al., 2011). As suggested by the more general studies cited above, these team projects can be sites for overall gains, but can also prove challenging for underrepresented students. Within engineering education research, several studies have explored the social dynamics of student teams and identified negative experiences for women in particular, providing a solid baseline to investigate the experiences of underrepresented students on engineering student teams more broadly.

For example, Ingram and Parker found that the female participants in their study were isolated on their respective engineering project teams (Ingram & Parker, 2002). In this two year longitudinal study, the impact of gender on the social processes of collaboration of a student team was investigated by observing gender-linked interaction behaviors experienced by two female students on their project teams. According to Ingram and Parker, gender-linked behaviors are ways of interacting that reinforce socially accepted gender roles, such as men being aggressive in the workplace and women being passive, or men taking leadership roles and women taking support secretarial roles on teams (Ingram, 2005). Although evidence of different interaction styles between men and women was not substantiated in the study results, women did consistently experience feelings of isolation (Ingram & Parker, 2002). Isolating or ostracizing female team members may also be a gender-linked behavior, and one that can negatively impact the experience of women in engineering (Ingram, 2005). The feeling of being isolated or restricted to certain roles is important negative emotions to monitor because they are counter to effective team performance.

Similarly, seminal work by Tonso considered how team effectiveness and gender are experienced in successful engineering student teams (i.e. teams able to complete an assigned task), and she contextualized the teams within the campus culture (Tonso, 2006). Tonso concluded that improving women's experience in engineering requires not only increasing the number of women present, but also changing the larger campus power relations that become acutely evident during teamwork (Tonso, 2006). For example, she recommended individual accountability to counter the exploitation of lower status students that is often either ignored or accepted within engineering.

Other researchers have considered how gender is operationalized within the context of engineering culture more broadly and how it impacts women's experience in industry. Some authors have explored how the typically masculine engineering identity has impacted the experiences of women in engineering. For example, Faulkner considered gender dynamics within engineering workplaces and highlighted the everyday interactions that support men's participation in the community of practice but inhibit women's participation (Faulkner, 2009a, 2009c). Faulkner's multiple studies highlight interpersonal interaction between peers as critical to female engineers' sense of belonging and engineering identity development.

Finally, multiple studies have considered the role of gender in engineering and STEM education in terms of organizational culture (Carlone & Johnson, 2007; Settles, Cortina, Malley, & Stewart, 2006; Tonso, 1996). For example, multiple studies included in this literature review place a significant responsibility on leadership or authority figures in providing opportunities for women to have positive experiences in STEM and education. According to Settles et al., for example, a department chair can promote the voice of female employees through direct interaction and through departmental policies that limit gender bias (Settles, Cortina, Stewart, & Malley, 2007). In other words, effective leadership can make the difference between a positive and negative experience for women in an engineering department, keeping in mind that these experiences directly relate to performance outcomes and job satisfaction (Settles et al., 2006; Settles et al., 2007). Therefore, these authors indicate authority support as essential to foster positive experiences for women in engineering.

2.2.4. Factors Influencing Student Team Experiences

Factors that influence students' experiences on teams include both student-student and student-faculty interactions within the context of the larger engineering culture. First, student-

student, or peer, interactions affect how students experience teams (Kapp, 2009; LeDoux, Gorman, & Woehr, 2012; Lent et al., 2006; Purzer, Baker, Roberts, & Krause, 2008). For example, Kapp described student-student interactions in a team building intervention that allowed student to discuss their individual personalities and what potential obstacles existed for the team because of the variety in personalities and work styles (Kapp, 2009). The results of the study led to more positive perceptions of the team experience (Kapp, 2009). Similarly, Le Doux looked at how interpersonal perception influenced three key team process outcomes: conflict, cohesion, and team efficacy (LeDoux et al., 2012). The results of the study suggest that group members' positive perceptions of one another were related to higher levels of task completion and lower levels of relationship conflict. These and other studies demonstrate the ways that student-student interactions influence how students perceive their team experience.

Although multiple researchers acknowledge the impact of common interpersonal interactions on team experiences for all students, underrepresented students such as African-Americans have additional interactions that can impact their team experience. For example, African-Americans were more likely to experience racism in interactions with other students than in interactions with faculty and staff (A. R. Brown, Morning, & Watkins, 2004). The high probability of experiencing a raced interaction with peers is problematic because perceived racism or discrimination causes African-American students to experience negative psychological responses such as stereotype threat (Steele, 1997) or disengagement to cope with negative ethnic stereotypes (Schmader, Major, & Gramzow, 2001). In addition, the social norms that reinforce privilege in engineering can decrease African-American students' sense of belonging (Foor et al., 2007). Consequently, African-American students' team experiences are influenced by normal

interpersonal communication challenges, but must also confront additional issues related to interracial interactions.

In addition to peer interactions, faculty interactions play a significant role in students' academic development and team experiences (Burbach, Matkin, Gambrell, & Harding, 2010; Vogt, 2008). For instance, the instructor and the environment he or she creates influences students' attitudes toward team or group activities (Chapman et al., 2010; Matusovich, Jones, Paretti, Moore, & Hunter, 2011). That is to say, the way students interact on teams is a direct reflection of the classroom culture established by the instructor. Moreover, authority figures (i.e. faculty and teaching assistants) are encouraged to intentionally promote an egalitarian environment where diverse contributions are valued and rewarded (Tonso, 2006, 2007e). For example, grading approaches that promote team cooperation rather than within-group competition are essential to building interdependence and mutual respect among team members. In addition, situated learning research positions faculty as the experts that provide access to or initiate students into the engineering community (Lave & Wenger, 1991), and engineering faculty act as gatekeepers to identify students as engineers within the community (Tonso, 2007a). Even if engineering faculty limit their responsibility within student teams, their impact is undeniable (Matusovich et al., 2012).

More specifically, faculty can also play a significant role in African-American students' perceptions of how their race impacts their interactions on engineering student teams. African-American students' sense of belonging is mediated by faculty-student relationships, which in most cases are complex interracial interactions (Chapman et al., 2010). According to Foor, given that some students groups can be marginalized during their engineering education, faculty have a critical role in either perpetuating or disrupting the power relationships that dominate the culture

of engineering, which in turn can hinder or help the sense of belonging for underrepresented groups (Foor et al., 2007). In addition, African-American students can place faculty in a paradoxical position with respect to raced interactions, where race can neither be overemphasized nor ignored (Tuitt, 2011). That is to say, faculty have to find the balance in acknowledging the race of students of color without exaggerating the significance of race in their interactions. As a result, faculty management and guidance is essential to ensure that all students, including underrepresented students, are able to contribute the collaboration and success of the team (McWey et al., 2006).

Despite research on the effects of student-faculty interactions, however, many engineering faculty themselves have unclear or inconsistent views about their role. For example, some engineering faculty don't view teaming skills as something that can be taught (Shuman, Besterfield-Sacre, & McGourty, 2005), and some do not consider teaching these skills as part of their responsibilities (Matusovich, Paretti, Motto, & Cross, 2011; Matusovich et al., 2012; Paretti et al., 2011). Faculty also often believe that collaborative teaming skills are taught in other areas of the engineering program and not within their courses (Matusovich et al., 2012; Paretti et al., 2011; Pauli et al., 2008). Finally, some researchers cite the lack of team management training as a potential barrier to faculty incorporating team activities in courses (Adams, 2003; Paretti et al., 2013).

2.2.5 Summary of Teaming in Engineering

As described above, existing research on teamwork in engineering education points to the need to study the effects of teams on underrepresented students in engineering. First, effective teaming skills are essential for current professional engineering practice, including industry and academic careers. As a result, teamwork has been incorporated in to the engineering curriculum

and has an increasing presence in engineering classrooms. At the same time, broader research on group work in higher education indicates that team projects can have both positive and negative effects on student experiences. Moreover, research suggests that the interpersonal challenges of student teams can be more pronounced for women and minorities, and research within engineering education demonstrates these challenges for women. The gap in research on African-American engineering students, coupled with research highlighting the impact of student-student and student-faculty interactions on this population, points clearly to the need to study the effects of teams on underrepresented minorities in engineering.

2.3 Theoretical Frameworks for Understanding Multiracial Teams

Given the gap in research described above, the proposed study seeks to explore the effects of team experiences on African-American engineering students. Two theoretical frameworks scoped the study design: *Intergroup Contact Theory* (ICT) and *Multiple Identities* (MI) Note: In this review of pertinent literature, I use the language of each study's author to describe teams' racial composition (e.g. multiracial, mixed-race or cross race) and individual categories (e.g. students of color, African-American, or Black).

2.3.1 Theory 1 (Intergroup Contact)

While focusing on the perspective of African-American students, my study more generally explores the interactions among students from different races on engineering teams. As a result, intergroup contact theory (ICT) is useful for discussing potential multiracial student team dynamics. Intergroup contact is a promising and complex social psychology theory that originated from Allport's contact hypothesis (Dovidio et al., 2003; Pettigrew et al., 2011). Intergroup contact is defined as the direct physical or face-to-face interaction between members of different groups (racial, political, or sexual orientation) and the emotional psychological

responses people experience due that social contact (Dixon & Reicher, 1997; Dovidio et al., 2003; Pettigrew, 1998). The groups are classified as in-group and out-group through a social comparison and categorization process, where in-group refers to people who are similar to the self and are categorized with self, and out-group refers to people who are different from self and not categorized with self (Burke & Stets, 2009). Because the theory identifies conditions that support positive and negative outcomes for participants (see below), it provides a useful framework to describe team interactions. In addition, to my knowledge, this theory has not yet been applied in the context of engineering or engineering education.

The contact hypothesis suggests that when intergroup contact is intentional and supported by authority (e.g., faculty mentors), bias and prejudice can be reduced (Dovidio et al., 2003). The contact hypothesis has four prerequisite features for positive outcomes: (1) equal status within the contact situation; (2) intergroup cooperation; (3) common goals; and (4) support of authorities, law, or custom (Pettigrew, 1998). Recent advances in the development of the theory have added two additional prerequisite conditions: (5) personal interaction, and (6) friendship opportunity (Dovidio et al., 2003). Through multiple meta-analyses, social science researchers have confirmed all six as mediating conditions to achieve positive intergroup contact, but specified authority support as the most critical (Pettigrew, 2008). All six mediating factors are defined below in Table 1.

Table 1: Conditions for Positive Contact (Dovidio et al., 2003 & Pettigrew 1998)

Condition	Definition
Equal Status	Both groups enter with and expect equal status that is maintained during the contact situation; where equal status refers to “equivalent group power in the contact situation” (Pettigrew, 1998, pg. 78)
Cooperative Interdependence	Mutual cooperation among team members where goal attainment requires intergroup collaboration rather than simply the sum of independent individual efforts
Common Goals	A shared task that all group members consider worthwhile (e.g. winning a team competition) and that supports synergy within team activities

Condition	Definition
Supportive Norms	Local cultural rules, laws or customs that support acceptance, tolerance for difference, and positive contact
Personal Interaction	Voluntary formal or informal individual experiences with out-group members that result in cooperation
Friendship Opportunity	Familiarity and intimacy with an out-group member that builds over time and provides increased appreciation of the relative attractiveness of out-group members more generally

With those conditions in mind, intergroup contact has been studied in a myriad of social contexts, including international migration patterns (Schlueter & Scheepers, 2010) and race relations in the United States (Bowman, 2010; Johnson, Johnson, & Maruyama, 1983; Tausch et al., 2007) and in European countries (Binder et al., 2009). Empirical research on intergroup contact in the U.S. has primarily focused on race relations between Blacks and Caucasians in education, neighborhoods, and national organizations such as the military (Dovidio et al., 2003; Johnson et al., 1983). For example, one study on the U.S. educational system investigated activities to improve race relations as the schools were being desegregated (Scott & McPartland, 1982). The results of the study found improved racial attitudes, but also found that maintaining stratified status also contributed to racial tolerance. In another study, this one longitudinal, empirical research on Australian, German, Japanese, and Mexican-American students was summarized to demonstrate which factors are essential versus facilitating (Pettigrew, 1998). Pettigrew distinguished between essential factors (authority support and cooperation) and facilitating factors (common goals and equal status) that contribute to positive outcomes from intergroup contact such as reduced bias and anxiety. Similarly, intergroup contact was used to explain people's non-voluntary contact during the desegregation of a South African neighborhood (Dixon & Reicher, 1997), where contact reduced intergroup anxiety when authority support was present. Intergroup contact has thus been tested in a wide variety of social

contexts, and, as an intervention supported by the factors identified in Table 1, has proven useful in reducing prejudice in a variety of intergroup contact situations (Pettigrew & Tropp, 2006).

2.3.1.1 Conditions for Positive Intergroup Contact

Notably, all the prerequisite conditions listed in Table 1 do not have to be achieved to promote positive intergroup harmony (Pettigrew & Tropp, 2006), reduce prejudice (Pettigrew et al., 2011), or create positive contact (Pettigrew, 1998, 2008). According to Pettigrew, previous intergroup contact researchers overburdened the hypothesis with too many context-specific facilitating factors, without meeting the original conditions (Pettigrew, 1998). For example, multiple studies acknowledge the difficulty of achieving equal status within the contact situation due to stratified societal or institutional conditions (Hewstone et al., 2002; Maoz, 2011; Pettigrew & Tropp, 2006). Specifically, researchers have linked equal status to in-group bias (Hewstone et al., 2002), and have shown that it is not essential for positive contact.

Similar to equal status, no empirical evidence suggests that having a common goal is essential to the contact situation (Pettigrew & Tropp, 2006). The common goal condition was emphasized in intergroup contact research in terms of cooperative learning (Johnson et al., 1998; Johnson et al., 2007). Having a common goal is a means to diminish competition within the group, which is viewed as unfavorable in a contact situation (Dovidio et al., 2003), but it is not a required condition for positive contact to occur. Despite its questionable status as a requirement, common goals may be linked to sharing ideas, negotiating multiple ideas, supporting individual contributions, or shared understanding, and research on teamwork more broadly suggests that common goals are important to successful teams.

At the same time, the literature does specify conditions that are essential to positive intergroup contact across contexts. First, the results of multiple studies suggest that authority

support is essential (Dovidio et al., 2003; Pettigrew & Tropp, 2006). For example, Dixon and Reicher (1997) claim that lack of government support led to negative intergroup contact during the desegregation process in a South African neighborhood. Others found authority support essential to positive intergroup contact in educational settings to minimize stigmatized groups feeling devalued (Schmader et al., 2001) and to overcome ineffective interracial communication due to subtle aversive racism (Dovidio et al., 2002). Authority support is thus critical in intergroup contact as a means to establish acceptable social behaviors and to act as a referee when interracial communications break down.

The second essential component of positive intergroup contact is cooperative interdependence. Cooperative interdependence is defined as mutual cooperation among team members, where goal attainment requires intergroup collaboration rather than simply the accumulation of separate individual efforts (Pettigrew, 1998). To put it another way, cooperative interdependence is a group condition where all parties must work together to successfully achieve the common goal (Dovidio et al., 2003), which aligns closely with cooperative learning approaches (Johnson et al., 2007). According Dovidio, a contact situation should be structured within a cooperative framework where members of the respective groups have distinct but complementary roles to contribute to a common goal (Dovidio et al., 2003). Conversely, within-group competition, the opposite of interdependence, inhibits positive effects from a contact situation (Pettigrew, 2008) and discounts the learning gains of cooperative learning approach (Johnson et al., 1983; Johnson et al., 2007). Therefore, mutual positive interdependence is irreplaceable in a contact situation to avoid in-group competition and to foster the natural synergy that emerges from collective effort working on a common goal.

2.3.1.2 How Does Intergroup Contact Work

Notably, while the conditions for positive intergroup contact are clear, the underlying mechanisms are not well understood (Pettigrew & Tropp, 2006). Several authors identify the process of the intergroup contact as a lingering research question (Dovidio, Eller, & Hewstone, 2011; Pettigrew, 2008; Pettigrew, Christ, Wagner, & Stellmacher, 2007; Pinel, 2002). For example, the quality and quantity of interaction required for positive intergroup contact (Dovidio et al., 2003), in addition to the length of time on the contact (Dovidio et al., 2011; Pettigrew et al., 2007), remain unknown, as do the effects of the institutional context in which intergroup contact is applied (Pettigrew, 2008).

Despite a lack of robust research regarding mechanisms, however, Pettigrew does suggest four underlying processes to achieve positive intergroup contact (IC): 1) learning about the out-group, 2) changing behavior, 3) generating affective ties, 4) reappraising the in-group (Pettigrew, 1998). Learning about the out-group is a cognitive process where new information is integrated into current understandings and improves attitudes by correcting negative views of the out-group. The second process, changing behavior, is a precursor of attitude changes that are the result of contact situations and which require an action to adjust to new expectations for contact. In other words, the way people interact varies as their expectations of the out-group changes. The third process, generating affective ties, entails encounters which spark positive emotions such as empathy or the reduction of anxiety over time with repeated positive contact. For example, repeated positive contact can lead to intimacy with the out-group as a result of positive emotions. Finally, in-group reappraisal is the cognitive adjustment to reduce in-group bias and the voluntary choice to increase interaction with the out-group. In other words, in-group reappraisal is when the personal value of out-group interaction increases to be closer to the personal value of in-group interaction.

Although these four processes can work individually or collectively to contribute to positive intergroup contact, meta-analytic results suggest that the affective processes (i.e. empathy and anxiety reduction) are relatively more effective than the cognitive factors such as new knowledge (Pettigrew & Tropp, 2008; Stathi & Crisp, 2010). For example, the result of a meta-analysis indicated significant correlations between anxiety reduction related to knowledge about out-group and empathy (Pettigrew & Tropp, 2008). Similarly, the opportunity for friendship is mediator for positive out-group attitude, where perceptions about out-groups members can change with experience. In other words, as people experience positive intergroup contact, they can integrate new information into beliefs and recategorize group membership (Riek, Mania, Gaertner, McDonald, & Lamoreaux, 2010). Recategorization is the psychological process of realigning or reprioritizing group membership salience (Pettigrew, 1998), and it shifts out-groups members into a shared group membership. In addition, Binder et al. found that contact quantity and quality with out-group friends helped reduce prejudice and increased the number of out-group friends, and the contact effects were strengthened when the out-group friend was perceived as typical of their group (Binder et al., 2009). Such results suggest, for example, that if African-American students perceive their majority team members as friends who are typical of members of the majority race, the positive effect of the contact would be reinforced and could lead to a recategorization that enhances their attitude toward majority students more broadly.

2.3.1.3 Personal Characteristics Brought Into Contact Situation

Finally, personal or individual characteristics can impact the contact situation. Social science research has identified personal characteristics including sensitivity to racism (Pearson et al., 2009; Sellers & Shelton, 2003), threat level (i.e. group vs. individual) (Tausch et al., 2007),

group identification (i.e. group membership and value) (Pettigrew, 1998), and stereotypes (Czopp, 2008) or attitudes (Jackman & Muha, 1984). One personal characteristic is the level of awareness of the out-group size, which is the degree to which a person is aware the ratio of in-group to out-group members (e.g. the number of African-American student in the class).

Although the out-groups size does not have a statistically significant impact on anti-out-group attitudes, a larger out-group size does increase the opportunity for intergroup contact (Schlueter & Scheepers, 2010). In addition, confounding variables can also contribute to positive intergroup contact. Actual contact situations such as the classroom or team activities present variables that cannot be controlled for outside an experimental setting. For example, previous exposure to team members in prior classes is an example of a variable that cannot be controlled in the current study (Pettigrew & Tropp, 2008). Also, people that hold prejudicial beliefs deeply might avoid contact and resist positive effects of intergroup contact (Pettigrew, 1998). Finally, intergroup contact researchers encourage future researchers to concurrently take into account the subjective factors involved in both in-group and out-group members within the contact situation (Pettigrew, 2008).

2.3.1.4 Positive and Negative Outcomes after Contact

The extensive use of intergroup contact in social science researcher has identified both positive and negative outcomes as well as essential mediating factors, as described above. The positive outcomes include a reduction in anxiety (Binder et al., 2009; Jackman & Muha, 1984), increased trust (Dovidio et al., 2002), effective communication (Ely et al., 2012), and the sharing of resources. They also include reduction of intergroup bias (Dovidio et al., 2003) and anxiety (Jackman & Muha, 1984). Moreover, as group members gain greater empathy for out-group members during interaction, the contact situation can provide new information about previous

perceptions or misconceptions (Pettigrew & Tropp, 2008). New information learned through intergroup contact can result in a reduction of interactional anxiety (Riek et al., 2010), increased intercultural exchange (Pettigrew et al., 2007), and effective communication (Ely et al., 2012). In addition, interracial trust was identified as a positive outcome of intergroup contact (Dovidio et al., 2002). Notably, trust has been recognized a key component of functional engineering teams generally (McNair et al., 2008; Pohopien et al., 2012). Finally, the effects of intergroup contact can be generalized to the entire out-group when features of out-group membership characteristics become more salient (Dovidio et al., 2003; Pettigrew & Tropp, 2006). In other words, if being an engineer is a more salient than race for African-American students' personal identities, then their personal racial identifications can have less impact on multiracial teams. Overall, the research on intergroup contact establishes the potential for the reduction of prejudice (Binder et al., 2009) and other social anxieties via multiracial student team activities in engineering.

Despite the numerous positive outcomes from intergroup contact, however, research also identifies negative outcomes when the conditions for positive interaction are not met. These negative outcomes include poor communication (Dovidio et al., 1997), violence (Hewstone et al., 2002), resentment (Tuch & Hughes, 2011), and distrust or anxiety (Stephan & Stephan, 1985). The worst negative outcomes from intergroup contact can result in physical violence. For example, intergroup bias has been linked to social hostility that can hinder effective intergroup communication (Dovidio et al., 1997), and result in socially undesirable behaviors leading to acts of violence (Hewstone et al., 2002). To avoid such higher levels of conflict, some people choose to avoid intergroup contact or purposely reduce the level (i.e. frequency) of contact.

Other negative outcomes as a result of intergroup contact include anxiety and in-group bias. The level of contact with out-group members, stereotyping of out-group members, and

assumed dissimilarity of out-group members are significantly related to anxiety (Stephan & Stephan, 1985). For example, if participants grow up in homogenous single-race communities, they are likely to have more anxiety about interacting with majority students and will tend to avoid additional contact beyond mandatory team meetings. In addition, unconscious racism tends to be denied or unrecognized, which creates a significant potential for miscommunication due to incongruent interpretations of discriminatory behaviors (Dovidio et al., 2002). Also, racial resentment and in-group bias can reinforce stereotypes that are used to justify social stratification (i.e. the persistent underrepresentation of domestic ethnic minorities in engineering is justified by stereotypes about inferior intellect or work ethics) (Pettigrew & Tropp, 2006). Another negative outcome from intergroup contact, stigma consciousness (Pinel, 2002), can lead to intergroup avoidance (Pettigrew, 1998). Stigma consciousness is the awareness of negative stereotype status, which can have negative interpersonal consequences such as creating more intergroup tension (Pinel, 2002) and interpersonal distrust (Pettigrew & Tropp, 2006). Thus, the quantity and quality of intergroup interaction is influenced by the beliefs about the interaction partner in terms of level of anxiety and in-group bias. As a result, negative intergroup contact can enhance negative outcomes such as prejudice (Pettigrew, 2008).

2.3.1.5 Criticism of Intergroup Contact Theory

Importantly, there are some criticisms of ICT. Pettigrew, one of the leading ICT researchers, discussed the most prevalent criticisms in a recent review of the theory (Pettigrew et al., 2011). One criticism is that contact is limited to the individual level only. Some researchers argue that the theory fails to operate at the group level and thus has diminished potential to influence group conflict. (Pettigrew et al., 2011) Another critique suggests that positive intergroup contact (IC) can hinder the progress for social change because it minimizes conflict,

causing minorities to be less willing to fight for social change (Pettigrew et al., 2011). Within engineering for example, if African-American engineering students have positive intergroup contact within team projects, they might be less inclined to value or advocate for minority serving programs in the college of engineering. However, this possibility is counter to Bell's proposed social justice strategy of interest convergence to further social justice efforts in the context of critical race theory (Delgado & Stefancic, 2012).

2.3.1.6 Summary: Intergroup Contact Theory

In conclusion, ICT remains potentially relevant to this study despite recent critiques. First, the theory has been applied in a wide range of contexts, which suggest it could be equally applicable in the context of engineering. The meta-analyses and longitudinal studies used to evaluate the theory have established the effectiveness of the conditions proposed within the theory. In other words, although causal relationships have not been proven, generally positive outcomes have resulted from the numerous empirical studies that apply the theory, whether the outcomes were intentional or fortuitous. Also, the theory provides a broad but plausible explanation of all team members' behaviors, which is an important use of theory in a qualitative study (Creswell, 2009). As a result, the intergroup contact theory is a useful perspective in my study.

2.3.2 Theory 2 (Multiple Identities)

Where intergroup contact theory provides a potential framework to explore how students perceive their interactions with team members and faculty mentors, multiple identities theory provides a lens to understand the relationships between the participants' team experience and their personal and professional identities. Multiple identities theory provides a way to examine how an individual's demographic (e.g. race, class, gender, ethnicity, and age), cultural, social,

and personal identities intersect. This approach emphasizes that a person's experience is not simply an additive sum of his or her individual identities; instead all identity dimensions impact an experience simultaneously, with different dimensions more salient in different contexts. The section of the literature review summarizes the development of the model of multiple dimensions of identity as it grew from work addressing multiple oppressed identity dimensions (S. R. Jones & McEwen, 2000) and was then reconceptualized based on additional student characteristics (Abes et al., 2007). The section then reviews various studies that have applied the theory to African-American students, highlights the intersectionality of college students' evolving and dynamic multiple identities, and identifies the negative impacts of multiple identities that may be in conflict with each other. The section concludes with a discussion of literature describing approaches to characterizing participants' description of their multiple intersecting identities that emerged during data analysis (Burke & Stets, 2009).

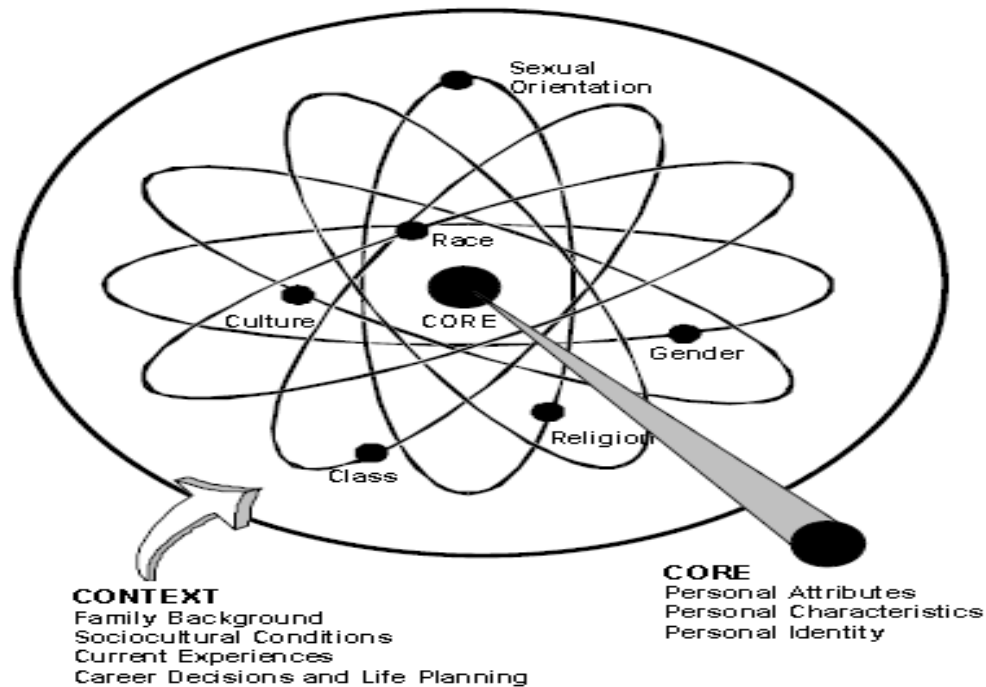
2.3.2.1 Background

Studies that examine the multiple dimensions of student identity may offer critical insights into the ways in which race, class, gender, sexual orientation, and a host of other factors intersect to influence the degree to which individual students experience phenomena such as team interactions. Researchers in race and gender theory have consistently raised concerns about isolating individual dimensions of identity as explanatory factors, and instead focus on the ways multiple dimensions vary in salience and intersect differently in different contexts. Jones & McEwen (2000), from grounded theory using interviews with undergraduate women, developed a conceptual model of multiple dimensions of identity that visually represents a core sense of self or personal identity, with intersecting circles surrounding that core representing the various dimensions of socially defined identities and contextual factors (e.g. life experiences and family

background) (S. R. Jones & McEwen, 2000). Importantly, these identity dimensions may not all be equally salient in every context, and the intersections among dimensions vary with environment.

The model, shown in Figure 1, visually represents the identity dimensions present in everyone but experienced in different ways based upon context, salience of the dimensions, and intersection of identities (S. R. Jones & McEwen, 2000). The core personal identity at the center describes a person's central sense of self based upon personal values and group membership (S. R. Jones & McEwen, 2000). The circles around the core each represent significant identity dimensions that intersect with contextual factors. The location of the dots on the circles represent the relative importance or salience of each dimension for a given context at a specific time; more salient identities are closer to the core and less salient identities are farther away from the core, and these positions change based on context. Overall, the model makes a distinction between the self perceived inside one's self and the social categorizations outside self that are repeatedly negotiated. The negotiation is a result of the changes in the salience of the various dimensions with context as students engage in an ongoing journey of self-exploration and identity construction. On the whole, the model emphasizes both internal and external student development, while distinguishing visible versus invisible identity dimensions. For example, race and gender are visible while sexual orientation and family background are typically invisible.

Figure 1: Conceptual Model of Multiple Identities (S. Jones, 2000) ¹



To expand the model, an investigation was conducted to understand the meaning-making capacity and the dynamics of lesbian college students' multiple dimensions of identity (Abes & Jones, 2004). The results suggested compartmentalization as a mediating factor such that, for this population, students did not see their lesbian identity in conflict with other dimensions of their identity (Abes & Jones, 2004). The results were based upon two related findings that emerged. First, the story narratives elicited through interviews indicated a complex relationship between participants' sexual orientation and other identity dimensions. In other words, the manner in which the participants' sexual identity intersected with their other identity dimensions varied by context and the relationship to their core sense of self. Second, the process of constructing a lesbian identity was influenced by the relationship between contextual influences, meaning-

¹ Susan R. Jones & Marylu K. McEwen. A Conceptual Model of Multiple Dimensions of Identity, *Journal of College Student Development*, Baltimore, Maryland. The Johns Hopkins University Press, 2000, pp. 409. Displayed with permission of S. Jones.

making structures, and the content of the identity (Abes & Jones, 2004). The meaning-making structures, defined as strategies to organize understanding of personal identity, served as filter to determine the context shaped their identity (Abes & Jones, 2004). Specifically, this study revealed the role of meaning-making processes in identity development of lesbian college students and added complexity to our understanding of the multiple identities model.

Based upon the analysis of the results of Abes & Jones (2004), the model of multiple dimensions of identity was reconceptualized to include more complexity in identity construction by integrating a development domain. The developmental domain, self-authorship, or meaning-making as defined by Baxter-Magolda (2008), provided a means to explore the relationship between context and the socially constructed identities (Abes et al., 2007). Specifically, the model was reconceptualized to include meaning-making for a more complete understanding of how students negotiate complex relationships between personal and social identities. The reformulated model displays two dimensions that visually represents the interactive nature of the three components of identity construction: context, meaning making, and identity perceptions (Abes et al., 2007). The revised model positions meaning-making capacity as a filter between the context and the set of concentric rings shown in Figure 1; the complexity of the individual's meaning-making capacity is captured by variations in the depth and permeability of the filter. Individuals with highly developed (i.e. higher order) meaning making capacity have a thicker and less permeable filter than individuals with less developed capacity. Ultimately, the model provides a holistic representation of the ways students perceive the relationship between their personal development and their social identities, including the intersections with their cognitive and interpersonal development (Abes et al., 2007). The results of the Abes et al. work demonstrated a continuum of meaning-making capacity (self-authorship) that highlighted

students' transition from formulaic and externally influenced identity salience to the expression of a more consistent sense of core identity that was adaptable in a variety of contexts (Abes et al., 2007). In other words, as students develop more self-authorship, they rely less on external influences to interpret context and start to establish a stabilized self-concept core.

2.3.2.2 Multiple Identities of African-American students

Few researchers to date have utilized multiple identities to explore the experiences of African-American college students or students in specific disciplines such as engineering. Studies that have explored the multiple identities of African-American college students include Tate & Lynn's study of women of color in engineering (Tate & Linn, 2005), Stewart's study of Black college students negotiating their multiple identities (Stewart, 2008), and Stewart's subsequent study of Black college students' perceptions of the influence of spirituality on their multiple identities (Stewart, 2009). The results of these studies and others demonstrate the complexity of individual dimensions of identity as they affect students' experiences in school, and suggest that the meaning-making process can be critical to academic success (consistent with other student groups). For example, Orbe found that first generation students distinguish between their social and academic peer groups, and the impact of their identities on their experiences depends on the context (Orbe, 2004, 2008). Other researchers found similar results for female students of color in engineering (Tate & Linn, 2005) who differentiated between social and academic peers. Furthermore, many students experienced feelings of difference as they adapted to an environment with a different racial composition than their home communities, which increased the salience of their racial identity (Tate & Linn, 2005). Tate and Linn (2005) identified the intersections of the identities of female students of color such that the participants who felt less comfortable in engineering as a discipline also found it difficult to find study

partners to support their academic performance. In other words, social identity directly impacted these women's academic (or engineering) identity, and was an impediment to choosing an engineering career (Tate & Linn, 2005).

Outside engineering, the existence and acknowledgment of African-American students' multiple identities is consistent within the literature. For example, while investigating the awareness and integration of multiple sociocultural identities of Black students at a PWI, Stewart found that the participants selectively exposed parts of their identity to suit the context of a situation (Stewart, 2008). Moreover, all participants perceived that there was more to them than their visible identities, but they also recognized that these surface identities were integral to their core sense of self (Stewart, 2008). Also, some Black college students acknowledged the dynamic nature of their complex identity that allowed them to perceive themselves in seemingly contradictory ways. For example, the Black college students perceived their spiritual, racial, and academic identities as congruent, which implied that adaptation of their identity was based on the context (Stewart, 2009). The results of Stewart's (2009) study suggest that Black college students recognize the multiple facets of their identity, but may need opportunities to explore the meanings of the intersections of their multiple identities.

In addition to considering how context affects the salience of different identity dimensions, researchers using multiple identities have also considered how the experiences of African-American college students impact their academic success. For example, in Tate & Linn's study of women of color in engineering, participants clearly articulated identity as context-dependent, and while they felt fully engaged in their engineering programs, they also expressed feelings of difference and not belonging based on race and gender (Tate & Linn, 2005). As a result, social isolation could present a barrier to their academic success because they

were unable to form study groups and take advantage of learning that occurs when students discuss course content to reach a collective understanding. Yet Tate & Linn also found these students strongly identified with engineering and their performance was on track for the successful completion of their program, despite interactions that reduced their academic sense of belonging (Tate & Linn, 2005). In other words, these women of color in engineering negotiated their multiple identities to manage the social challenges and found ways to maintain good academic standing despite the challenges. Similarly, some Black students in Stewart's study acknowledged the role that the educational system played in promoting their identity development, which did not occur in isolation or solely within the individual, but rather in connection with the processes, structures, and external environments (e.g. academic department culture) (Stewart, 2008). In other words, these Black students recognized how the department culture influenced their personal identity development and academic integration, which in turn shaped their academic success. Therefore, understanding how Black engineering students negotiate their multiple identities to address social challenges is important because this negotiation can significantly impact academic outcomes.

The findings of studies of African-American college students described above point to the importance of intersectionality and the interactions of the different dimensions. Researchers have concluded that how African-American students perform in academic setting has as much to do with how they identify themselves as it has to do with their academic ability (Strayhorn & Terrell 2010). For example, some Black collegians experienced a diminished sense of belonging at a PWI due to lower socio-economic status (SES). Similarly, Jones' work highlights the relationships among intersecting identities where tension can emerge between visible identities such as race or gender and invisible ones such as class or sexual orientation (S. R. Jones, 2009).

Additionally, tension can emerge between privileged and oppressed identities such as being male in a higher SES and being gay. For example, previous research found that Jewish gay men used multiple strategies to mitigate the intersectionality of identities, including their sexual and religious identity (Schnoor, 2006).

Furthermore, students vary in their understanding of identity integration as they began to make meaning of the intersecting identities. For example, in Stewarts' study, some Black participants expressed their struggles with weaving and connecting the multiple facets of their identity over time during their academic career (Stewart, 2008). The extent of the struggle was mediated by individual efforts to gain acceptance and by their investment in others' opinions (Stewart, 2008). In other words, students who often sought outside approval and confirmation tended to have more difficulty integrating the multiple facets of their identity in an academic setting. In addition, Black students explained that their perception of the intersectionality of their multiple identities went beyond merely describing the parts of the whole and instead involved making meaning between their identity dimensions and their composite self-concept (Stewart, 2009). Moreover, some Black students perceived their multiple identities as interconnected, coherent, and synergistic. Although the students considered some dimensions as externally defined, such as race and academic associations (i.e. student organizations), they also acknowledged those dimensions could also be internally salient, as with their religious or spiritual understanding (Stewart, 2009). The concept of intersectionality illuminates the complexities of the lived experience by providing a heuristic to discover the relationships between identity categories and larger social systems of inequality (S. R. Jones, 2009).

2.3.2.3 Identity Salience and Intersectionality

The interaction and intersection of multiple identities is a dynamic negotiation and developmental process that evolves based on salience and intersectionality (S. R. Jones & McEwen, 2000). The salience of an identity dimension is a negotiation between internal awareness and external scrutiny and rooted in perceptions of experiences (S. R. Jones & McEwen, 2000). Moreover, the identity intersections themselves can influence the relative salience of a particular identity dimension. In other words, which identities are intersecting in a given context can impact the personal value of any given identity dimension in order to reduce the emergence of an identity conflict. For example, gay students may interpret their sexual identity as conflicting with their engineering identity because few if any people are out in their engineering department. Some authors stress avoiding identity conflict through managing perceptions and negotiating identities. Jones, for example, discussed tension between privileged and oppressed identities (S. R. Jones, 2009). The relationship between privileged and oppressed identities cannot be understood outside the societal power dynamics and illuminates the significance of the intersectionality that constructs and complicates multiple identities (S. R. Jones, 2009). That is to say, personal and social identities are constructed based on learned societal circumstance and sociocultural norms. For example, some majority students may not consciously view African-Americans as intellectually inferior, but may still express bias or discuss negative stereotypes when student teams are being formed. Also, Jones described tension that could create an identity conflict between visible and invisible identity dimensions, where individuals must undergo the process of managing how we think others view us and how we view ourselves (S. R. Jones, 2009).

Other authors suggested identity centrality as a moderator to identity conflict and psychological well-being, such as Settles' study of female scientists (Settles, 2004). Identity

centrality is defined as the personal importance of an identity dimension, and it is critical to understanding the relationship between negative events and the psychological well-being of the person subject to the negative event. For example, a racially discriminatory event such as being singled out for a racial characteristic during a class discussion can have a significant impact on a person whose race is critical to their core sense of self, but may have less impact for a person who sees race as less salient to their self-definition. In addition, Settles (2004) found evidence that higher levels of identity conflict correlated to negative outcomes such as performance issues, higher depression, lower self-esteem, and lower life satisfaction. Identity conflict can threaten a person's core identity and mute the effects of coping strategies that were previously effective. As a result, early detection of potential identity conflicts for African-American engineering students may enhance administration retention efforts.

In light of the complexity of multiple identities described above, evaluating individuals' understanding of the complexity of their own multiple identities can be challenging. Some social scientists contend that the multidimensional nature of identity requires the flexibility of qualitative research methods to investigate the intersecting identities during a human experience (Shields, 2008). For example, some psychologists recommend qualitative research methods to explore fundamental questions pertinent to intersectionality analysis (Syed, 2010). On the other hand, previous research has also used hierarchical regression analyses, which are common in psychological studies, to evaluate the intersectionality of demographic constructs (i.e. ethnicity, gender, and age) in terms of the relationship between perceptions of discrimination and psychological well-being among African-American youth (Seaton, Caldwell, Sellers, & Jackson, 2010). Furthermore, multiple researchers specify the strength of intersectionality analysis is in its nuanced conception of identity (E. R. Cole, 2009; Nash, 2008; Syed, 2010). Interestingly, the

tracking and evaluation of nuanced characteristics of identity is consistent with the phenomenological analysis performed in this study (Hycner, 1985). Furthermore, critical race theorists call for using intersectionality to evaluate how identities and awareness of social structures are developed among organizational members where power differential exist (Cho, Crenshaw, & McCall, 2013). In other words, intersectional identities are inherently linked to social structure and power dynamics. Therefore, in the current study, the intersectionality analysis illuminates that race, gender, class, and self-concepts simultaneously influence the perceptions, experiences, and opportunities available for individuals.

2.3.2.4 Summary: Multiple Identities

The model of multiple dimensions of identity was developed to provide insight to the ways in which race, class, gender, sexual orientation, and a host of other factors intersect to influence the ways in which individual students experience phenomena such as team interactions. Multiple identities is a conceptual framework that has been previously used to investigate the experiences of African-American or Black students in college, primarily at PWIs, and it provides a lens through which to explore how race, gender, class, and self-concepts simultaneously influenced the perceptions and experiences of African-American men on multiracial student teams in engineering.

2.4 Summary of Review of Literature

In summary, this chapter reviewed pertinent concepts related to student teams in engineering with team members from multiple racial groups. First, I described existing research on teamwork in engineering education and articulate the research gap that identified the need to study the effects of teams on underrepresented minorities in engineering. As a result of investigating multiracial student teams, I summarize intergroup contact studies that provide a

meaningful way to reflect on cross-race interactions. In addition to intergroup contact, the multiple identities model provides a perspective through which to interpret how the multiracial student team experience was related to participants' intersecting identities. The literature in this review establishes the scope of my study and provides a framework to explore a student group that is under-studied in existing engineering education literature. While phenomenology itself is a data-driven approach and the frameworks do not guide the analysis, they do shape the study design and provide a set of lens to help situate the findings.

Chapter 3: Research Methods

3.1 Methods Overview

Given the challenges that team environments can pose for underrepresented minority students and the lack of research on underrepresented minority students' team experiences, this study uses a phenomenological approach to explore African-American student experiences on multiracial engineering teams at a predominantly white institution (PWI). In particular, intergroup contact theory (ICT) as defined by social science researchers (Pettigrew, 1998) provided a basis for the data collection instruments developed for the study and contributed to the discussion of the results in terms of the interracial dynamics within the engineering student teams. In addition, multiple identities (MI) theory was used to explore African-American men's sense of identity within the multiracial team context. The exploratory nature of the study aims to identify significant features of the participant descriptions to capture the essence of the experience. Specifically, the study addresses the following research questions:

Overall Question: How do African-American males experience multiracial student teams in engineering?

RQ1: How do male African-American engineering students describe their experience on multiracial teams?

RQ2: What patterns or themes emerge in the way male African-American engineering students describe and interpret their experiences on multiracial teams?

RQ3: How do the experiences of male African-American engineering students on multiracial teams relate to their sense of identity?

Table 2 summarizes of the data collection, analysis, and outcomes relative to these questions.

Table 2: Summary of Data collection, Analysis and Outcomes

Research Question	Data Collection	Data Analysis	Outcomes
Overall: How do African-American males experience multiracial student teams in engineering?			
How do African-American males experience multiracial student teams in engineering?	Combined Interviews	Phenomenological Analysis: Combination of structural and textural statements	Phenomenological Statement
1) How do male African-American engineering students describe their experience on multiracial student teams?			
a) How do male African-American male students describe experiences on their multiracial student team?	Combined Interviews	Phenomenological Analysis: Emergent clusters of meaning from list of significant statements	Structural and textural description statements
b) What contextual or background features are relevant to their experience?	Combined Interviews	Individual Participant Profiles Development	Individual Participant Profiles and Member Check
2) What themes emerge in the way male African-American engineering students describe and interpret their experiences on multiracial student teams?			
a) What are the common themes across African-American male students' descriptions of their team experiences?	Clusters of Meaning Tables	Phenomenological Analysis: Comparison of themes across participants	Individual Descriptions Clusters of Meaning tables and emergent themes
b) What are the unique themes for male African-American student's description of experiences?	Clusters of Meaning Tables	Phenomenological Analysis: Unique themes to individual participants	Detailed descriptions of unique themes that emerge from individual experiences
3) How do the experiences of African-American men in engineering on multiracial student teams relate to their sense of identity?			
a) What identity dimensions are salient to participants during the experience?	Combined Interviews	List of intersecting identity statements	Emergent themes from intersecting identity statements
b) How do intersecting identity dimensions impact their experience?	Combined Interviews	List of intersecting identity statements	Emergent themes from intersecting identity statements

To address these research questions, I interviewed eight African-American male engineering students three times over the course of single semester while they were working on a team

project. The three interviews, respectively, gathered background context about the participant at the beginning, explored the team functionality during the project, and enabled participants to reflect on the team experience at the end. Interviews were transcribed verbatim by me and two trained transcribers. The transcribed interviews were combined in MS Word documents to create an analysis file for each participant. From the analysis files, I created list of significant statements for each participant that were then grouped into clusters of meaning to identify themes. In this methods chapter, I begin with my reasoning for selecting my strategy of inquiry, phenomenology, and my personal worldview and philosophical approach I bring to the study. Next, I discuss the research design, starting with the unit of analysis followed, by the participant description and site selection. Finally, I describe the data collection and analysis process, including measures to ensure quality and bracketing of my bias.

3.2 Using a Phenomenological Approach

Phenomenologists believe that knowledge or perceptions cannot be detached from the knower (Moustakas, 1994), which is counter to the positivist paradigm common in engineering. In other words, phenomenologists believe that information about participants' experiences is embodied within them and can only be revealed as participants describe the experiences during conversations. In particular, the experience of the phenomenon must be understood within context and from the perspective of the informant, and is not be perceived as universal truth. Additionally, phenomenology focuses on the aggregated experience of several individuals, in contrast to narrative research which highlights the experience of a single individual (Creswell, 2007). To put it another way, phenomenological research is a strategy of inquiry where the researcher describes the essence of a lived experience perceived by and described by multiple individuals who experienced the phenomenon of interest (Creswell, 2007; Patton, 2002).

Originally, phenomenology was the study of how people describe things they consciously experience through their senses (Moustakas, 1994; Patton, 2002). Current phenomenological research asks the fundamental question, “What is the meaning, structure, and essence of the lived experience of a phenomenon for a group of people?” (Patton, 2002, p. 104)

Specifically, phenomenology focuses on understanding the essence of a lived experience (Creswell, 2007; Patton, 2002). In this case, my phenomenon is defined as the experience of being an African-American male on a multiracial engineering student team. From a phenomenological perspective, a participant’s experiences with a phenomenon can be captured through his or her thoughts, feelings, examples, ideas, perceptions, and context description of the experience (Moustakas, 1994). In other words, how participants talk about the experience and interpret or make meaning of the experience reveals the essence of the experience for each participant (Moustakas, 1994; Patton, 2002). Phenomenological analysis then seeks to disclose the essence of a lived experience by identifying the commonalities across participants’ in-depth descriptions (Creswell, 2009).

Multiple factors contributed to my rationale for selecting phenomenology as the primary inquiry strategy. First, my research questions, stated above, require a qualitative methodology such as phenomenology that allows a researcher to explore a subjective, lived human experience (Creswell, 2007). My overall research question seeks to understand what African-American men experience during their participation on multiracial student teams and how the experience relates to their sense of identity. Second, selecting phenomenology was important to my study design because the inquiry strategy focuses on individual participants. As a result, the phenomenological approach allowed me to research individual perspectives, in addition to characterizing the group experience. Third, the phenomenological approach influenced the

primary data collection process, in-depth interviews. In-depth individual interviews require participants to select details of the experience and inherently force them to be part of the meaning-making process as they characterize the experience (Seidman, 2006). Seidman (2006) described the phenomenological interview sequence as a means for human behavior to become meaningful and understandable when placed in the context of participants' lives and the interactions with those around them. Fourth, the phenomenological approach is important to my dissertation topic because few studies in engineering education research to date have investigated the experiences of African-American students in general. As a result, the phenomenological approach allowed me to explore the nature of interactions and understand the experience of African-American men on multiracial students' team within the specific context of the engineering culture. Overall, then, my study seeks to understand the meaning, structure, and essence of African-American male engineering students' experience on multiracial student teams.

3.3 Personal Research Paradigm

According to Creswell (2009), the worldview, strategy of inquiry, and method are all essential parts of a complete research design and need to be identified because they influence the practice of a researcher. Phenomenology, combined with social constructivism, reflects my worldview and the approach that I applied in my dissertation. Phenomenology aims to produce a concrete and complex description of a lived experience (Finlay, 2009). It involves three key assumptions. First, a lived experience must be described, explicated, and interpreted to be understood (Patton, 2002). Second, it is important to know both what happened during the phenomena and how the participants interpret the experience (Patton, 2002). Third, phenomenological research assumes that a central essence of an experience exists, where the

essence is the core interpretations that are mutually understood through common perceptions. In other words, a phenomenon must be understood from the perspective of group experiencing the phenomenon and the common features they illuminate.

More broadly, social constructivists extend the constructivist perspective to position knowledge as socially constructed. Social constructivism explores the perceptions and beliefs of those within a specific context (Patton, 2002). From a constructivist perspective, knowledge and meaning are constructed by human beings in context as they interact with the people and objects in the world in which they are interpreting (Creswell, 2009). That is to say, the understanding or meaning of phenomenon is based on the perspective of the participants, who speak from their social interaction and personal history (Patton, 2002). Accordingly, I emphasize the participants' meaning-making, structure, and interpretation of their experience on multiracial teams. Therefore, in my study I provide a concrete and complex description of the lived experience of African-American males on a multiracial student team that emphasizes the participants' meaning-making and interpretations of their experience.

3.4 Research Design

3.4.1 Overall Research Design

In order to answer my research questions, I adopted a phenomenological approach to understand the experience of male African-American students on multiracial student engineering teams. In general, very little is known about African-Americans' experience on multiracial student teams in engineering; therefore, the current study was exploratory in nature. To begin, I describe the research site that provided the context for my study. Next, I describe the participant pool, where the flexibility in the selection process broadened participation. All research was conducted with the approval of the Virginia Tech Institutional Review Board (IRB # 13-901)

3.4.2 Research Setting- Site selection

The research site was a predominantly white (PWI) large public research university with a broad range of engineering majors; the undergraduate population in engineering is dominated by a predominantly white males. I chose a public university that is closely connected to the surrounding rural community for multiple reasons. First, because so little prior research exists in the area, the topic warrants an exploratory, in-depth study at a single site that limits variations in institutional context. Future work may include comparing the results of the current study to a replication of the study at other PWIs as well as at minority serving institutions. Second, the selected institution has specific characteristics that supported data collection. Second, though predominantly white and male, the engineering college at selected institution had the student composition to support soliciting a sufficient number of African-American men. The selected site was likely to have numerous multiracial student teams with at least one African-American. Third, phenomenology typically requires ready access to the participants multiple times and the ability to establish rapport, both of which were critical to the successful execution of the study design; my proximity to the selected site supported both requirements.

Two characteristics of the selected site provide important contextual factors that likely influenced participants' experiences. First, the study site was a research intensive university with a strong engineering reputation, which meant that academic success was highly valued and somewhat competitive. Second, the PWI is located in a mountainous rural region with a low percentage of ethnic minorities. This physical isolation can impact African-American men who typically rely on family emotional support to complete strenuous academic programs such as engineering, similar to first generation students (Strayhorn & Terrell 2010). Therefore, the larger community (i.e. campus and department culture) was included as part of the scope of the social

context explicitly explored in the current study, and part of the data analysis is based on the participants' perspective on their experience.

3.4.3 Participants

My sampling approach was consistent phenomenological research methods and previous phenomenological studies (Rockenbach, Walker, & Luzader, 2012). Participants for this study were drawn from a larger study of African-American students' experiences on teams. The inclusion criteria for the full study included self-identified African-American full-time undergraduate students, 18 years of age or older, currently enrolled in an engineering course with a team project. The participant pool was not restricted by academic level in school or major because of both the exploratory nature of the study and the limited pool of African-American engineering students at the research site. That is, I intentionally sampled broadly across both year in school and engineering major to ensure a sufficient sample size and to provide a broad range of perspectives to identify salient themes across contexts.

Participants were recruited through a combination of initial in-person solicitations at meetings of minority-serving student groups such as the National Society of Black Engineers (NSBE) and events sponsored by the college's academic support center, and follow-up emails. During the in-person recruitment, I provided interested students with the recruitment letter for their records. Each in-person recruitment was followed by a solicitation email (Appendix A1) sent through groups or center listserv. Per my approved IRB, the follow-up solicitation email was resent a maximum of three times. From the email, students completed the online demographic survey prior to the first interview that was used as screening tool to ensure the desired variation across demographics (e.g. gender, major, and class). The demographic survey can be found in Appendix A2 and was administered through my university approved Qualtrics account.

Generally, I recruited students across a range of characteristics including gender, year of study, and major. To support the exploratory nature of the study, I intentionally recruited African-American students with diverse backgrounds and experiences. Stewart (2009) suggested that recruiting African-American students with different backgrounds (i.e., social classifications or neighborhood composition) in a single study provides sufficient variation of experience to not require the inclusion of students of another race. Second, I used typical case sampling strategy, which is a type of purposeful sampling, that highlights what is typical, normal, or average, and presents a greater chance to fully describe the case (Patton, 2002). Initially, I defined typical participants as African-American students that grew up in and were educated in the United States. However, consistent with the phenomenological approach, the average experience materialized over the course of the study. Finally, I also used snowball sampling to compliment the other two sampling techniques. Snowball sampling is the process of identifying additional potential participants through the key informants. Some participants referred other African-American students who had not responded to the initial open call to join the study.

The final participant list was designed to include representation across year in school as well as engineering major, with an equal number of men and women. The list was reviewed by colleagues to verify the desired variety was achieved in the participant pool. I sent an initial email to schedule the first interview time. Prior to the first interview, I reminded them of the purpose and goal of my study and asked if they had any questions. I also explained the entire data collection procedure and the requirements to receive the study compensation of \$50, which was pro-rated and disbursed based on the number of interviews completed. Specifically, the participants were paid a portion of the compensation at the end of each interview as follows: \$10 first interview, \$15 second interview, and \$25 third interview.

In total, the full study included eighteen participants, nine women and nine men. For the present study, I included only the data from eight African-American male participants; one male was excluded because he identified as African rather than African American. For phenomenological research, various qualitative experts recommend 3-10 participants (Creswell, 2007), a maximum of 25 participants (Seidman, 2006), and 10-20 participants (Patton, 2002). Eight participants is thus within accepted bounds, and the combined sampling approaches ensured a sufficient sample size to achieve saturation.

Multiple factors led to my decision to focus on the male participants. First, multiple social science researchers studying students of color have called for the disaggregation of data by sex (D. Cole, 2010; Harper, 2013; Strayhorn, 2010), and multiple identities theory suggest that race and gender may intersect in ways that produce different results for males and females (Abes et al., 2007). For example, Tate & Linn (2005) found that women of color in STEM have different engagement preferences, such as collaborative learning activities, than male students of color. Also, the perception of peer interactions has been shown to vary by gender for racial and ethnic minorities (Locks, Hurtado, Bowman, & Oseguera, 2008). Thus focusing my analysis on a single sex provides more useful information than trying to find a “one size fits all” approach that could potentially lose essential contextual nuances.

Second, given the existing research on women’s experiences on engineering teams, (Ingram & Parker, 2002; Tonso, 2007a), the challenges faced by African-American males reflected in national conversations such as “My Brother’s Keeper” (Obama, 2014), and the emerging focus on African-American males within the engineering education community (Matthews & Loftus, 2014), I have opted to focus this study on African-American males. A recent report in ASEE’s *Prism* summarizes current researcher and administrators concerns about

the lack of representation of Black males throughout the field of engineering, from undergraduate programs through employed professionals (Matthews & Loftus, 2014), noting that they represent 4% of the engineering population (Yoder, 2014).

This choice was further confirmed by recent disturbing social events, including the deaths of Trayvon Martin in Florida (Rudolf & Lee, 2012) and Michael Brown in Ferguson, Missouri (L. L. Miller, 2014), which have called in question what value this country places on the lives of African-American males. Therefore, the combination of scholarship and social justice fortified my decision to focus on the African-American males in my study.

The final sample for this study thus includes eight African American men studying engineering at a large eastern predominantly white institution (PWI). The pool includes three first-year students, two sophomores, one junior, and two seniors.

Table 3: Participant Demographic Summary

Pseudonym	Field
Clay	computer science
Zion	engineering mechanics
David	industrial/systems engineering
Knight Wing	biological systems engineering
Jake	mechanical engineering
Phil	mechanical engineering
Sterling	undecided
Harbor	computer engineering

Participants’ pseudonyms and engineering fields are listed in Table 3; the table excludes academic level to maintain the anonymity of the participants who were typically the “only one” or one of a few African-Americans in their department.

3.5 Data Collection

Several steps were involved in the data collection process. First, prior to the first interview, the informed consent form was reviewed with the participants, who were provided with a copy to sign and a copy for their records. The phenomenological three interview sequence as described by Seidman (2006) was the primary data source for my study. According to Seidman (2006), understanding the lived experience of other people and the meaning they make of that experience is at the root of in-depth interviewing. The interviews in my study were in-depth and semi-structured in nature to allow flexibility in responses. The primary goals of the sequence were to first gather background information on the participant, then to capture a description of the participant's experience, and finally to allow the participant to reflect on or make meaning of the experience (Seidman, 2006).

3.5.1 Instrument Development

After developing an initial set of interview protocols in conjunction with an expert panel, I used pilot testing to refine the 1st and 3rd interview protocols because they solicited personal background information and individual meaning making, where the second interview focused on the general characteristics of the project and presented fewer challenges to design. The pilot test addressed the usefulness of each protocol, including word selection and the order of the questions. For example, I requested feedback from pilot participants on the clarity of word choices for all interview questions and the likelihood of soliciting responses that would contribute answers to my research questions. The pilot occurred during over winter break after the Fall 2013 semester. The pilot included students of all races, which provided a critique of the interview protocol and added to the validity of the data collection process. The pilot interviews were audio recorded, transcribed verbatim, and evaluated to enhance the data collection process.

Specifically, I verified my ability to bracket my bias during the interviews and maintain a level of report such that the participants felt comfortable providing rich, thick descriptions of their experience. The demographic summary table of the pilot participants is displayed in Table 4; with respect to majors, the pilot included students from ME, AOE, IE, and CS.

Table 4: Pilot Data Demographic Summary

Pseudonym	Race	Gender	Academic Level
Annie	Caucasian	Female	Graduate
Anthony	African-American	Male	Graduate
Jackson	Bi-Racial (C/Hisp)	Male	Graduate
Jamal	African-American	Male	Undergraduate
Jill	African-American	Female	Graduate
Pam	African-American	Female	Undergraduate
Sally	Caucasian	Female	Graduate
Steve	Caucasian	Male	Graduate
Tami	Bi-Racial (C/Pac)	Female	Graduate
Ted	Caucasian	Male	Graduate

The data collection format for the pilot consisted of a single interview that included questions from the 1st and 3rd protocol. The practice and feedback from pilot participants led to several protocol adjustments. For example, I adjusted flow of questions to support participant

comfort with interview process. Also, the participants identified alternative wording to clarify the questions and to help solicit responses that included information relevant to the phenomenon being studied (i.e. interracial interactions within student teams). The following sections describe the final protocols.

3.5.2 First Interview- Background

According to Seidman, putting participants’ experiences in the context of their lives and gaining a sense of their baseline perceptions about the experience is the goal in the first interview (Seidman, 2006). This background context allows the researcher to identify parts of the experience that may be salient for the participant. Therefore, my first interview aimed to understand what previous team experience have my participants had and what life experiences may have affect how they interpret their current team experience. Table 5 lists the interview questions, including potential probes, and what type of information I gained from the response.

Table 5: First Interview Proctocol for background context

	Warm-up	Measure
Q1	What department are you in?	Department
Q2	How important is teamwork in your major? Follow-up: How do you know?	Department
Q3	Can you tell me about your experience on teams in a previous engineering course?	Team Description
Q4	Are you involved in any team activities outside of engineering?	Team Description
	Background Context	
Q5	Mainly this interview is to understand your background, so tell me how did you decide to study engineering? Follow-up: Are you the first in your family to study engineering or go college? Mother or Father? How does your family feel about you studying engineering?	Background

Q6	How would you describe your neighborhood where you grew up? Follow up: Was your neighborhood mixed or mainly a single race? Was going to college the norm in your neighborhood or did most kids your age in your neighborhood go to college? Why or why not?	Background
Q7	How would you describe your high school? Was it similar or different than your neighborhood? Follow up: Was your high school mixed or mainly a single race? You described you neighborhood and/or high school as _____, what does that mean to you? How did your high school prepare you to study engineering?	Background
Q8	How would you say your high school or family influenced your decision to study engineering?	Background
Q9	College team experiences are often impacted by pre-college team experiences. Please describe any team experiences you had prior to college in high school or family events? Follow-up: Can you give me an example?	Background
	Interview Wrap-up	
Q10	Ok, thank you that is helpful. So to wrap up, I need to get a sense of how you think about teams. What does teamwork mean to you? Follow up: Is teamwork important for engineering practice? Why or why not?	Initial Teamwork meaning or definition
Q11	What do you expect your role to be on the team this semester?	Team Role
Q12	Is there anything about your past team experience that I didn't cover that you would like to talk about? Follow up: Do you have any questions about the study?	Catch All

The responses to the above interview questions provided me with enough background information and context to put participant responses into an appropriate perspective that highlighted their perceptions of previous team experiences. The responses also led into the second interview by suggesting parts of their previous team experience that were salient for each participant and providing a basis for follow-up questions or areas to compare across responses.

For example, all participants stated teamwork was emphasized within their engineering department. Also, most participants had some team experience prior to the current study.

3.5.3 Second Interview- Current Team Experience

The second interview in a phenomenological study captures the contemporary experience and tangible details of the phenomenon of interest (Seidman, 2006). In this study, the second interview gathered significant statements about the participant's current team project. My task as the interviewer was to assist the participant to reconstruct, in as much detail as possible, the current state of the phenomenon of interest (Seidman, 2006). I used the second interview to gain an understanding of the details of each participant's current team project. In addition to a detailed description of current team project, I asked for specific examples of current team activities to illustrate the team project feature being articulated. The interview protocol questions inquired about the duration of the team project as well as examples of how the team members worked to complete a task. The interview protocol was semi-structured to allow salient features to emerge during a natural conversation about the team experience. Table 6 lists the interview questions, including potential probes, and what type of information I gained from the responses to each question. Importantly, while the phenomenological interview is open-ended to solicit details about the participant's experience, intergroup contact *Theory* (ICT) provided important sensitizing concepts regarding interracial interactions and motivated some of the follow up probes to the interview questions. The salient ICT features are specified in the last column of Table 6.

Table 6: Current Team Experience description

	Warm-up and Background	Measure
Q1	<p>Now that you have started the project, how would you describe your current team project?</p> <p>Follow-up: Do you think all team members understand the goal for the project (Common team goal)</p> <p>How long is your team project?</p> <p>How many team members work on your project?</p> <p>Did you select your team members or where they assigned?</p>	Team Description
	Team Experience: Student interactions	
Q2	<p>How would you describe your interactions with your teammates?</p> <p>Follow up: Can you tell me the role of each team member or how each member contributes to the team?</p>	Team Experience Interdependence
Q3	<p>How would you describe the level of respect for one another within your team?</p> <p>Follow-up: Can you give me an example of when a teammate made you feel respected or valued?</p>	Equal Status
Q4	<p>Did you feel comfortable working with all team members?</p> <p>Follow-up: Have you ever asked for help from a team member?</p>	Intergroup anxiety
Q5	<p>Do you socialize with team members outside of class or project?</p>	Friendship Opportunity
Q6	<p>Are there areas of conflict for the team?</p> <p>Follow-up: What are typically the issues that cause team conflict, can you give me example?</p>	Personal Interaction
	Team Experience: Faculty interactions	
Q7	<p>Now to switch gears, what was the role of the faculty mentor or the instructor in charge of your team?</p>	Faculty Description
Q8	<p>How would you describe your interactions with your faculty mentor or instructor?</p>	Authority support
Q9	<p>How would you describe the faculty mentor or instructor interaction with the other team members?</p> <p>Follow-up: Were all team members respected by your faculty mentor for your team? Why or why not?</p>	Equal Status

Q10	Did your faculty mentor provide feedback or help resolve your team conflicts? Follow-up: How was conflict resolved or what type of feedback?	Authority support
	Interview Wrap-up	
Q11	At this stage of the project, how would you describe your overall team experience this semester? (e.g. positive or negative)	Team Description
Q12	Is there anything about your team experience that I didn't cover that you would like to talk about?	Catch All

In second interview, I looked for salient features in the descriptions that characterized both peer and mentor interactions. For example, I listened for specific interactions that the participants associated with any interaction judgments, such as the effectiveness or efficiency of the team. In addition, I checked whether the participants' perception of their teaming experiences had changed from the first interview.

3.5.4 Third Interview - Reflection

The third interview allowed participants to reflect on their experiences and make sense or meaning of the experiences. The goal of the third interview was to gather significant information about how the participants interpreted their experiences in terms of the intellectual and emotional connection between the participant and the experience (Seidman, 2006). In particular, listening for emotions attached to the context of the experience was an important way to understand what an experience meant to the participant. For example, participants enjoyed working with teammates, but felt sadness over being isolated as Black male on the campus. According to Seidman (2006), the task of the interviewer during the third interview is to maintain the focus of the interview on meaning-making and interpretation. That is, as the interviewer I redirected the conversation toward participants' interpretations and probed to go beyond the description of what was experienced to how participants felt about what they experienced. During the third

interview, the participants explored past events, provided concrete details of current team status, and speculated about future teaming behaviors. For example, the participants planned to use successful approaches from the current project to resolve a group conflict in the future. I also used the third interview to clarify interpretations of the participants' background perspectives and current descriptions discussed during the previous first two interviews. The foundation established in the first two interview was used to make the third interview productive (Seidman, 2006). Thus, the combination of the three in-depth interviews worked together to enhance the validity of the phenomenological study (Moustakas, 1994).

The interview protocol used for the third interview is shown in Table 7. Similar to the first and second interviews, the protocol lists the question number, the interview question and potential probes, and the information I gained from the responses to each question. The primary goal of the third interview was to assemble the participant's interpretation and perceptions of their team experience. The protocol was semi-structured to allow salient features of the participant description to emerge during a natural conversation.

Table 7: Third Interview for reflection of the experience

	Warm-up and Background	Measure
Q1	Now that you are near the end of the project, how would you describe your team project?	Team Description
		Background
	Follow-up: Do you think your team members understand the same goal for the project (Common team goal)	Team Experience
	How long was your team project? How many team members finished your project? Did your team members change over the course of the project?	Team Experience
	Team Experience: Student interactions	
Q2	Now that you are near the end of the project, how would you describe your interactions with your teammates over the course of the project?	
Q3	How did your team interactions make you feel?	Equal Status
	Follow-up: What types of interactions with your team members do you think are important?	

Q4	Can you tell the role of each team member or how each member contributes to the team? Follow-up: What did the team roles mean to you? Was it important to assign team roles? Why or why not?	Interdependence
Q5	What did it mean to you to work with these team members?	Personal Interaction
Q6	What does the team conflict mean to you? Follow-up: What choices did you make to handle team conflict, can you give me example?	Personal Interaction
Q7	What type of interactions made you comfortable working with your team members? Follow-up: Have you ever asked for help from a team member?	Intergroup anxiety
Q8	Did your comfort level working with any team members change over the course of the project? Why or why not?	Intergroup Anxiety
Q9	What does your friendship with your team members outside of class mean to you? Follow up: What types of interactions allowed you to develop a friendship with team members outside of class?	Friendship Opportunity
	Team Experience: Faculty interactions	
Q10	Now that your project is almost over, what was the role of the faculty mentor or the instructor in charge of your team?	Faculty Description
Q11	What did your interactions with your faculty mentor or instructor for the course of the project mean to you?	Authority support
Q12	What did the respect of your faculty mentor for your team mean to you?	Equal Status
Q13	What about feedback from your faculty mentor was helpful to you or your team? Follow-up: How did your interactions with the faculty mentor make you feel?	Authority support
	Interview Wrap-up	
Q14	Do you still think teamwork important for engineering practice? Why or why not?	Team meaning
Q15	How will your team experience help you as a professional engineer?	Engineering Identity
Q16	How did your team experience prepare you to be an engineer?	Engineering Identity
Q17	How would describe yourself as an engineer?	Engineering Identity

Q18	Overall, what lesson did you learn from your team experience this semester?	Team Description
Q19	Is there anything about your team experience that I didn't cover that you would like to talk about? Follow up: Can I contact you in the future to verify study results?	Catch All
Q20	I am particularly interested in race dynamics of teams, were you the only person of color in the group? (if not previous discussed) How do you feel about being the only African-American on your team?	Intergroup Contact

The wording of the questions promoted meaning making and reflection by the participant. I asked if certain features of the team experience changed during the course of the project. I followed the response to most questions with an inquiry about what it meant to the participant. For example, some participants stated their interactions with team members were “good” and I probed to understand what “good” meant and how they felt about the team interactions being “good.” Additionally, I avoided assuming I understood statements regarding the team experience and redirected the interview responses toward interpretation of the experience based on the participant’s words.

The first interview occurred during the first weeks of the spring 2014 semester. The one exception was a participant added later in the study due to snowball sampling. I scheduled the second interview with each participant at the conclusion of the first interview, allowing at least 2-3 weeks between interviews to allow reflection and evaluation as recommended in phenomenology research (Moustakas, 1994). As a result, the second interview occurred during the two weeks prior to spring break. The final interviews occurred during the last two weeks of the semester, primarily before exam week. However, some participants had travel plans and conducted their final interview after they completed final exams. Generally, the participants

fulfilled the planned meeting schedule, but some interviews had to be rescheduled for various unanticipated challenges.

3.5.5 Additional Data Sources

In addition to the three interviews, I developed other forms of data to strengthen the data collection process. First, I wrote memo notes regarding the participant's responses and any physical context during each interview. Second, immediately after each interview I wrote field notes for the interview that included methodological notes (e.g., "make sure I pause before probing") or physical context notes (e.g., "this participant found it hard to talk about team conflict"). These additional sources supported the findings when combined with the raw interview data and provided supplemental information about the essence of each participant's experience to help refine themes. The procedure of writing analytical memos to support trustworthiness in phenomenological analysis is consistent with phenomenological research experts (Hycner, 1985) and previous phenomenological research (Rockenbach et al., 2012).

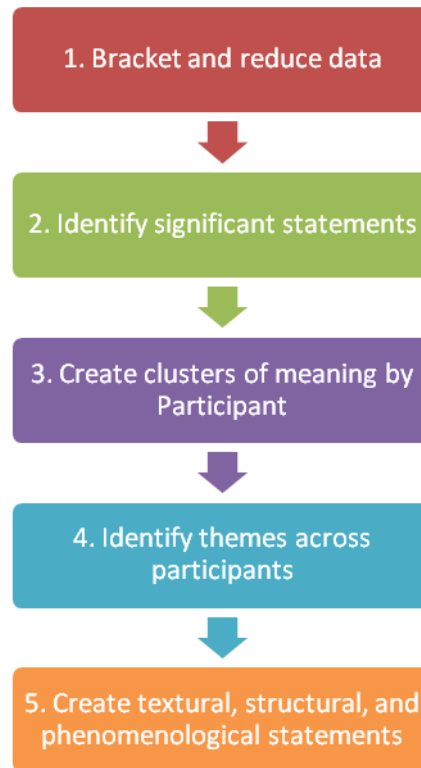
3.6 Data Analysis Procedure

3.6.1 Phenomenological Analysis

According to Creswell, a general consensus exists among phenomenologists on the data analysis steps in a phenomenological study (Creswell, 2007), including bracketing and reducing the data, identifying significant statements relative to the phenomenon, clustering those statements into meaningful groups and identifying both the textural (what happened) and structural (how participants experienced it) elements, and finally, developing the relevant themes (Creswell, 2007; Groenewald, 2004; Moustakas, 1994). For my study, I used a combination of this process as described by Creswell, Groenewald, & Moustakas and the more detailed analysis

steps provide by Hycner (1985). Figure 3 illustrates this process, followed by a more detailed explanation of each step.

Figure 2: Visualization of Data Explication



The first step in the phenomenological bracketing and reduction was separating statements of general meaning. According to Hycner, general statements includes any words, phrases, non-verbal or para-linguistic communications which express a unique and coherent meaning (irrespective of the research question) clearly differentiated from that which precedes and follows. This definition was operationalized in my study as any coherent statement made by the participant during at any time during the three interview sequence. To identify these statements for each participant, I combined all three interviews into a single participant file and removed all interviewer statements (with the exception of interviewer interruptions or comments within a longer participant comment, such as “I see” or “Uh huh” or “Ok”). In this approach, the

combined interview file is a holistic view of the entire interview process (Seidman, 2006), which stipulates the individual as the unit of analysis. Next, each statement in the combined file was assigned a unique line number. This process has also been referred to as the data reduction or phenomenological horizontalization and it results in a long list of labeled statements used for the next step (Hycner, 1985; Rockenbach et al., 2012; Seidman, 2006).

Step two involved identifying statements relative to the phenomenon of interest (anything about the participant's team experience), which resulted in a list of significant statements that described both the phenomenon and how the participants experienced it (Creswell, 2007). The list of significant statements was the first check point with peer reviewer. We individually marked significant statements and had multiple discussions to negotiate consensus on any difference in opinion of a particular significant statement.

Step three involved grouping significant statements into larger clusters (Hycner, 1985) and then creating clusters of meaning. Once consensus was reached for the list of significant statements for each participant, the statements were grouped by topic and redundant statements removed. I used appropriate judgments to organize groups of statements with similar meaning based on a holistic perspective of the participant's responses and contextual factors. In other words, the clusters were developed in the context of my understanding of the participant in conjunction with the statements themselves, not in a vacuum without context. Following Hycner, at this point no single statement was prioritized or weighted over another; similar statements were simply grouped together without assigning value (Hycner, 1985). Once the statements were grouped and redundant statements were removed, the "cluster of meaning" was defined. At this point, I adjusted the prescribed procedure and used the participant's words to capture each cluster rather than reword segments. My judgment was used to select one significant statement

that best represented the cluster, though I occasionally combined statements to maintain context. The process was repeated individually for each participant, and the emerging clusters were collected on a second document where the cluster names were developed. The final clusters for each participant were verified with the peer reviewer and the final version of the clusters table was the consensus between researchers. The final Clusters of Meaning tables can be found in Appendix B. Finally, following Hycner, clusters that emerged from multiple statements across a participant's interview set were treated as primary clusters for that participant, while clusters that included only a few statements across all interviews were treated as "unique" for that participant.

Step four focused on identifying the themes across participants, which involved comparing and contrasting clusters across participants. To create each theme, I grouped all participant statements from related clusters and identified the common experience. At this point, a second peer reviewer reviewed the list of related cluster statements and identified the common experience. The common experience, identified by each researcher, was compared and discrepancies were discussed in detail to reach consensus. The consensus of a common experience was identified as an emergent theme developed from a cluster of statements.

The final step in the process involved creating the textural, structural, and phenomenological statements. The textural statement provides a description of the activities, behaviors, and functions that occurred during the team project. The structural statement described the setting or context that influenced what participants experienced as well as participants' feelings, judgments, and emotions. For each participant cluster, brief descriptions of these textural and structural categories were noted on the participant cluster table. Clusters were then compared across all eight participants to find commonalities. Based on the individual textural descriptions,

a collective textural description was used to develop a composite textural statement. Similarly, the individual structural descriptions were used to develop a composite structural statement.

At this point, prior to developing the final phenomenological statement, I conducted a member check, as recommended by Hycner. For each participant, I used the participant's words to develop a detailed description of that participant's experience, including their major clusters (Seidman, 2006). Part of the profile was developed to preview the individual emergent clusters. I sent each participant an MS Word document that included their cluster table (Appendix B) along with a summary of all three of their interviews highlighting the issues and experiences I considered relevant as well as my understanding of their perceived racial and/or engineering identities. Participants read their Word documents and verified the statements and findings with me. Other than a few participants who requested different pseudonyms, all were comfortable with the participant summaries, clusters, themes, and identity statements.

Once member checks were complete, the final overall step was to combine the textural and structural statements to develop the phenomenological statement. This statement represents the essence of the collective experience of the phenomenon of interest and is the final objective and product of phenomenological study and analysis.

3.6.2 Multiple Identities and Intersectionality Analysis

The analysis surrounding participants' identities replicated the phenomenological analysis procedure. A separate analysis was performed for this part of the data because the phenomenological analysis focused on the commonality of the team experience across the participants and the identity analysis focused specifically on the salience of different identity dimensions. The identity analysis generated a different list of significant statements that focused on identity. First, I created list of identity statements from the combined interviews for each

participant. This list included two identity dimensions pertinent to the current study: racial and personal/professional (e.g. “I was kind of the leader that organized the meetings”). Next, I identified where and how those identity dimensions were salient to students’ team experiences, and grouped those salient identities into clusters. The last step of the analysis was to identify common emergent themes across these identity statements. Similar to the general phenomenological analysis, the clusters and themes were checked and verified with peer researcher.

The analysis of the multiple intersecting identities deviated from the phenomenological analysis outlined by Hycner (1985) in that to maintain the context of the intersecting identity statements, a textural (what) and structural (how) were not separated in the list of significant statements. That is to say, I was unable to evaluate the identity statements made by the participants in the same manner in which their team experience was characterized. For example, “I am a problem solver” could not be broken down into what and how. Thus the results are not incorporated into the separate textural and structural statements. However, through this analysis process, I was able to isolate identity statements that were related to the participants’ experiences on their multiracial team, particularly identity statements that influenced interactions. As a result, the multiple and intersecting identities provided nuances and context to allow essence of the experience to be understood from the perspective of the participants, which is the goal of phenomenological research (Patton, 2002).

3.7 Ethical Considerations and Bracketing Bias

Because researchers should be sensitive to ethical considerations throughout all phases of the study design (Creswell, 2009), I describe the ethical considerations addressed in my study design. First, I designed my study to employ rigorous data collection and analysis procedures

(Creswell, 2007). For example, in my study I followed methodologies established by phenomenological research experts to collect and analyze my data, which helped ensure the reliability of my description of the phenomenon and the trustworthiness in my interpretation of themes or conclusions. Second, I secured IRB approval for the study, which also required participant consent prior to data collection. Third, I conducted a pilot study to develop instruments and verify the appropriate language use for interview questions. Fourth, I maintained each student's anonymity by creating pseudonyms for each participant. Fifth, due to the personal nature of the study, I was proactive in member checking to ensure I accurately represented the experiences of the participants. Finally, all data was maintained on a secure electronic data management (i.e. VT scholar site to house all dissertation data) with access provided to only the author and my dissertation advisor. My approach is consistent the standards of qualitative research design. (Creswell, 2009; Patton, 2002).

Bracketing my personal experience and bias is also fundamental to phenomenology (Creswell, 2007; Moustakas, 1994). As an African-American engineering student, I have significant prior experience on student teams that I worked to bracket during my dissertation work. Bracketing meant suspending my presuppositions and interpretations of my participants' experiences during all phases of the study. For example, I regularly asked the participants to clarify the meaning of their experience rather than assuming their experience was similar to mine or my interpretation. To verify my ability to bracket my bias, I first listed my presuppositions and openly discussed them with my dissertation committee (Hycner, 1985). Below is a disclosure of my previous experience with the phenomena of interest and a list of my presuppositions:

I worked on several project and design teams in my undergraduate education. I had good and bad experiences. Good experiences include practicing a leadership role for my design

team. A negative experience was being grouped as the only female and African-American on course project teams. A foreign national student had an issue working with me because of my race and I was placed with a different partner on a short project.

1. The participants in my study were not in a class that I was teaching, which limited the scope of my influence on their participation. The study was the first contact I had with most participants; I had minimal prior interactions with 3 participants (1 male and 2 females).
2. The analysis emphasized the participants' words about positive and negative interactions, including counterexamples to enhance credibility and support deeper understanding.
3. Background text from the interview conversations is included in the results chapter when necessary to provide an appropriate level of detail and avoid over-interpreting participant statements.
4. Intentionally bracketing my personal racial identity, allowed the participant to naturally talk about their race and other team dynamics. I avoided directing the interview to focus on race as my racial identity is very salient due to several experiences during my engineering education. I only asked the participants specifically about race at the end of the final interview. However, race was in the title of my study and was included in the recruitment email and the consent form, and participants may have thus been sensitized to the importance of race in the study.
5. A systematic approach to manage my data further minimizes the potential impact of my bias on any phase of the study. For example, data analysis focused on explaining each participant's perception, not my opinion of their experience.
6. Member checking activities verified accuracy of interpretation and explanation of the experiences (Creswell, 2007).

7. An audit trail was maintained to minimize my bias (Patton, 2002) for the duration of the study to track analytical and methodological memos.

3.8 Credibility and Trustworthiness

Credibility and trustworthiness in the context of my study includes accurately characterizing the essence of the lived experience of the African-American male participants on their multiracial student team, with my personal bias bracketed for the duration of the study. Several steps of the research design ensure credibility and trustworthiness (Creswell, 2009):

1. I brought a paper copy of the interview protocol to ensure consistency in the questions I asked and to document my notes about responses during the interview.
2. All interviews were audio recorded and transcribed verbatim to ensure accuracy of participant responses.
3. I developed a summary table of the emergent common and unique themes to display the operationalized definitions supported by direct quotes (Creswell, 2007).
4. I discussed my analysis approach and emergent themes with my committee (during update and progress meetings), my research group, and my intellectual neighbors to minimize misinterpretations of significant statement or the meaning of a group of significant statements.
5. In addition to re-reading the transcripts multiple times, I established intercoder agreement by having a peer researcher verify multiple phenomenological steps during the analysis (see Section 3.6).
6. My member check responses from participants verified my interpretations of the responses. I received positive feedback from my member checks and the participants corroborated the analysis results and my interpretations and findings of those results.

In addition to efforts to maintain credibility in qualitative research, my study design also incorporates reliability or trustworthiness guidelines specific to the phenomenology inquiry method. First, I only interviewed male African-American engineering students currently working on a student team project. Second, the phenomenon of interest occurred in the natural state of the participants' engineering education (Creswell, 2009). In other words, the students were participating in multiracial team regardless of my study. Third, in my efforts to use the participants' words, I also included substantial excerpts to provide a thick, rich description to convey and explain findings. Fourth, the three-interview sequence enhanced validity by incorporating structural features to support meaningful interpretation of the experience (Seidman, 2006).

Additionally, I took care to maintain the credibility of my data analysis through multiple peer reviews. First, I had multiple checkpoints with my peer reviewer, who had previous experience doing phenomenological research. Although my peer reviewer and I are both African-Americans, we have very different world views, which in turn required effort to reach consensus on clusters and interpretations. As African-American researchers, we may be more sensitive to interracial dynamics of student teams as we both completed undergraduate engineering programs which included student teams, but the differences in our world views and process for negotiating consensus helped mitigate any potential bias. Furthermore, my data analysis process was also critiqued multiple times by my research group, which adds to my confidence in the analysis validity. Additionally, I added a second peer reviewer in the later stages of the analysis process. Specifically, a second peer researcher verified the multiple and intersecting identities analysis due to her familiarity with problem-based learning and identity theory. Another aspect that supports the credibility of my analysis is the systematic explication

of data that forced an inductive analysis to identify emergent themes, both common and unique, that were discussed with peer reviewers and intellectual neighbors. Therefore, multiple reviewers, peers and experts, supported the credibility of my study results.

3.9 Methods Chapter Summary

I conducted a phenomenological study in which I interviewed male African-American students about their experience on engineering student teams. Based on my constructivist worldview, my study design and research questions justify my inquiry approach and data collection and analysis, which are summarized in Table 2. I followed the phenomenological three-interview sequence in the study and detailed procedure for data analysis management to ensure. All aspects of my study design are consistent with phenomenological expert recommendations to establish reliability and trustworthiness of the overall study results.

Chapter 4: Results

4.1 Results Overview

This chapter describes the results generated from my phenomenological data collection and analysis. Following Hycner's systematic approach to phenomenological analysis (Hycner, 1985), the explication of my data resulted in themes or clusters that emerged from grouped units of meaning identified from lists of significant statements. As described in Chapter 3, the list of significant statements taken directly from the combined interview transcripts was the main source of text for analysis.

The chapter is organized based upon three guiding research questions.

RQ1: How do African-American engineering students describe their experience on multiracial teams?

RQ2: What patterns or themes emerge in the way African-American engineering students describe and interpret their experiences on multiracial teams?

RQ3: How do the experiences of African-American engineering students on multiracial teams relate to their sense of identity?

Together, these three questions address the overarching question: How do African-American males experience multiracial student teams in engineering? This question is answered through the final phenomenological statement articulating how this group of African-American male engineering students described their experience on a multiracial student teams.

The chapter begins with a profile of each participant, identified by pseudonym, and is provided as the background and contextual factors relevant to the overall research question of the study. The contextual foundation helps link each participant's team experience to the social and organizational context within which he operates (Seidman, 2006). After introducing the participants, I address RQ1 by providing the textural statement describing what the participants

experienced and the structural statement describing how the participants experienced being an African-American male on a multiracial student team in engineering. Next, to answer the second research question, I define and describe the common themes across participants. Additionally, I discuss interesting themes that were unique to half or fewer, of the participants that add to the description of the experience. To address the third research question, I discuss the how the multiracial team experience is related to the participants' sense of identity. The combination of the answers to my three questions were used to develop the phenomenological statement, which addresses my overall research question and articulates the essence of the lived experience of being an African-American male on a multiracial student team in engineering at a PWI.

4.2 Background Context of Participants

The following profiles for all eight participants were generated based interview data, my field notes, and my audit trail memos. Earlier drafts of these profiles were sent to each participant as the member check.

4.2.1 Clay

Clay is a computer science student and the background information he discussed during his interviews included his family, why he got into engineering, and his neighborhood racial profile. First, his father was in the military, which exposed him to various races throughout his life. As a result, Clay stated, "I don't really see like race; race has never been a thing to me.... I have tons of different, like, my friends are all different kinds.... I have friends from all over the place." Clay and his sister are first-generation college students, and he is the first to study engineering in his family. His parents are very proud that he is studying engineering and his family definitely contributed to his decision to study engineering and his choice of school.

Finally, Clay described the area that he grew up in as a mixed-race, upper middle class suburban neighborhood.

Clay's background provides context for the construction of some of his social identities. For example, Clay indicated low racial identity when he explained that "race has never been a big thing to me." In college, Clay's roommates are from Guam, El Salvador, and the U.S. and he never thought about the racial dynamics of his team experience until participating in this study.

Clay also made statements regarding personal and engineering identities in terms of his team experience. In particular, he saw himself as a "co-leader" for the project and a "good friend" to his partner. Likewise, the opportunity to develop friendships with his teammates was important to Clay. Interestingly, Clay also described CS students as socially awkward, and thus his friendship with his teammate was critical to his team and overall engineering experience. Additionally, Clay saw himself as an engineer who solves problems and he enjoys his CS work.

Clay's team lasted three weeks with a single teammate that he selected. With regard to his team experience, Clay described specific peer interactions that he thought were important, including the opportunity to develop friendships, as well as comments about his general temperament toward teamwork. His general positive disposition about teamwork was evident when he said, "I never really had a bad team experience. Luckily, [the team project is] overall just going very well." In terms of team interaction, Clay emphasized "constant contact" as his interpersonal communication style, and he valued personal interactions with team members as he made comments about them "get[ting] more comfortable around each other." Clay's comments were about spending time with teammates outside of work to learn about them. Also, Clay thought trust was critical to his team interactions and generally maintained a positive disposition towards teamwork for the duration of his project. For example he said, "I think it [teamwork]

will only going to get more important 'cause I'm going to be working on much more complex problems with many more people." Additionally, some of Clay's team interactions were influenced by his self-perception. Clay stated, "I'm never afraid to ask for help cuz I, I know, I know I am not like the smartest person out there." The fact that he views himself a moderately intelligent person directly impacts his team interactions and help-seeking strategy. Clay's general positive disposition toward teamwork positioned him to successfully navigate the team dynamics within a multiracial student engineering team.

In addition to his peer interactions with teammate, Clay also had positive interactions with the faculty responsible for his team project and the faculty in his department. When asked about his interactions with the faculty advisor, Clay responded, "Oh, umm, they're really nice cuz he's umm, a very nice laid-back guy. So it's really easy to talk to him and ask him questions and for help." In other words, the positive interactions Clay had with his faculty mentor contributed to him feeling comfortable asking the mentor for help or getting clarification on technical concepts.

Additionally, Clay's interactions with me were consistent over the duration of the study. Generally, he saw the importance of teamwork for engineering work and was enthusiastic about his major. Clay is a generally happy and positive person who acknowledges the significant influence of his father on his life. He was fairly self-aware and confident about what he was capable of doing and comfortable with learning from others. Furthermore, his mixed race upbringing and interactions with different races made his race less salient than other participants, but his status in upper middle class was fairly salient (i.e., his class trumped race). Nevertheless, Clay appeared comfortable during the interviews and at ease in talking and sharing with me as the interviewer.

4.2.2: Harbor

Harbor is a computer engineering student and very interested in programming. Harbor's mother has a master's degree in information technology, his father has a master's degree in finance, and his older brother is a neuroscientist. His parents wanted him to study engineering for the professional opportunities, and he attended a large public high school that he thought prepared him for college. Despite moving a few times, Harbor grew up in a mixed-race, middle class, suburban area where most students attended college after graduating high school.

In addition to his family and pre-college background, Harbor described social aspects relevant to his multiracial student team experience. He saw himself as a "hands on engineer" and was passionate about programming. Harbor had a significant number of cross-race interactions prior to his current team experience, and mentioned the salience of his race when he stated that he was the "only Black person" in his class. Since Harbor was the only African-American in his classes, he did not have the opportunity to interact with other African-Americans in this setting. As a result, Harbor saw his being the only one as barrier to "building community" but he "got over it" and joined student groups targeted for African-American students (e.g., the National Society of Black Engineers or NSBE). Nevertheless, Harbor did not feel that his race impacted his team experience. Finally, Harbor was fairly self-aware in that he recognized that some of his teammates were stronger than he was in certain technical areas, and he commented on learning from his teammates.

Harbor generally had a positive outlook on his team project and interactions with his teammates. Harbor's team experience lasted six weeks with three teammates that were assigned by the course instructor. Harbor suggested that he learned from his teammates when he said, "I think the team has worked out pretty well for us; we've taught each other." Harbor went on to explain how his teammates would exchange programming ideas (or ways of programming)

through emails and compare their individual ideas with the entire team. Consistent with other CS and CPE participants, Harbor emphasized the interdependence among the team members. Harbor described his team's interdependence by saying, "I like separating out the parts, but I am more of a hardware side, so you still need to work as a group, to do it (complete project)." In addition, Harbor made multiple statements about his personal interactions with his teammates. For example, Harbor said, "We built a good group chemistry, 'cause we had to stay with the same group for the entire semester." In this statement, Harbor suggested that his working with his team for the entire semester supported building good "group chemistry." Harbor learned that team projects are "too big" for an individual to complete and that being able to "compromise" is critical to team dynamics. Finally, Harbor discussed making sure that each team member was "okay" with team decisions. As a result, personal interactions with teammates were significant to Harbor's team experience based on the numerous statements he made about cooperating with team members to enhance how the team functioned.

In addition to peer interaction with teammates, Harbor also described impartial interactions with the faculty members responsible for his team project. For example, Harbor only talked to the course instructor only about exams, though sometimes the instructor made "technical suggestions." Harbor described his interactions with the instructor and the teaching assistant (TA) as being "low stress." Furthermore, Harbor discussed providing the course TA weekly reports on their project status, but rarely found it necessary to talk with TA during class, as his team was confident about their approach to the project. Finally, Harbor said he was "comfortable" interacting with faculty and defined his interactions with faculty as "normal" in his department.

Notably, Harbor's interactions with me during interviews changed over the duration of the study. Harbor is more of an introvert who enjoyed his team experience more and grew more comfortable with teammates and with me as interviewer, as the semester went on. I had to intentionally work to establish rapport with Harbor and put him at ease during interviews. Typically during his early interviews, Harbor provided one word answers and had to be prompted to elaborate. He gradually opened up and increased communication as he got more comfortable in the contact situation with both his team and the interview sequence.

4.2.3: Jake

Jake is interested in mechanical engineering and his dream job is to work in the automotive industry. Jake is the first person in his family to study engineering and his family is a strong influence on him. For example, his sister attended college at the research site and strongly encouraged him to follow in her footsteps. Also, both his parents graduated from college and had "big plans" for him to graduate with an engineering degree. Additionally, Jake thought his education at a mixed-race high school prepared him well for college. However, the advanced classes that Jake took in high school were typically single race (White students) with a small number of students of color (e.g., "4 out of 20"). In other words, Jake's high school was generally mixed race but his classes were more racially homogenous. Furthermore, the urban neighborhood where Jake grew up was less diverse and consisted primarily of "Blacks and Hispanics." Ultimately, Jake had some cross-race interactions prior to college and his strong family ties contributed to his strong self-concept and perception of belonging in engineering.

Jake was extremely self-aware and described how his race became salient during multiple interactions within his team experience. He explicitly expressed his concern for the racial composition of the larger community when he said, "I just wish there were more Black people,

Black, African-Americans, or just more people in our major, or just in our school.” In relation to Jake’s higher race salience, he also experienced interactions where he felt stereotyped within his academic and team environment. Jake commented about feeling stereotyped more than any other participant. For example, Jake stated, “I do, I always do feel like I have to like, can I prove myself, just cuz of being a Black male.” Another level of complexity in Jake’s self-concept included him being too proud to ask for help. He also made no statements that suggested he had a strong sense of belonging within engineering.

Despite the combination of Jake’s self-concept and his diminished sense of belonging, which may suggest an identity conflict, Jake enjoyed his multiracial student team experience. Jake’s team experience lasted five weeks with three teammates that were assigned by the course instructor. He had a generally positive disposition toward teamwork, but specific interactions with members of his multiracial student team had a significant impact on his experience. First, Jake chose to limit his opportunity to develop friendships, explaining that, “I noticed early, that there are certain people who you can, you can consider friends because of how you joke or how you talk or how, like your likes and dislikes.” Jake went on to explain that he just “didn’t really find any common ground” with teammates, but stated that he liked them as teammates or “acquaintances.” Jake also described experiencing some team conflict, but he described how the team was able to negotiate a resolution through a direct conversation. Specifically, he and a member of his team had unmatched expectations and his group was able to negotiate the expectations with the support of the faculty member overseeing the team activities.

In addition to positive and negative peer interactions, Jake had very few faculty interactions that impacted his team experience. He only spoke with the TA during class, and the TA typically addressed the entire team rather individual students. Jake was indifferent to this

interaction and felt the TA provided “technical advice” when called upon. Although Jake had neutral interactions with the TA, he had contrasting interactions with the instructor. A positive interaction with the instructor was mentioned earlier when the instructor intervened to settle a dispute between Jake and a team member regarding an unmatched expectation. Conversely, Jake also experienced negative interactions with the instructor where he was singled out during a class lecture. As a result, Jake thought it was “easier to talk to friends” about technical concerns until the concern could not be resolved, which forced him to seek the advice of the instructor.

In light of Jake’s reservation with an engineering professor or an authority figure, I took care to make him feel comfortable during the interview. During the interview process, Jake was very open and expressed his gratitude for the opportunity to talk about his perspective of the team experience. Jake gave extensive quotes and was comfortable providing stories to illustrate his feelings and how he interpreted interactions. Although Jake spoke about some topics that were clearly difficult for him, he eventually was able to articulate his thoughts when given time to select his words. For example, Jake was very emotional and I could hear the sadness in his voice when he expressed his desire to see “more Black people” on the campus and in his engineering department. His effective communication was consistent with his highly developed sense of self or self-concept.

4.2.4: Knight Wing

Knight Wing is studying biological systems engineering and has a military parent. Knight Wings’ parents raised him in a mixed-race suburban area in which he most comfortable when compared to a single race area. His family background in the military made him confident in his ability to successfully participate in a multiracial student team because he grew up around people of many different races. Additionally, Knight Wing’s strong family background is the foundation

of his highly developed self-concept. Also, he chose to study in BSE because he read the curriculum and was interested in the “bioprocess.” As a result, it is easy to perceive the connection between Knight Wing’s family background and the salience of his various social identities.

Knight Wing’s self-concept impacted his team experience. For example, Knight Wing considered himself an “engineer in training” that critically thought about his engineering student teams, including the division of labor. Both racial and engineering identities were salient for Knight Wing at a level that was comparable to the other participants. Knight Wing stated he was one of “two Black males” in his engineering class and eventually he and the other Black male developed a rapport during class. But he also saw his ability to get along with a variety of people as a “valuable asset.” He was flexible with respect to dividing work by roles or task based on which approach is most effective. Knight Wing described an effective method for a team to solve problems: “Sometimes we’ll be like, oh, who’s the leader. Who’s you know, vice president, who’s treasurer? But in the end like, we’re all there for the same purpose. So, what we really need to focus on is you know what to make ends meet.” As a result, Knight Wing, as all other participants, had a positive general disposition toward teamwork and gave a balance of positive and negative characteristics of his multiracial team experience.

Knight Wing’s team experience lasted two weeks with three teammates that he selected. During his interviews, Knight Wing described multiple peer interactions and commented on interpersonal communication and team dynamics. Specifically, Knight Wing considered the opportunity to develop friendships as a team dynamic that must grow and develop, as indicated in his statement, “I feel like it’s kind of like acquaintance to a friendship, you know? Like, it kind of just grows, from there.” Knight Wing described the process of becoming and functioning

as a team as “getting involved” in each other’s lives. However, despite these positive team dynamics, Knight Wing also described conflict as part of his team experience, defining it as “when one person like proposes an idea, and then one person takes it too seriously, and shuts them down.”

In respect to faculty interactions, while most participants were indifferent to faculty interactions, Knight Wing characterized his interactions with faculty as respectful but limited. Noting, “I need to work on that. I don't really interact enough with my professors.” Although Knight Wing recalled negative interactions with faculty in the past in terms of being belittled, he described his interactions with the faculty mentor and TA as “respectful” during his current team project. These faculty interactions involved specific topics; he talked to the TAs about homework and only discussed problem solutions or problem solving approaches with the faculty mentor.

The manner in which Knight Wing interacted with me during his interviews was also interesting in terms of evaluating his narrative of his team experience. First, he was initially very skeptical of the study and curious to understand my impetus for conducting a study that focused solely on African-Americans. However, his willingness to communicate his feelings increased over the duration of the study. Additionally, he enjoyed pondering his response to the “big picture” questions at the end of the final interview. Finally, despite his initial skepticism, Knight Wing also requested a follow up interview as he had reflections about his new team experience that he wanted to discuss; timing prohibited conducting this interview prior to completion of the study.

4.2.5: Zion

Zion is an engineering mechanics student and his father, who is a government employee, is proud that Zion, not only a first generation college student but also is the first to study

engineering in his family. Zion was raised in a mixed-race suburban area where his high school teachers encouraged him to study engineering in college because of his performance in math classes. According to Zion, he is studying engineering mechanics “because of Jesus,” and it was divine intervention that allowed him change his major and switch into from another major without resistance.

Zion had a strong sense of his personal identity, which impacted his team experience. First, Zion had a strong religious dimension to his self-concept, and he saw himself as a natural leader. For example, he stated, “I’m not necessarily the logical thinker. I’m just the leader who keeps organization.” In addition, Zion made statements indicating racial salience when he said, “there are only three African-Americans, (within his class) and two of them are on the same team, which is my team.” However, Zion’s race was less salient than his engineering identity, which he was more focused on, but also uncertain about. When asked how he saw himself as an engineer, Zion said, “That’s what I’ve been struggling with on the inside, trying to figure out what kind of engineer I am or if I’m even an engineer.” Zion was questioning whether he was an engineer at all, despite successfully navigating and nearly completing his engineering education.

Zion’s team experience lasted sixteen weeks with five teammates that were assigned to his project by the course instructor. Zion described multiple interactions with teammates that were personal in nature and impacted his team experience. For example, Zion had a significant conflict during his team experience that he explained by saying, “one’s religion conflicted with one’s mouth.” He described how he negotiated the situation such that he agreed to avoid talking about his religious beliefs and his teammate agreed to avoid using profanity during team meetings. In particular, Zion learned from that situation to “separate my personal beliefs from my work experience.” Furthermore, Zion described being stereotyped multiple times but stated,

“I’m never going to need to use the fact that I’m a minority to get anything.” Another way Zion described his social interaction with teammates was when he emphasized team cooperation. According to Zion, “minds to collaborate really makes a difference,” reflecting his beliefs in the importance of cooperation. Cooperation was a core personal value that influenced his relaxed social interaction with his team.

Faculty interactions, however, were less positive for Zion. The lack of faculty and departmental support was another challenge Zion had to overcome that contributed to his team conflict. He indicated this lack of support by saying, “She (faculty advisor) told us the goals that we were expected to achieve, and as soon as the funding was lost you could tell, for her, it really didn't mean much anymore. We lost touch, communication wasn't as good, and the project was just going downhill fast. And then she left (the university). As the faculty support decreased, Zion and the members of his team grew frustrated with the project, which also led to disagreements in team decisions. As result, Zion perceived a connection between the lack of faculty support and the initial team conflict, which led to the more significant personal conflict described earlier. Despite these challenges, Zion had a generally positive disposition toward teamwork. He “got practice” in teaming skills by participating on multiple teams during his education.

Zion was very comfortable throughout the interview process. I interpreted his willingness to elaborate on his thoughts as comfort during the interviews. He made detailed comments that generated long quotes and resulted in longer interviews compared to the other participants. His comfort was apparent during his three interviews, to the extent that he spontaneously broke into praise and worship during his last interview as he reflected on how much he overcame during his engineering education.

4.2.6: *Phil*

Phil is a mechanical engineering student who views education as means of social advancement. Although both parents earned professional degrees in education, Phil is the first to study engineering in his family. He chose mechanical engineering because it is a “wide open” field. Phil’s interest in machines emerged early in his life; as a child he took apart an old house phone and remote controls. Growing up in small communities, Phil was educated in a rural K-12 school and graduate from what he termed a “redneck high school.” He saw his engineering education as means to avoid being “trapped in the neighborhood.” Phil’s high school and home community were primarily white with one or two families of color. As a result, Phil experienced significant cross-race interactions as child but often felt “prejudged.” Phil’s team experience lasted four weeks with four teammates that were assigned by the course instructor.

Phil’s self-concept influenced his selection of his team role. He saw himself as a good technical writing engineer and often chose to have significant responsibility in terms of the report writing for the team. He was also willing to be a leader, as he felt comfortable on “multicultural diverse teams,” because he had extensive cross-race interactions growing up. Furthermore, Phil’s engineering identity and the salience of his race were moderate relative to the other participants. He described multiple situations in which he felt stereotyped, and, thus he had developed sophisticated defenses against those he perceived to “prejudge” him. For example Phil explained, “whenever I walk into a class and they (faculty) give me this look of, he's expecting me to be a troublemaker, like the bad kid and I give them the look of like of just "Ha, you goin regret that look!"” Phil also took a direct approach to rebutting being stereotyped by academic figures (i.e., classmates, teachers, administrators). For example, Phil brought to a professor’s attention statements that he made during lecture that reinforced negative stereotypes and the professor apologized to Phil.

Similar to all other participants, Phil had a positive view of teamwork and discussed both positive and negative interactions with teammates. One positive aspect of Phil's experience was the opportunity he had to develop friendships: "We actually talk a little bit outside the class, too... I consider him to be a friend. I definitely prefer having a friend on a team." However, learning conflict management was also a part of Phil's team experience. According to Phil, a team member did not want to do his portion of the project. Phil managed this mismatch in expectations by "talking to him and I guess trying to gauge the situation and in the end, I was like yeah, just do it and get it sent to me." Finally, Phil's interactions with his teammates were impacted by a team member that was added after the project had begun and required role and team chemistry adjustments.

With regard to faculty interactions, his interaction with the TA for the project was limited because the TA did not speak English well. According to Phil, the TA had a specific role for the team project, to start the lab each day and grade his team's weekly assignments. Conversely, Phil had a more personal relationship with the course instructor. Although Phil did not consider the instructor a mentor, he considered the instructor "a friend" and they "talked about life stuff." Phil felt respected by the instructor and commented on how the instructor helped with homework and frequently gave him advice on technical things.

Phil and I also had interesting interactions during his interview process. He was very comfortable throughout the interview sequence as he generally provided rich descriptions of his experience. He was easily able to tell a story or provide more details to articulate whatever point he was making. Phil also made several jokes and we laughed frequently during his interviews. Even when he spoke about difficult topics such as being stereotyped, he always had a positive perspective on the negative experience. Finally, his comfort with discussing previous and current

concerns about the topic indicated his high level of self-awareness and suggested a calm demeanor in reflecting on interracial interactions.

4.2.7: *David*

David is studying industrial systems engineering but was originally interested in computer science and business. However, David's influential father, who is a practicing civil engineer, strongly encouraged him and his brother to study engineering for the professional opportunities. According to David, he moved multiple times prior to coming to college, and he grew up in middle class suburban areas that were racially mixed. David believed that his high school prepared him for college and it was where he started to learn about "different cultures." Strong family ties and childhood experiences shaped David's sense of self and understanding of his race.

. David's self-concept and social identities became relevant during his multiracial student team experience. From a personal identity perspective, David saw himself as a good listener, which was a useful characteristic for his team. He also felt he was a flexible teammate because he would "choose his role or task" after studying the problem statement to understand what was important to the project. Additionally, David expressed a developing engineering identity when he said, "I am a persistent problem solver" but did not make any declarative statements about being an engineer. Race was salient for David in that he noted "there's a couple other African-Americans students" in his department. He did feel his teaming experience prepared him to work professionally.

David's team experience lasted five weeks with two teammates that were assigned by the course instructor. David's self-concept resulted in a variety of interactions with his teammates. Similar to the CS majors, David stressed the importance of cooperative interdependence during

his interview sequence. David made multiple statements about the high level of engagement and social interaction among his team members. For example, he said, “We’d go over to one of their houses and then, all get our laptops out and just talk about what the next step to do with and then work on it and maybe split things if we have to... So, we’d just work on it together.” He described positive team interactions such that, “We got along fine... I mean, as people. When we’re not working on the project at the time, we can still like appreciate each other’s company, so it was a good environment.” He described these team interactions as “relaxed” with little to no conflict.

Similar to other participants, David had different types of interactions with the TA versus the course instructor. The TA was responsible for the lab portion of the course and tried to help his team with their project. According to David, the TA circulated the lab while the teams worked to answer questions and to check project status. Conversely, David identified the faculty member as an instructor, but not a mentor designated specifically for his team project. Generally, David was indifferent to the instructor and TA, felt comfortable talking to them individually but restricted his conversation to technical aspects of the course or troubleshooting his team project. As a result, David described the interactions he had with faculty as neutral in nature and characterized them as indifferent.

Despite his indifferent relationship with the academic staff responsible for his team project, David was very comfortable and forthcoming during his interview sequence. Specifically, David had a generally calm demeanor and was engaging during interviews. Based on our interactions, I believe he was interested in the topic, particularly regarding how teamwork fit into his engineering education. For example, with some questions he paused to think about his answer and I had to take care to wait for him to answer. He was thoughtful and reflective in his

response to interview questions. My general impression was that he saw the importance of teamwork and had a quiet confidence. In my field notes, I recorded that David might be a good example of a typical or average case because he is happy, thoughtful, and consistently neutral.

4.2.8: Sterling

Sterling is in the general engineering program and has not declared a major, but he chose to study engineering because he enjoys physics and engineering is “hands on and I could build stuff which is pretty cool.” He is the first person in his family to study engineering, but both of his parents have a bachelor’s degree. According to Sterling, his mother is happy that he is in college, while his father wanted him to study medicine but is ok with engineering. Initially Sterling grew up in a predominantly Black (single race) area, but moved to a racially mixed middle class urban area when he started high school. According to Sterling, the urban area where he grew up was near a “downtown” area that was consistent with living in a major metropolitan area in the United States, and he observed the racial composition of the area “change” over time. Interestingly, Sterling was not “friends” with the teens close to his age in his urban area. However, he did feel his high school education prepared him for college.

Sterling emphasized interpersonal communication during his interviews and had a strong sense of his self-concept. Based on his experiences during his formative teen years, the salience of Sterling’s race was particularly high. Specifically, Sterling observed that there were “two other Black kids” in his advanced classes in high school. Additionally, Sterling anticipated his race impacting his team experience but he was “pleasantly surprised” that it did not. Sterling stated, “I expected some sort of stereotypical like things. But, no, it was, it was race-free.” In terms of being the only African-American on his multiracial student team, Sterling said, “the fact that I’m Black did not mean anything in our team dynamic.” Nevertheless, the salience of

Sterling's race was generally more elevated than his engineering identity. Specifically, Sterling saw himself as an "engineering student" that was learning to be an engineer.

Sterling's current experience lasted five weeks with three teammates that were assigned by the course instructor. Sterling's interactions with his teammates were critical to his experience. Sterling felt respected by his teammates and valued their opinion of him. In particular, he made several statements regarding team dynamics such as, "It's actually been, really cool. Different people, like two of them are (military students) and they're like really cool kids. They are funny, so it's cool." Sterling also described a "divide and conquer" approach to work division. He articulated his team role by saying, "I mean, we didn't officially say that I was the leader. But I think everybody knew that I kind of organized, like, the meetings, I organized every meeting we had." The fact that teammates trusted him with this critical role for him, demonstrated their respect for him. As a result, Sterling noted, "It's not always true that people stereotype based on race. And it felt good." He perceived his team interactions a positive or "pretty chill" with "no significant interruption."

Despite the positive peer interactions, Sterling had limited interactions with the academic staff responsible for his team project. For example, similar to other participants, Sterling was not comfortable with the term "faculty mentor." Sterling explained he had a lecturer and a TA responsible for his project. He did not interact with the lecturer during class or team activities but only during office hours. However, despite the limited interaction, Sterling described his interaction with faculty member as "cool" and said he was "understanding." In other words, the faculty member seemed supportive of Sterling during the few times they interacted. Sterling also limited interaction with the TA assigned to his team project. The TA floated around the room to check the progress of the team and also had to approve Sterling's group's design application.

Once the approval was received, there was minimal communication between the TA and Sterling or his team. Therefore, Sterling was indifferent to faculty interaction because he had positive but limited contact with the faculty responsible for his team project.

Sterling was comfortable and engaged during the entire interview process. Sterling's responses to questions were measured and typically balanced. Furthermore, a mature and thoughtful perspective was demonstrated throughout the interview process with Sterling. He was self-aware and confident about his thoughts and reflections. For example, he discussed his thoughts about life-long learning and how his previous experience with conflict influences his conflict management approach within team projects. Finally, Sterling expressed his appreciation for being part of the study and his intention to consider his behaviors during team projects in the future as he continues his engineering education.

4.3. Textural and Structural Statements (RQ1)

RQ1: How do African-American engineering students describe their experience on multiracial teams?

The textural and structural statements developed from the data address the first research question as they describe both what participants experienced (textural statement) and how they experienced it (structural statement).

4.3.1 Textural Statement

What did the African-American males experience through their participation on a multiracial student team within their engineering courses? When the participants talked about their experiences on a multiracial student team in engineering they used words such as “constant communication” with a group of 2-6 students of different races. They also spoke of “collective thinking” to describe working together to solve all portions of the project, rather than the “divide

and conquer” approach employed in team projects prior to the current project (e.g. team experiences outside of engineering such as sports teams, pre-college team experiences, or projects within the first year engineering program). Finally, the participants described making decisions about the project direction based upon what the group was “good at” or the knowledge, skills, and abilities present within their multiracial student team.

4.3.2 Structural Statement

How and in what context did the African-American males experience their participation on teams with student of different races within their engineering courses? Most participants spoke about the importance of teamwork and its prevalence in engineering work. Several described their experiences as productive and efficient. Additionally, several participants described the importance of contributions from all team members and the practice of “working together” to reach the best solution by compromising or “combining ideas.” Some participants mentioned “getting more comfortable” with team members of their multiracial student team and described them as “pretty chill” people. Additionally, although the participants described some specific situations where race impacted team interactions, they generally did not believe that their overall team experience was impacted by race. At the same time, participants generally desired more personal interaction with teammates beyond team activities, but were typically not able to establish friendships with cross-race team members. Overall, then, this group of African-American males generally described how they experienced their multiracial student teams in terms of peer interactions as productive and collegial, with little to no perceptions of racial dynamics but also little or no opportunities for individual friendships beyond the project interactions.

At the same time, while the participants generally had positive interactions within their multiracial team, they also experienced being an African-American male on a multiracial student team within the context of the larger social structures of their engineering departments and the university setting. As a result, some participants were less comfortable interacting with teammates during the large or common lecture portion of the course in which their team project was included. At the departmental level, the participants described indifferent interactions with faculty, and this indifference carried into the team experience. A few participants were able to develop positive relationships with faculty, but most either avoided faculty within their department or experienced some negative interactions. One participant even described anger and frustration for being singled out in class regarding his skin color by an engineering faculty member. In addition, the participants expressed isolation within the department and university. Typically, the participants knew the total number of African-American students in their department. “I was one of [single-digit number] African-Americans in my department” was a sentiment expressed by multiple participants. Not surprisingly, then, participants were typically the only African-American on their team. Similar sentiments of social isolation were expressed regarding the larger university climate, such as “being stared at” while walking on campus.

4.4 Emergent Common Themes Across Participant (RQ2)

This section presents both common (experienced by more than half of the participants) and unique (experienced by half or fewer of the participants) themes to address the second research question:

RQ2: What patterns or themes emerge in the way African-American engineering students describe and interpret their experiences on multiracial teams?

Following Hycner (1985), I identified the common and unique themes by comparing themes across participants. In other words, after developing individual themes tables for each

participant (see Appendix B); the primary and unique themes were compared to identify themes common to all or most participants. Table 8 indicates the both common and unique emergent themes for each individual participant. In Table 8, the plus sign identifies which individual participant themes were consistent with the emergent theme and the minus sign highlighted in yellow indicates a counterexample or a divergent nuance of the operationalized theme definition. Additionally, the total number at the bottom of Table 8 indicates the total number of participants, for whom the theme emerged, including both consistent and counterexamples. Because my sample population was reduced to eight participants, any theme common across more than half the participants was considered common (Hycner, 1985). The four common themes for the group include positive personal interaction, lack of friendship opportunity, indifferent faculty interactions, and conflict associated with unmet expectations. Two additional themes, stereotype awareness and interdependence, also emerged as significant due to their prevalence in the literature regarding the study population and intergroup contact; stereotype awareness emerged for four participants, while interdependence emerged for three. The additional themes will be discussed as “unique” because they are not common to a majority of participants (Hycner, 1985).

Table 8 : Summary of Themes by Participant

Common Themes					Unique Cluster	
Participants	Personal Interaction	Lack of Friendship	Indifferent Faculty	Conflict from Unmet Expectations	Stereotype Awareness	Interdependence
Clay	+	-	+			+
Harbor	+	+		+		+
Jake	+	+		+	+	
Knight Wing	+		+	+	+	
Zion	+	+		+	+	
Phil	+		+	+	+	
David	+	+	+			+
Sterling	+		+			
Total	8	5	5	5	4	3

4.4.1 Positive Personal Interaction

The first common theme across participants was positive personal interaction. Personal interaction was operationalized as voluntary informal interactions with the team as a group that required some level of self disclosure. Specifically, personal interaction included statements about team social relations such as general comments on informal communication (e.g. liking teammate or likeability, enjoying working with teammates, “chilling”, and joking). All participants experienced personal interactions within the team in which they felt comfortable sharing their ideas about the project direction, steps to take, and how to proceed. For most participants, in addition, this comfortable professional communication was linked to informal social interactions in which team members could “kick back” and just hang out with one another. Some participants were willing to engage in such socializing early in the project, but for others it developed over time. But in almost every case, the positive professional and the positive social dynamics were linked. First, David for example described positive professional communication when he stated:

Interviewer: and why was this person easy to work with? What made them easy to work with?

David: He was just like, he was pretty knowledgeable and like, (pause) we were, I don't know I guess we just like, didn't really have any problems while we were working, like we were all on the same kind of level, as far as the project went, so, it went pretty smoothly, is what I'm trying to say.

In this statement, David valued the knowledge, skill, and ability of a particular teammate and described the ease of communicating with team members. Later in his third interview David discussed informal communication such as the choice his team made regarding meeting at the home of a teammate who lived close to him,

Interviewer: Okay. So, what, I mean, was it kind of like a rotation of people's houses? You all didn't want to meet on campus? You just wanted to meet at his place?

David: Uh, I guess. Like, I guess. He actually lived like really close to me. And I guess the other guy didn't mind driving there, so

Interviewer: Gotcha. Okay. And, and so, I mean, but, was everybody cool?

David: Yeah, I mean, I feel like we were cool.

Interviewer: did you? Okay. And why do you think that is?

David: Uh, I mean, we got along fine we were just I mean, as people. When we're not working on the project at the time, we can still like appreciate each other's company, so it was a good environment, I'd say in that sense.

In the above statements, David explains how his team created a positive team culture and was fairly relaxed in their interactions.

Several participants engaged in such professional and personal interaction with teammates freely. For example, Sterling's experiences were similar to David's:

Interviewer: Okay. And so uh, just in general, how would describe or, uh, your interactions with your teammates? Like, what was it like working with them?

Sterling: It was pretty good; we were mostly at the same level and I mean sometimes I had to um, take action on my own. Like, sometimes people didn't do like their thing just because I think just because of the way their day was going, um, they didn't do things and then some days I wasn't really active, but I think it all evened out and it was, we had a pretty good interaction. It was like support, like a support. It was a good supporter, you know. We were supporting each other.

In this statement, Sterling experienced his team function to "cover for each other" as supportive. To be supportive, Sterling had to know some personal information about his teammates, which required self disclosure from his teammates. At the same time, Sterling had days where he was not "really active" and his teammates had to cover for him. As a result, he described experiencing "good interaction" with teammates that was both personal and professional.

Furthermore, some participants' perceptions of personal interactions changed over the duration of the team project. For example, when Harbor was asked about socializing with

teammates outside of class he responded with the following statements in his second and third interviews:

Harbor (2nd Interview): We don't, we haven't really developed a bond, cuz from normally groups develop long when they meet outside of class, and sort of arrange those things, but we've never actually developed anything.

Harbor (3rd Interview): Hm, for the six of us, probably during our first meeting, where we're just like, started discussing what we're going to do. How we're going to do things. I think we got sidetracked, started talking about other things, then we just, yeah, just became closer as a group.

The combination of these statements illustrates the significant change in Harbor's experience as his group "became closer as a group" as a result of the personal interaction. In this case with Harbor's team, the informal team communication supported the professional team communication.

Zion was the one counterexample to the emergent theme and emphasized separating professional communication from personal interactions when he stated:

Interviewer: Alright. Is there, getting to know them, is there any particular, like type of interaction that you think is important, or is there any like, "this needs to happen for the team to function well"?

Zion: Uh, yeah, there's certain things. Little things um, location could be one of them. Um, we tend to work out in the middle of the open. Um, which I think is good, 'cause we're going to be ourselves, no matter what. And by open I mean, we're working inside of our building. So everybody in there knows us. But it, it tends to keep out, um, I guess a little bit more, our personal, personal selves. So that because we're in the open, we're interacting as a group in front of the public, um, we can act a little bit better or we act a little bit more professional I guess, in front of each other. Um, so it's not like tight knit, business meeting every single time, 'cause we're getting into the nitty and gritty and stuff like that, but we don't let loose 100%.

In this statement, Zion is suggesting that holding the team meeting in the common area for students in his department helped his multiracial team use better or more professional interpersonal communication skills. In other words, it allowed him to avoid engaging in personal

interaction with his teammates. This avoidance of personal interaction can be interpreted as intergroup anxiety. Intergroup anxiety is defined as anxiety stemming from interacting with out-group members (e.g. students from a different race) and is caused by prior contact, prior knowledge (e.g. stereotypes, prejudices, and expectations), or situational factors such as class or social norms (Stephen & Stephen, 1985). Therefore, the emergent theme linking positive personal interaction to professional communication was moderated by intergroup anxiety and mediated by self-disclosure. Self-disclosure during personal communication is closely related to the second theme that emerged, the lack of friendship opportunity.

4.4.2 Lack of Friendship Opportunity

The second common theme across participants was that despite positive, comfortable, non-project personal communication, participants experienced few opportunities for deeper friendships with individual members of the multiracial student team or out-group members. Friendship opportunity was operationalized in the data analysis as an empathetic (caring) personal relationship with an individual out-group team member that develops over the course of the contact situation or team project. This general definition was further characterized in various ways according to participant responses to questions regarding socializing with teammates outside of class. For example, any statement the participants made about their willingness to engage in or avoid a cross-race friendship with a team member was included. Generally, participants described a lack of opportunities to develop friendship based on different interests or social activities. In addition, some participants described a decreased motivation to pursue friendships as they had established a social network early during their engineering program. That is to say, the participants were more inclined to pursue friendships as a freshman or sophomore

but less likely in their junior or senior years. Jake illustrates participants' reservations about cross-race friendships when he explains,

Jake: I mean we've only, I mean, no (does not socialize outside of class). I think everybody's an acquaintance. If I can be blunt, yeah, everybody's, everybody's an acquaintance. I mean, we all, everybody has different personalities. I mean, I didn't really find any common ground between them. Just cuz, umm, it's not like I don't like them or anything. It may sound kind of mean but it's just that, my crowd I guess, they're like, it's just. I noticed early, that there's certain people who you can, you can consider friends because of how you joke or how you talk or how, like your likes and dislikes. And I just saw, from what I saw from their, their personality made me, this doesn't fit in with my (social groups), I guess you would say.

Like several participants, Jake distinguishes between friends and acquaintances based upon communication styles and social norms, including what can be joked about and what types of social activities he enjoys.

Jake's comment suggests that dissimilar interest prevented him from developing potential friendships with his teammates. Other barriers to friendship opportunities include the lack of incentive, as described in this excerpt from Sterling:

Interviewer: uh, you kind of just had a professional relationship with them? Is that how you, is that how you see it? (Yeah, yeah) It was just like, you know, this is just work and this is what I do (Yeah) and so they're not really in that kind of friend category. (Yeah)

Sterling: Yeah, I didn't get to know them well enough. I didn't, I didn't really put that, that was, yeah. I was motiv- there's no motive to get to know them past the professional level for our work.

David expanded on his lack of motivation by connecting it to time:

Interviewer: Do you think that happens often (friendship develops over the course of the project)?

David: Uh, yeah, I'd say sometimes, but like, I think it'd happen more often for me younger in college than like, now. Or earlier in college I guess. When you're trying to make friends, like, that's kind of your goal. And then like, I guess at this point people are more established, and so who like, they hang out with, so.

Interviewer: So more so when you're a freshman and a sophomore. (Yeah, yeah) Alright. But now that you're a junior you don't have time for all that. (Pretty much) Okay... And do you think that a lot of it is just like you said by this time you kind of got your friends, yourself established, you know? You're not necessarily looking to expand stuff, is that it?

David: I mean, it's not that I'm, um, not looking to expand but, I guess maybe not as eager as I was, like back then, when I knew fewer people, but I wouldn't I mean, I wouldn't, what am I trying to say, purposely like, to say, alright like this is it, you know what I mean? But I just let things flow naturally if they do. Whereas like earlier, I'd like force things more often, earlier in college.

David was more willing to take risks in making friends during the first few years of his engineering education, but now has an established social network that is separate from his academic contacts.

Although most participants described the lack of friendship opportunities within their team or barriers to the development of a friendship, some counterexamples were present. For example, Clay described a teammate that he considered a friend during his second interview:

Clay: Yeah, I've had the same partner in every project, throughout the semester. He's been my partner since like, earlier CS classes, So, yeah, so we're really comfortable working together. I have, I have gotten to know, 'cause I hang out with my partner a decent amount outside of just working. So just, I mean just getting to know him better.

Similarly Phil stated the following,

Interviewer: Okay. Would you, do you consider any of your teammates friends?

Phil: Uh, yeah. Uh, the one guy, [name] I'd consider as my friend. The one of the guys name was [name]. He was one of the original members of the group, I consider him to be a friend.

Interviewer: Okay. Why?

Phil: Um, just the way we interacted. We actually talk a little bit outside the class, too.

Interviewer: Okay. And so what, what was that like? Do you prefer having a friend on the team like that, or do you prefer like kind of working with people you don't know?

Phil: I definitely prefer having a friend on a team, because it's a lot easier to talk to him. You can uh, relax with him, you can do work while at the same time enjoy yourself. It's a lot easier. Um, I could, and can, do I guess. But, it's a lot more enjoyable to be relaxing with a friend than trying to pretend with someone you don't really enjoy being around.

These quotes demonstrate that the ways friendship opportunities directly impact these participants' perspectives on the team environment and create more positive experiences.

Importantly, in both cases participants were willing to spend more time with outgroup team members, increasing their opportunities to interact and develop cross-race friendships.

4.4.3 Indifferent Faculty Interaction

The third theme concerns participants' interactions with the faculty and/or TAs who functioned as the authority figure for the team project. Overall, while participants noted neutral to positive interactions with faculty and TAs, most were indifferent to the interactions and didn't consider them significant elements of the team dynamics. Phil had perhaps the most positive interaction when he described how he experienced his relationship with the faculty in charge of the course:

Phil: The instructor and I were actually on pretty good speaking terms. Yeah, I might even call him a friend. It was pretty cool. Yeah, we talked about programming and life stuff.

Most students; however, did not describe such close personal relationships with faculty. Instead, they experienced comfortable but low key interactions such as those Clay described:

Interviewer: Ok, and so how would you describe your interactions with that instructor?

Clay: Oh, umm, they're really nice cuz he's umm, a very nice laid-back guy. So it's really easy to talk to him and ask him questions and for help. So he's not, someone who's going to not answer your question or call you or like look down on you, for not having something. So, he's definitely very easy to talk to.

Interviewer: Ok, easy to talk to and do you think he respects you as a young computer scientist?

Clay: Yeah, I definitely do. I do think he respects me.

Despite these generally positive experiences, most participants were indifferent to their interactions with faculty and TAs. Sterling, for example, said about the course TA:

Interviewer: So, what does he normally say, when he's walking around?

Sterling: umm, so far, he looked at like our progress. And how would for we got and he, we had to prove that the issue we chose, like how we chose the, to make a prosthetic arm that replaces tools, he had to approve that. And he did. And I think, that's mostly what he does so far, because we don't really need his help except his approval.

And later in his third interview, he described a similar perspective

Sterling: I mean, he would answer like questions we had, um, we had a couple of them, but like I don't, I don't know. We just asked him how to do things or like, explanations on the questions on the worksheets, but apart from that, there wasn't really a close interaction with the workshop leader.

Sterling was comfortable asking questions of the course TA, but did not have “close interaction” or personal communication. David’s description echoes Sterling’s second interview:

Interviewer: Ok. So what is the TA, dealing with the group?

David: Like, since a lot is done together, you know like, come up with a question and I guess she'd come over and like mess with our program, and try to like help us out, explain concepts if we need it, that kinda thing.

Interviewer: So it's always, kind of technical stuff?

David: well not fully, a lot of it was conceptual, as far as like the statistics. Yeah, so it wasn't all technical.

Jake’s description of his interaction with the faculty member leading his course reflects the same sense of comfort paired with indifference:

Jake: We, uhh, I have seen that our group, can generally answer the questions on our own. Like we can, we can fight through it on our own, I guess, but I guess, we'll ask him (the faculty member) if we need to. Like we always, we're not afraid to ask them, we actually did ask him a couple of questions, when we didn't understand something. But

we're not afraid to ask him, but we also aren't afraid to try to solve it ourselves, before we have to go to him.

Interviewer: Ok. So, but, how would you describe your interaction with him?

Jake: Personally or as a group? (both) As a group, we, everything is going smoothly, you know. He's make, he goes around and checks to make sure that everybody's on the same page. Make you that we don't stray too much from the project.

Similar to the other participants, Jake saw the faculty member as a back-up plan for asking for help after struggling with his teammates.

In two cases, however, despite these general or indifferent experiences interacting with faculty, two participants described negative interactions. Zion described his challenging relationship with project faculty mentors as follows:

Interviewer: How would you describe your interactions with that faculty mentor? (Poor) It was poor, why was it poor?

Zion: It was poor because we tried to meet, once a month, when we should have been meeting every two weeks, at the least. Umm, she was very busy and points in time, and so a lot of us, we had to communicate through email and as the semester went on, especially after funding, it started out fantastic, like (academic level) second semester when we chose her, she was telling us all the plans that she had and it sounded great. Summer came back, umm, came back after this summer, started out very well. She told us the goals that we were expected to achieve and as soon as the funding was lost, you could tell, for her it really didn't mean much anymore. Umm, because she was pretty much looking for the publication, I'm guessing. Not that she was a mean person or anything, it was just, like that was what she was looking for out of it. And so now, the only obligation that she had towards our group was the fact that, she knew that it was a project that we had to do. So she tried to help as much as she could, as far as her concerns were, after that point. So it really wasn't a big deal to her anymore. It was more or less she just didn't want to really leave us high and dry, I guess and that's where things started going downhill. Because we lost touch, umm, communication wasn't as good, and the project was just going downhill fast. And then she left [the university] umm, and she didn't tell us until the semester was coming to a close, so when we came back, we had to find a new person, right then and there.

After this faculty mentor was replaced with a department representative, Zion described his interaction with the new faculty member in the following statements:

Interviewer: Sure, alright. Okay. And uh, did you, with the losing the funding I know you also lost a faculty member, mentor. Did you ever pick up a faculty mentor?

Zion: Not really. (No?) We had to put the, you know, we had to put somebody in the place because we couldn't just be kids running the project. But we, I think we only met up with him one time. At that was at the very beginning of the semester. Everything else was just us. We emailed and contacted him for um, I guess well, well, yeah. But um, he was in charge of the class, so I don't know whether you would classify that as our advisor because that, that's not what he was doing as an advisor. He, it was, when we contacted him, it was in terms of finances, things like that. 'Cause he was in charge of the class, so. I don't think we ever really used him as an advisor.

Interviewer: So he never talked about anything technical with the project with you all.

Zion: Nope, not unless it was um, you know, randomly throughout the school year, you have to meet up with the three teachers of the class and tell them where you are. Those would be the points in times where they would plug in and say, 'so what you got?' 'Okay how about this?' You know, throw this in there. We'd be like, okay, we'll take that into consideration. That would be the only times.

These statements indicate his negative perspective on faculty interactions, despite the extenuating circumstances.

For Knight Wing, a negative faculty interaction occurred prior to the team project, as he explains in his third interview:

Interviewer: Alright. And um, were you comfortable [asking professor about homework solutions and points]? I mean, did you see, did you feel like you could?

Knight Wing: It's not like he was just like, 'oh, well, if you look here on page three', you know. He'll be like, 'yeah, that problem is actually pretty hard. What you have to do is you know, this, this, this. Then, remember this, you know. Kind of, guide, I guess.

Interviewer: Yeah, it is. Okay. So, so do you feel like the faculty member like uh, showed you respect by doing that? I mean, was he, or was he kind of talking down to you?

Knight Wing: It was respectful. I mean, I've definitely been in faculty positions where, in conversations where just like, 'Oh, well, you know, you do this.' Like, 'You're stupid, it's this'. Yeah, you know. Yeah.

Interviewer: And you just had to kind of take it?

Knight Wing: Yeah, just like, I'm stupid, oh man, oh man.

Although Knight Wing did not connect this experience with his current team's faculty mentor, he did note that he had very little interaction with faculty in general. Although Knight Wing had a negative perception of his faculty interaction, his disappointment had minimal impact on his multiracial student team experience.

4.4.4 Conflict from Unmet Expectations

The final emergent theme from the participant statements is the way in which conflict materialized from unmet expectations linked to professional behaviors, and these conflict were resolved through direct discussion. For Zion, the conflict resulted from differing expectations about appropriate behaviors in team meetings:

Zion: We had a lot more, letting loose and it really um, it set off a very bad vibe between a couple of team members, a little bit of arguments going on, and anytime you spend a lot of time with somebody, that can be an option. But because it was too much personal inside the work environment, it got really bad, so. Um, one's religion conflicted with one's mouth. 'Cause I was talking about you know, I just tend to sing, or tend to talk about (Schnoor) a lot, wherever I am. And um, the other individual tends to curse, a whole lot. That kind of stuff just got washed out.... As the year went on, I knew what not to do, what buttons not to push and certain locations. And it was a hard thing for me. You know, to learn how, what professional really meant, um, separating my personal beliefs from my work experience. Um, we had a discussion outside of the project, just when we were doing homework together.

In this statement, Zion's unmatched expectation is the level of professional communication during team meetings. He specifically felt that the use of profanity during team meetings was in direct conflict to his personal religious views and his team member appeared to feel that his

religious expressions were equally inappropriate. Similarly for Jake, the unmet expectations also addressed behavior during meetings:

Jake: During the first meeting, he was working on his, umm, homework, I guess. Or whatever, for math, and he wasn't really, he would contribute stuff with the group, but it was like, it was a little distracting, because he would be doing his homework like while we're talking. The first team meeting, all I saw was him putting his homework before the groups... cuz if I'm putting in 100% and your only putting in 50%, and we're getting the same grade, I'm not gonna, I don't like that. Cuz I mean, I want you to know, I want my grades to reflect the work I put in.

Here, Jake was disappointed that his teammate was working on homework for another class and did not give his full attention to the team during the team activity.

As the above demonstrate, some participants experienced conflict due to unmet expectations. Other participants didn't experience conflict during current team experience but articulated circumstances where mismatched expectations could or did result in team conflict.

For several participants, these unmet expectations focused on how team members should respond to one another's ideas, as Knight Wing explains:

Knight Wing: Basically, I feel like it's when one person, like proposes an idea, and then one person takes it too seriously, and shuts them down. So then, like the proposer is offended, so now they're already at odds. And then from there it just escalates, till, until there's of fever pitch, or they just like resolve it.

Knight Wing, like several participants, expected teammates to listen to each other and consider contributions from all team members rather than shut one another down. For Harbor, this process of shutting others down operated not at the level of discussion, but at the level of task:

Harbor: Uh, some, if you have someone who is really good at something and like they've been doing it a long time, and they think they can go faster than everyone else can. So, they think it will be more efficient than the other half of the group, the other people won't learn anything or get much experience in it, which is the point of this, to get experience, in the field, so.

Although none of the participants supported shutting down individual voices within the team, some participants saw the challenging of ideas as productive and not a form of conflict. Sterling during his reflective interview explains the difference between team conflict and accountability when he stated,

Interviewer: so, how would you define team conflict?

Sterling: I think it varies. Like, there is, if you have significantly, if you're significantly dysfunctional, like if you can't work together, then that's something to mention as team conflict but like, there's certain times that you would have different views or like, you would like not be able to complete certain tasks at certain times, in certain ways, but I don't think those are, that, that, I don't think it's necessary to call that team conflict, because every team has that. Um, but, in our case, there's nothing significant that broke down our, um, our efficiency or like our, um, like our work was never really influenced by our interpersonal relationships because, mostly because we never engaged in anything more than that work, and we did most things um, in the right time. But, there's always like, times that I didn't like what other people did with their part, um, and I kind of complained, I told them that, I told them what I felt, and they fixed it. People did that to me, too. Um, but I don't think that calls to be conflict, to be called conflict.

Sterling made a distinction between holding teammates accountable and actual team conflict, which he terms as “significantly dysfunctional.” That is to say, some conflict may be necessary to move the team forward, but bad conflict can hinder team functionality. Therefore, team conflict as the result of unmet expectations of acceptable team behaviors was final common theme, but more importantly the participants felt confident they effectively addressed the conflict direct personal conversation and distinguished between necessary and bad conflict.

4.5 Unique Themes (RQ 2)

In addition to the common themes across most or all participants, two critical themes emerged during the analysis that had a significant impact on some of the participants: stereotype awareness and interdependence.

4.5.1 Stereotype Awareness

Stereotype awareness (SA) refers to participants' awareness of negative stereotypes about African-Americans in engineering as well as their effort to disprove those stereotypes. The stereotypes were linked to negative perceptions of the "Blacks' intelligence" (Shapiro, Williams, & Hambarchyan, 2013) and included being lazy, not contributing to team or "working", not being smart enough to learn from mistakes, being less focused on work, being a distraction, and being a disruptive during class or acting as a "troublemaker." While all participants except Clay, referenced these negative stereotypes about African-American men over the course of the interviews, four of the eight participants went on to describe in detail how this awareness of shaped their team interactions. Because only four participants discussed this shaping in detail, the theme is considered "unique" by Hycner's standards, but the fact that seven of eight participants identified the stereotypes suggests further study is warranted.

For Jake, stereotype awareness was a threat to his engineering identity construction. He made numerous statements across the interviews about experiencing negative stereotypes during his current team experience:

Interviewer: all right. Ok, so do you feel like right now, that there is a clear level of respect, I mean everybody kind of respects you? You mentioned how you kind of evaluated them, do you think they have pretty much done the same with you?

Jake: And I, I just, I hate that stereotype. So I already, before I even get in a group, I always want to make sure that, that stereotype is already thrown out the window. And that's why I like to take the leader role, because I feel like that's the best way to prove, that hey, I'm here to work. I'm here to get that "A" just as much as you are. And, when I walked to the group, they seen me like, seeing my like, "Oh, he's not going to do any work." That's why, and maybe they were thinking it, but they were very well not showing it. So that's why, the minute I get in the group, I made sure that I was not on my phone, at first, or I was not distracted at first. I was making sure that I was following along. And make sure that I was contributing ideas, and make sure that if, I was organized and stuff like, I would make sure like, he would write stuff down on the list, and it was like, okay keep us on track, so we don't get to distracted, or like get too umm, lollygagging, in some

areas. So, just trying to make sure that they know that I am here to work, as much as they are. That's what I like to do, when I do group work.

In this statement, Jake expresses his awareness of the negative stereotype positioning African-Americans as lazy or having a diminished work ethic and his intentional effort to disprove them.

Later in the interview, Jake went on to say,

Interviewer: So you just want a chance to prove yourself?

Jake: Yeah. Before you go, you put me, if you're gonna write me off, at least let me show what I got and if I written off, then I want to know why I'm written off. That's why I like self-criticism, I want to know, what I did wrong, so I can improve on it next time. I don't want to make the same mistake again. So that's why, I love, I mean I like, yeah I really do appreciate self-criticism. I really do, I like getting a chance to show what I got, and if I don't, if I can't do it the way you want, then let me, then tell me, so I can learn, cuz I mean, I wanna learn, make myself better. Make myself, make sure that I don't do that same mistake, I can do the same job for you the next time you ask.

Jake expressed his commitment to avoiding being “written off” or discounted by teammates as he proactively worked to disprove the negative stereotype of African-Americans’ lack of intelligence and their inability to learn from mistakes. Other participants expressed similar experiences. For example, Phil explained:

Phil: The teachers and whenever I walk into a class and they give me this look of, he's expecting me to be a troublemaker, like the bad kid and I give them the look of like of just "Ha, you goin' regret that look!"

Phil took pride in proving teachers wrong who prejudged him and assumed he was going to be a “troublemaker” in class. In this case, Phil described the stereotype of African-American males being a “troublemaker” or disruptive during class, which is closely aligned with the idea of the “low performing Black males” and academic failure. Similarly, Knight Wing made comments about how stereotypes impacted his team experience:

Interviewer: Do you feel like your race at any time impacted your team experience?

Knights Wing: Hm. At any time, maybe in the beginning, like forming the team. More of, um, more of hm, probably more of like society, society views and stereotypes, things that are formed, like that have gained, like, heavy following over the years. But you have to once you, you know, present yourself, then it's, you know, then it's you. But, but if you see someone I don't know, stereotype society, that stuff, it just like plays to a bigger role.

Interviewer: So, did you, you feel like your teammates kind of initially stereotyped, they had stereotypes about you, or they thought certain things about you?

Knights Wing: Possibly, yeah.

Interviewer: And you think that, you know, once, once they kind of got to know you (Yeah) just like you got to know them. (Yeah)

Knights Wing: Then it, then it all like phased out, you know yeah.

Knights Wing acknowledged his awareness of negative stereotypes in general about African-Americans in larger society (e.g. representations of African-American males in movies, television, and social media) but explained how they just “phased out” or went away as he and teammates go to know each other through personal interactions. However, Knights Wing also made comments that suggested that he felt more challenges in addition to being stereotyped:

Interviewer: So, did you feel obligated like you had to kind of you know, kind of get rid of some of their stereotypes about you know, Black men, or Black people in general?

Knights Wing: Did I feel like I had to? I don't think I felt obligated. But I, I just kind of felt, I've been through, in freshman year, I went to one of the meetings, things, an organization called [program name] or something. And uh, it's for like Academic something, students, I don't know. Anyway, umm, and I went to that and they were, they were telling like Black males are so there's only a certain number of you here. So, you should always, I mean like, don't always be on your best behavior, but keep in mind that what you do, like affects the rest of us here. Yeah, and I was like, oh, that's a very good point. It's a very good point. I mean, I had nothing to fear, 'cause I won't do bad stuff. I'm a good kid. Good man, but um, I don't, it's just I want to represent us in the best light, if that's possible, yeah. So, yeah.

Knights Wing highlighted the small number of Black males on campus and believed his behavior would be considered reflective of his entire social identity group, African-American males in

academic situations. That is to say, he was already aware of the stereotype and described not wanting to represent “Black males” in a negative way. As a result, the meeting made him aware of potential impacts of his actions on other African-American men, which in turn reinforced his efforts to disprove the negative stereotypes.

Phil also mentioned that the negative stereotypes are just something “Black males have to deal with” and described adopting a proactive approach:

Interviewer: Do you, personally you feel like your race has impacted your team experience at all?

Phil: Um, I don’t know quite know. Hm, I don’t really know exactly. It’s not simple to answer it correctly. ‘Cause a lot of the teams I get on there are kind of like a preconceived notion of how like a Black person will act in class. So when they see me they’re already kind of surprised. So they spend like a lot of the time trying to figure me out. So they constantly try to like be around me to figure out like what my plan is. What I’m doing. Kind of who I am in a way. And that I end up like kind of leading them because they’re following after me. So that team dynamic of being a leader is kind of like there from the beginning a little bit.

Interviewer: Because, because your teammates are trying to figure you out? (Yeah) Okay.

Phil: They’re already watching me, so I’m like okay let’s do this and they’re like alright, we’ll go along, see how it is.

Interviewer: Okay, and, and so how did you feel about that? Kind of like you know, they’re coming into it kind of watching you and trying to figure you out. What, what does that mean to you?

Phil: I got to be on my toes.

Phil’s comments are a clear example of his awareness of stereotypes and proactive approach to not reinforcing them. For him, leadership opportunities were a direct mediating factor in his satisfaction with the team experience.

In addition to proactively responding to being stereotyped, some participants experienced negative emotional reactions. Jake was the most articulate about negative emotions when he explained:

Interviewer: ok. And you feel like, do you feel like, you always have to do that? Just kinda, set it up, like, like you said, you know, I'm here to do work just like you are? (Jake: yeah) and you feel that you have to do that?

Jake: yeah, it's, it hurts sometimes, like just thinking about it but, it's true. I do, I always do feel like I have to like, can I prove myself, just cuz of being a Black male and stuff like that. It just (big sigh), is just tough sometimes, cuz you always, I always feel like I'm judged. Not judged, but like, you, you'll just get this feeling, like, I don't know. Like, not beneath them, but like you just, I don't know. It's just, I feel like it's just stereotypes really, do, do a number on us. And (big, big sigh) I don't know. I don't know really how to put it in words, I just know it's good feeling after, make sure that, I'm not, I'm not looked down upon, before I get myself to prove myself. Stuff like that.

Jake expressed how the negative stereotypes make him feel. Even more concerning, Jake appear to have internalized the negative stereotypes based on the combination of his statements.

4.5.2 Interdependence

The second unique theme, expressed by three participants, described making collective use of each team member's knowledge, skills or abilities (KSA) and emphasized the interdependence among the team. The theme included both mutual cooperation, in which individual goals support the overall team goal (i.e. common goal), and a need for intergroup collaboration to achieve project completion. Interdependence emerged as a major theme for three participants who studied computing fields (e.g. computer science and computer engineering), and they all stressed interdependence was essential to programming projects due to the nature of the work. The following excerpt from David's interviews best illustrates this point:

Interviewer: Did each team member; were there separate roles on the team?

David: I wouldn't say so. A lot of it had to be done together. There were some things we can do separately, but a lot of it, had to be done, like together. To be understood, to be real, you couldn't really separate it, as far as that.

Interviewer: And how did that work out?

David: Uhh, it was fine. I mean we just meet up together, and we just, all like, struggled together, I guess, with the problem. Like we do use this program and we just all like, look at one person screen and try to like, mess with different things, to improve or, yeah, for our experiment.

David described how his team worked through the problems collaboratively and sat alongside each other to enhance learning and improve project results. In his third interview, David further clarified these points when he stated:

Interviewer: Okay. So, just in general, like how would you describe how you interacted with your team members?

David: Uh, we'd go over to one of their houses and then uh, all get our laptops out and just talk about what the next step to do with, and then work on it and maybe split things if we have to. Or if we could, but some things you can't really split. So, we'd just work on it together.

David stated that his team chose to be physically collocated to work with each other because they were unable to designate isolated tasks. The other two computing students also described benefits of working on an interdependent team to complete a project in their department. Clay explained it this way as he spoke about his long term CS partner that he considered a friend:

Interviewer: So, I mean he's your friend, but how would, how do you all interact?

Clay: Umm, when were working, it's pretty serious. We like communicate back and forth pretty constantly to try to and, a lot of times we'll do pair programming, they call it, where one person sitting down typing and the other person's like talking to the person, like bouncing ideas back and forth. So, that's kind of how our communication goes a lot of the times. And if we're working on separate computers, we'll be sitting right next to each other, so. We almost always like work physically right next to each other, cuz then it's easiest to communicate different issue and such.

Clay emphasized physically sitting next to his teammate or being collocated. Furthermore, Clay identifies “pair programming” as a common practice in programming that occurs within the CS department. Later in the third interview Clay discussed the interdependence as follows:

Interviewer: Okay. So you think with three like, with three or more people, you need to, people need to have roles. (Yeah) Okay. That’s interesting because people talk about it differently, so. Okay. And do you think it’s related to the nature of the work?

Clay: Yeah, I, I do. I think it is. Um, I would say at least when it comes to coding I think that’s true, but I don’t know about, I mean, I haven’t been like every kind of situation obviously in teamwork and what works best, but I would say when, at least when it comes to like my field if there’s, if there’s three or more people. I think it tends to be better if there’s like a leader and then like people take different roles rather than just like doing task by task because fitting all the code together can kind of be a mess if it’s just like task by task people are doing. But, with other disciplines, it might, it might be different... Because at least with coding, you can be both working on the same part at the same time, if you’re both like on the same, like you can both be working together on the same computer, like bouncing ideas back and forth so it’s not necessarily important to do it that way, but I think you can be a little more efficient if you do it that way. (If you divide it up) Yeah. I think that can be a little more efficient. But, then if you do divide it up, you might have a little bit of difficulty combining code, so, they both have their benefits and downsides.

Clay viewed the team size as impacting the need for roles versus dividing work by task. Also, according to Clay, dividing task may be more complicated to do with the nature of CS work, and can also complicate efforts to combine code. Furthermore, Clay thinks being collocated and working on code is more efficient as the teammates work through coding challenges together.

Another example of how participants described a benefit of interdependence was articulated by Harbor when he described it as a means to ensure the accuracy of project results:

Interviewer: So has your view of teamwork, in terms of how it's going to impact your engineering practice, has that changed at all?

Harbor: uhh, no, I've always thought teamwork would be pretty important (ok) in engineering work, because doing the work alone, leaves a lot of mistakes even though they can be minor but, it will still hurt in the end.

Harbor suggests that having teammates check each other's work is a benefit of collaborating to minimize mistakes. Harbor also emphasized the nature of work in the computer engineering department and also spoke about learning coding practices from teammates. Therefore, all three participants that discussed interdependence as an emergent theme discussed multiple beneficial aspects of their multiracial student team being interdependent.

However, other participants did not describe benefits of interdependence and took a "divide and conquer" approach to dividing work. For example, Phil stated,

Phil: It's like we give each other, like little jobs to do. And then they all get it done, so when we come together it's like, "oh, we didn't TALK about what we were doing." But it's all finished, we just gotta put it together... We split it up; there're usually about eight parts to each report, We go okay, I'll do one through three, and somebody else will do like five through eight or something like that.

Phil described his team members collectively assigning tasks, each team member taking a discrete task, and the group coming together to combine the separate parts. In other words, Phil's team chose to divide and conquer the work for the project, which is counter to the benefits of interdependence described by other participants.

4.5.3 Summary of Themes

Table 8 summarizes the final common and unique themes across participants

Table 9: Operationalized Themes Definition Summary Table

Theme	Operational Definition	Brief Quote
Common Themes		
Positive Personal Interaction	Voluntary informal interactions with the team as a group that required self disclosure	"Probably during our first meeting, where we're just like, started discussing what we're going to do. How we're going to do things. I think we got sidetracked, started talking about other things, then we just, yeah, just became closer as a group." _Harbor
Lack of Friendship Opportunity	Failure to develop empathetic (caring) personal relationship with an individual out-group team member that develops over the course of the contact situation or team project	"I think everybody's acquaintance. If I can be blunt, yeah, everybody's, everybody's an acquaintance. I mean, we all, everybody has different personalities. I mean, I didn't really find any common ground between them." _Jake
Indifferent Faculty/TA interaction	Neutral to positive, but largely inconsequential, interactions with teaching staff (faculty and TAs) overseeing the team project	"We just asked him how to do things or like, explanations on the questions on the worksheets, but apart from that, there wasn't really a close interaction with the workshop leader." _Sterling
Conflict	Team process conflicts characterized by unmatched expectations about professional behaviors, resolved through direct discussion	"During the first meeting, he was working on his, umm, homework, I guess. Or whatever, for math and he wasn't really, he would contribute stuff with the group, but it was like, it was a little distracting, because he would be doing his homework like while we're talking. The first team meeting, all I saw was him putting his homework before the groups." _Jake

Unique Themes		
Stereotype Awareness	Situations in which a widespread negative stereotype about a group negatively impacts the performance of an individual who identifies with the group (AA)	"I already feel like I have to prove myself, being a Black person, and then you know, first being Black male, because of the stereotypes of people from the high school. Yeah, it's, it hurts sometimes, like just thinking about it but, it's true. I do, I always do feel like I have to like, can I prove myself, just cuz of being a Black male and stuff like that. It just (big sigh), is just tough sometimes, cuz you always, I always feel like I'm judged." _Jake
Interdependence (Computing)	Mutual cooperation among team members where goal attainment requires intergroup collaboration (not only individual efforts)	"A lot of it had to be done together. There were some things we can do separately, but a lot of it, had to be done, like together. To be understood, to be real, you couldn't really separate it, as far as that." _David

As described in Section 4.2, data collection included background information about participants (family, prior cross-race interactions) as well as year in school and team characteristics (duration, formation). No distinct patterns emerged between the personal/team characteristics and the themes, though several potential patterns are worth noting:

- Not surprisingly, the number of team experiences increased with academic level. That is, freshmen had fewer team experiences than the seniors. Moreover, one participant specifically identified academic year as a potential factors limiting friendship opportunities, though the lack of opportunities emerged as a theme for participants across all academic years.
- Almost all participants had parents or siblings who had earned college degrees (and some had engineering degrees), which may have provided some of the social capital (J. P.

Martin, Simmons, & Yu, 2014) these participants needed to successfully navigate their team experiences. In several cases, moreover, parental education/occupation appeared related to participants' choice to study engineering. For example, Clay studied computer science because of his father's work with the military.

- Although I did not specifically ask for socioeconomic status (SES) all participants described their background as middle class and all participants took pre-college AP courses and typically had prior experiences as one of only a small number of African-American students in those classes. Most participants had also grown up in mixed-race areas and/or attended mixed-race schools. As with parental education, these experiences could have supported participants' abilities to navigate the team environment.
- Last, most participants were on teams formed by their instructors. As result, some of the emergent themes such as the lack of friendship may be related to the fact that teams were selected by an authority figure (faculty or TA) rather than by participant choice. The fact that the one counterexample for this theme, Clay, worked with a teammate he selected reinforces this potential pattern.

As noted, however, no clear patterns emerged that would suggest causal relationships between family, education, or team characteristics and the emergent themes. Instead, these factors indicate future areas to explore relevant to the perspective the participants brought to the team experience.

4.6 Team Experience Related to Identity (RQ 3)

RQ3: How do the experiences of African-American engineering students on multiracial teams relate to their sense of identity?

In this section of the results, I summarize the ways in which the participants discuss their team experience in terms of multiple dimensions of their identity. In this analysis, I considered

both racial and professional identities, as both emerged as salient within the team environment to varying degrees. Specifically, while the salience of participants' racial identities both overall and within the team varied, as suggested by the previous discussion of stereotype awareness, professional identities associated with leadership were salient for most participants. In addition, particularly for those participants who demonstrated heightened stereotype awareness, these leadership identities became key tools in mitigating the potential impacts of negative stereotypes.

4.6.1 Racial Identity and Team Experience

Racial identity was operationalized in this study as including both the degree to which the participants self-identify as African-American and the salience of race within the specific situational context (i.e. the engineering team) (Shelton & Sellers, 2000). Because the study did not include any direct measure of racial identification, racial identity was evaluated qualitatively based on the frequency of race mentioned in responses and the corresponding comfort of each participant discussing racial issues. Thus multiple direct declarative statements such as "I am an African-American" and multiple references to family or personal emphasis of race were interpreted as evidence of a strongly salient racial identity. Conversely, statements such, "I don't see race" or "race doesn't matter to me," as well as few or no discussions of race other than in response to direct questions (i.e. Question 11 in Interview 3) were interpreted as evidence of a less salient racial identity.

The salience of race (i.e. being an African-American) overall, reflected in both the frequency and the intensity of comments about race across the three interviews, varied among the participants, but when asked directly, they typically did not believe race influenced their interactions with teammates or with the faculty or TAs responsible for their team. For example, the salience of Zion's racial identity was less pronounced relative to the other participants in that

he did not speak often about race and tended to brush off the issue. Like most participants, he did not perceive his race as impacting his team experience at all:

Zion: Okay, well, there's only three African Americans inside my school year graduating. And um, two of them are on the same team, which is my team.. So I don't think it has impacted my, my ethnicity you know, being involved in anything. Everybody respects me to the same level as anybody else. We joke. Everybody jokes, you know. Females in engineering, uh, African Americans in engineering, you know, whatever, uh, even the white male in engineering. But, it's [his race] never impacted, I don't think ever.

Zion did observe that he was one of a few African-Americans in his department, but felt he was respected at the same level as his other teammates. He also compared being an African-American to women who are also underrepresented in engineering. At the same time, his comment about the way "everybody jokes" highlights his awareness of his status as an underrepresented minority.

Harbor, although his interviews reflected a medium level of racial identity, reflected in more frequent general comments about race across his interviews, made similar comments suggesting that race didn't impact his team experience:

Harbor: Um, not my team experience, but in the class there, I think I was the only Black person. So, as for building like a community with people of my race in the class, it's quite low.

Although Harbor stated that race did not impact his team experience, he did see its impact on his experience in the larger community of his department. Not only did he notice he was the only "Black person" in his class, he also interpreted that as a barrier to building supportive social community.

Finally, Sterling illustrates those participants who had a highly developed racial identity, but also did not believe race impacted their team experiences. He explained:

Sterling: Actually, it did not. And I was sur- I kind of, I expected some sort of stereotypical like things. But, no, it was, it was race-free. I mean, it was pretty chill.

Yeah, I liked it because I did not, the fact that I'm Black did not mean anything in our team dynamic. At least as much as I know of. It did not mean anything.

Sterling spoke freely about race across his interviews and articulated the importance of being an African American multiple times, but he did not explicitly consider race a factor in his team dynamics.

Although the participants did not directly link their race to their team experience when asked, across their interviews they did describe raced interactions within the larger community in which the teams operated. For example, participants often noted that they were “the only” or one of a few African-Americans in their engineering course or department, and those recognitions often came with an awareness of the stereotypes about African American men not being “good” at engineering. One participant even noted that some students were “surprised” to see him class, suggesting the kind of raced social cues embedded in the engineering context. As discussed in Section 4.5.1, this stereotype awareness suggests that participants recognized that the team experience occurred within the bigger social context of engineering and site-specific factors such as the strong engineering reputation that valued high academic achievement. This awareness of racial stereotypes in the larger departmental, university, and professional communities influenced the behaviors and interactions of the participants, as suggested by the previous sections. .These behaviors included not seeking help from faculty or peers, and for those for whom stereotype awareness was relevant, proactively demonstrating a strong work ethic and/or leadership capabilities, as described in the next section. Thus while participants directly stated that race did not impact their team interactions, the larger raced dynamics of their departments often shaped how they approached their team experience.

4.6.2 Leadership Identities

While participants varied in their level of racial identity and stereotype awareness, most participants both saw themselves as leaders and saw leadership as an important component of team experiences. The participants considered leadership important to engineering teams and it influenced the roles and activities within their teams. They associated leadership with setting the mindset for the team, getting work done, and being productive. At the same time, they recognized that leadership could move around within a team and expressed comfort with shared or collective leadership as a means to manage their multiracial student teams. Second, and closely related to the racial identity of the participants, some participants responded to their awareness of the negative stereotypes about African-Americans in engineering by monitoring their level of engagement with the team project and strategically taking leadership roles, suggesting that their professional identities as leaders was used as a way to mitigate any potential negative impacts associated with their racial identities.

Below I begin with a few illustrative statements by the participants regarding the impact of effective leadership for their student teams. Clay, for example, described the role of the leader in establishing the team goal:

Clay: Usually there's one person who will more so take the lead, whether it's me or someone else. And from there, all the members have, like we all, like the leader, you know sets the mindset for everyone else of like where our goal is to go to.

In setting the “mindset” for the team, Clay believed that the leader, a position he was comfortable taking, establishes the expectations for team member behaviors and dynamics, which in turn directly impacts the overall team functionality and performance. Similarly, Zion described his inclination to take a leadership role, again emphasizing the need to have a leader who can move the team forward:

Zion: Um, my whole life, up until recently, I've always tended to take leadership role. Okay. I was never a background kind of guy. I'm a talkative, go getter and, I could like, I didn't mind taking background if I saw somebody else step up. But I don't like seeing um, I don't like seeing nobody step up, so that's when I would. On groups when I'm not the team leader, I will sit back and I won't tend to do much, unless I'm told to. ... In a group project where the grade is dependent on everybody in the class, if I see something not getting done, then I'm going, I'm going to do it, regardless of whether they say don't or not. I got it.

Zion would allow others to step up, but if another team member was ineffective then he would step up and take over the leading responsibilities. He associated leadership with getting the work done and making sure that he got an acceptable grade. Finally, Clay related leadership of his engineering team with personal productivity:

Clay: A leader mainly has to, you have to lead by example. 'Cause you can talk all you want, but if you're not doing it, then, you're not really, you're not being an effective leader. So I would say one of the biggest things actually is like probably lead by example and be the, if not the hardest one like definitely one of the hardest workers on the team. So being a hard worker, I'd say is yeah, that's probably also one of the biggest things for a leader, unless you want a very unproductive team. 'Cause if the leader's not productive, who, like, how can you expect the team as a whole to be productive?

Clay described an effective leader as someone who leads by example and establishes the expectations for the team productivity. In support of enhanced team productivity, however, participants also recognized that different team members can lead at different times, as Zion explains:

Zion: I certainly do think that what I've done and what everyone else in my group has done um, you know, I, I do think of myself as one of the team leaders still, specifically because, I am a strong um, in, I'm a strong minded individual. I'm a very assertive individual. I have the ability to assert but at the same time not be in charge. I think that's huge. Um, because you have to recognize how everyone is. Um, you can't make anybody do anything.

Zion considered himself strong minded and assertive, but also understood that sometimes being a productive team member also meant stepping back to acknowledge the abilities of his teammates. Clay saw similar opportunities for sharing leadership:

Clay: To me, teamwork, well, I think it has to have a leader, because without a leader, it could go off in a lot of different directions. And it doesn't necessarily have to be one individual, but it definitely needs leadership. Whether it's from one individual or multiple people. Um, it has contributing members, productive members. All who are looking towards the same goal.

While leadership emerged as an important dimension of professional identity and team dynamics for most participants, it was particularly salient for those participants who showed strong stereotype awareness. As mentioned in Section 4.4.1, these participants proactively attempted to disprove the negative stereotypes such as laziness or not contributing to the team project, often by adopting leadership roles. Recall that Jake explained why he chose to be extremely active and took a leadership role during the early stages of his engineering team experience when he said:

Jake: And I, I just, I hate that stereotype. So I already, before I even get in a group, I always want to make sure that, that stereotype is already thrown out the window. And that's why I like to take the leader role, because I feel like that's the best way to prove, that hey, I'm here to work. I'm here to get that "A" just as much as you are. And, when I walked to the group, they seen me like, seeing my like, "Oh, he's not going to do any work." That's why, and maybe they were thinking it, but they were very well not showing it.

Later in the interview Jake further explained:

Jake: Yeah, yeah, that's why I say, I really initially, started off strong. So that they already know, okay, we can count on this guy. He's not going to be a dead-weight. I can count on this guy to actually contribute.

In his statements, Jake explains that in early stages of his team project he wanted to establish himself as a leader and an active member of the team that his teammates could count on. He sought to avoid being "dead-weight" or reinforcing negative stereotypes.

In Phil's case, however, the negative stereotype moved him not toward the leadership position but toward the "second" position:

Phil: I don't know. There's enough to like, if you see what needs to be done you can get people to do it, you can, I guess, if I'm like the second person, then I can do what I need to do, and if I see something that's like, it really needs to be changed, I can get enough people together, they can change it. But the leader has a lot more stuff they have to take, I guess, more responsibility, something goes wrong, it's their fault.

Unlike the other participants, who were generally willing to be a leader or part of the shared leadership as needed, Phil wanted to avoid taking that dominant leadership role so that he was not responsible if the team fails or if "something goes wrong." At the same, he was comfortable being "second in command" to "do what I need to do" and get the project task completed.

In general, then, the participants described both the importance of leadership to the engineering team experience, as well as their own comfort in stepping up to those roles as needed. This connection between adopting leadership roles and disproving negative stereotype reflects a complex interplay among participants' professional identities as leaders, their racial identities, and the team experience.

4.7 Results Chapter Summary

This chapter summarizes the results of my dissertation study with respect to the three research questions. The chapter began with the background context and participant profiles. Next, in response to the first research question, the structural and textural statements summarized how this group of African-American male engineering students described their experience on a multiracial student team. Overall, the participant described their team experience as group project with 2-6 team members and emphasized informal personal interactions that supported professional communication and teaming behaviors. The emergent themes then answer the second research question, focusing on the social dynamics of team interactions, the lack of

friendship opportunities, the indifferent interactions with faculty, and conflicts associate with unmet expectations. As explained more fully in Chapter 5, these results suggest that the required conditions posited by intergroup contact theory research do not fully incorporate the perspective of interracial interactions described by the participants in this study. With respect to the third question, the participants expressed a range in the salience of their racial identity, and while none perceived their race as an issue in their team experiences, most identified raced interactions in the larger context of their department or institution that shaped how they initially approached the team experience. In this respect, professional identities associated with leadership and hard work were critical tools for mitigated potential or perceived negative stereotypes.

4.8 Data Limitations

As with any study, the data collection and analysis processes results in some limitations regarding these results. As with any phenomenological study, the results presented here necessarily represent the experiences of the study participants only, and while those results have implications for mixed-race student engineering teams broadly, the limitations are important to note in terms of both the transferability of the results and directions for future research:

First, the study includes only the perspective of one minority participant, not perspectives from the entire team. As a result, the team dynamics described the participants may be viewed differently by other members of the multiracial student team. For example, what the participants perceived as positive personal interaction could be a source of conflict or inefficiency for other team members. Similarly, these participants may have emphasized team interactions that other team members may regard as unimportant or excluded interactions others may see as critical to team dynamics in making meaning of the team experience.

Second, data collection lasted for a single semester (even for projects that spanned two semesters), which provided only a snapshot of contact and interracial attitudes and not a longitudinal investigation to verify persistence of positive intergroup positive attitudes (Pettigrew & Tropp, 2006). Also, some positive outcomes of intergroup contact can be missed with a short evaluation period of time (Phinney, Ferguson, & Tate, 1997) and a long term project can start to provide evidence of sustained positive impact of ICT.

Third, participants' level of racial identification was not measured prior to or during the contact situation, limiting the evaluation of participants' level of racial identity upon entering the contact situation (Hammack, 2010) to qualitative comments made during the interview process. As a result, I was unable to analytically determine if or how the team experience altered the salience of race for each participant's.

Fourth, the study may have excluded African-American engineering students not comfortable discussing their race. The initial solicitation and study description framed my study as exploring the impact of race in the context of student teams within engineering. As a result, self-selection may have limited the participant pool to those who already felt comfortable talking about mixed-race experiences and/or were already successful on mixed-race teams. The participant profiles, as noted above, do indicate that this group was relatively homogenous in terms of prior cross-race interactions and pre-college academic experiences, as discussed previously.

Fifth and closely related, the background information for participants could be analyzed more deeply to better understand how prior experiences shaped these participants' approaches to their student engineering teams. As described early, no discernible patterns emerged between

specific background characteristics and specific themes, but the participants were relatively homogenous with respect to socio-economic status and prior cross-race interactions.

A final consideration and potential limitation in replicating the study is my own relationship with the participants. As an African-American engineer, I was able to relate to the participants regarding their experiences in engineering and I was able to establish a rapport that allowed us to discuss some of the challenges associated with being an African-American engineering student at a predominantly white institution. For example, the participants appreciated the fact that I could relate to their struggle in being one of a few African-Americans in their engineering department, which may have made that issue easier to talk about for them. Also, as the participants articulated challenges of being an African-American male and the corresponding stereotypes, I was intentional in emphasizing my desire to accurately capture the essence of their experience and tell their story. In particular, when they communicated surprising details about their experience, I was able to mute my reaction to the information and focus on understanding rather than judging the merits of the information, which again supported their ability to talk in detail about those experiences. Finally, I reminded the participants numerous times about my efforts to ensure their anonymity, which gave them confidence to speak freely. The multiple ways in which I connected with the participants and promised to protect their identity was critical to the overall study because it fostered an open and enlightening discussion about their experience to occur over the course of the project.

These limitations and considerations provide specific areas to explore in future work, as described in Chapter 6.

Chapter 5: Discussion

5.1 Discussion Overview

This chapter synthesizes the results in Chapter 4 to my overall research question:

How do African-American males experience multiracial student teams in engineering?

The phenomenological statement, which integrates the textural and structural statements, is the primary result of the phenomenological analysis and thus explains the overall common experience of the group of key informants. As noted in Chapter 3, however, this statement is also nuanced by my analysis of the saliences of different identity dimensions within the team experience.

Following the phenomenological statement, the discussion chapter demonstrates how the results presented in Chapter 4 add to the current literature on the theoretical frameworks guiding the study, intergroup contact and multiple identities. I situate the results in broader context of prior research related to each of the major themes. First, I discuss the four common themes and two unique themes in terms of how they expand and contribute to relevant prior research. I then explicate the relationship between the participants' team experiences and their sense of identity, again focusing on the relevance of the data to existing literature on the experiences of African-American engineering students on multiracial student teams.

5.2 Phenomenological Statement

Within the interviews, the multiracial student team experience was significant to the participants in terms of their academic environment and multiple dimensions of their identity. The participants used words such as “constant communication”, “collective thinking”, and “choose what our team was good at” or “feasible approach” to articulate what they experienced

while working with students from different races. This group of African-American males generally described their teams as functioning effectively, with professional communication among team members, but expressed varied levels of engaging in interactions beyond team activities. All participants emphasized personal interactions as essential to their team experience. Specifically, they described the ability to interact with teammates beyond project work and thus get to know them personally in ways that expanded their perspectives on the behaviors and approaches observed during team activities. Typically, however, these interactions were confined to informal “whole team” socializing within and around team meetings. Interestingly, these informal personal interactions were related to professional communication among team members. For example, hanging out with teammates and engaging in personal interactions supported the professional communication.

Generally, from an emotional perspective, participants enjoyed these opportunities to “get to know” teammates on a personal level, but some negative interactions and social cues prevented this informal socializing. As a result, the willingness to engage in personal interaction varied by participant, and required the participants to feel comfortable exchanging personal information with teammates. And while self-disclosure in group socializing was common, the opportunity to develop close individual friendships with team members was absent for most participants. This lack of friendship was expressed in multiple ways as participants cited “different personalities” and a lack of “common ground” that inhibited friendship opportunities.

Despite the general positive team climate, however, almost all participants described some level of interpersonal conflict around unmet expectations regarding “appropriate” team or professional behavior, but most were able to resolve those conflicts directly and did not consider them significant problems that prevented team functioning. For example, participants described

actions taken to support professional behaviors that included changing the meeting location and staying on task during team meetings to avoid peers doing work for another class during team meetings. Thus while participants included both positive and negative characteristics of team experience, all had a positive disposition toward teaming in engineering, saw the value of teamwork, and felt confident they would be able to perform in similar environments as a professional practicing engineer.

While peer interactions were predominantly positive, though, the participants described generally indifferent interactions with the faculty supporting their team projects. Overall most participants did not express strong feelings about their interactions with faculty or TAs and did not consider them significant elements of the team dynamics. One participant was able to develop positive relationships with faculty, but others had minimal contact within the team and more broadly either avoided faculty within their department or experienced some negative interactions. The negative faculty interactions caused specific feelings such as anger and sadness for being singled out in class or pleasure in disproving a negative stereotype. But typically these negative interactions were outside the team experience and led to specific emotions by the participants, who otherwise generally held neutral feelings about their interactions with faculty responsible for their multiracial team.

Finally, participants typically described equal status within their multiracial student team, which some characterized as “race-free,” but they also described experiencing microaggressions within their department or the university that contributed to stereotype awareness and shaped the larger social context in which the team experiences occurred. Multiple participants described their proactive effort to disprove negative stereotypes about African-Americans in engineering. Whenever possible, the participant turned being stereotyped into a positive interracial interaction

as they directly addressed the stereotype through taking on leadership positions, intentionally demonstrating their willingness and ability to contribute to the team from the start of the project, or directly discussing the stereotypes with those involved. Specifically, multiple participants articulated their approach to take a highly engaged position on the team such as the leader to offset any stereotypes their teammates may or may not have held. Even so, participants expressed feelings of isolation where they were “one of” two or three African-Americans within their department and their classes, which reinforced stereotype awareness. Despite these racial challenges, all the participants felt they had allies to support whatever difficulties that arose during their multiracial student team project, as well as during their engineering education more generally.

In summary, the combination of the answers to my research questions led to detailed phenomenological statement above as the answer to my overarching question. Based on my study results, there are three ways to characterize how this group of African-American males experienced their multiracial student team in engineering. First, the participants had a successful team experience, including some conflicts that they managed effectively, and they maintained a positive disposition about teaming in engineering. Second, the common themes for this group of African-American males are positive peer interactions and neutral interactions with faculty, but they directly addressed racial stereotypes they felt existed in engineering and identified a lack of opportunities for individual friendships beyond the project work. Finally, the team experience was related to the participant’s sense of identity in that stereotype awareness often shaped their actions and roles they choose to take on the team. Overall, the participants expressed how they dealt with being stereotyped, but experienced positive or indifferent interactions while on their multiracial student team.

5.3 Emergent Common Themes Across Participants

The essence of phenomenon is captured in the phenomenological statement which was developed from the textural and structural statements in section 4.3. The textural and structural statements summarize the common themes that emerged from the data analysis for this group of participants. The following is a detailed discussion of each emergent theme that contributed all summary statements (textural, structural, and phenomenological) to characterize the essence of the lived experience.

5.3.1 Positive Personal Interaction

Personal interaction is defined by intergroup contact researchers as voluntary experiences with out-group members that can be formal or informal encounters that result in cooperation (Dovidio et al., 2003; Pettigrew, 1998). In my study, personal interaction was operationalized as informal social communication among team members that required some level of self disclosure and was linked to professional communication. In other words, personal interaction included all participant-team interactions and interpersonal communication that influenced cooperation within the team. As a result, the emergent theme of positive social interaction linked to professional communication and team dynamics is consistent with and adds to current ICT literature.

First, all participants were generally comfortable with cross-race interactions during their team project. In particular, the participants did not articulate anxiety heading into the multiracial team situation, which suggests their previous cross-race interactions were either neutral or positive – a suggestion supported by the background information provided by each participant. The previous interracial contacts are important because research has shown that early adolescents in more diverse neighborhoods (i.e. experience intergroup contact early in life) had more close

friends with members of out-groups (Phinney et al., 1997). In other words, since most participants grew up in a mixed race communities, they were more likely to engage in cross-race relationships, including positive personal interactions. Therefore, the emergence of the willingness to engage in personal interaction, which was essential to the team experience for these participants, is consistent with previous intergroup contact studies that suggest positive previous contact influences minority groups' willingness to engage in new intergroup contact situations (Binder et al., 2009).

Second, multiple participants made comments about cooperation that fostered positive interactions. For example, David made comments about a positive team culture and Sterling discussed how supportive his team was in "covering for each other." Such cooperation and related positive interactions have been related to team effectiveness (Brannick, Prince, Prince, & Salas, 1995; Campion, Medsker, & Higgs, 1993). In addition, the positive personal interactions described by the participants reflect positive intergroup contact, where the interactions reduced anxiety and increased empathy. The positive cross-race personal interactions described by the study participants are consistent with the majority of intergroup contact research that suggest intergroup contact leads to more positive attitudes about cross-race interaction (Pettigrew, 2008; Pettigrew & Tropp, 2006; Pettigrew et al., 2011).

Third, as with any social interaction, these personal interactions were generally enhanced over time. For example, Clay described how his team's social relations developed and they became more familiar with each over the course of the longer time period allocated for his team project. In other words, he got to know his teammate better during longer team projects. Similarly, over the course of Harbor's team experience, his personal interactions changed from neutral and innocuous to more intimate and comfortable. Social science researchers investigating

intergroup contact also support the idea that time is critical factor for developing positive personal interaction in a contact situation. In fact, previous research connected the time dimension with different developmental stages and desired outcomes predicted by intergroup contact theory (Pettigrew, 1998). Also, extended contact encourages reduction in intergroup anxiety and avoidance behaviors (Davies et al, 2011). Therefore, the enhancement of personal interactions over the duration of time in a team project is predictable given that research has shown team function as a developmental process as well (Tuckman, 1965).

Fourth, participants' descriptions of their team interactions align with previous research that identifies self-disclosure as a mechanism that supports and mediates personal interaction. Self-disclosure is defined as voluntarily providing personal or private information to another persona that leads to positive perceptions of interpersonal relationships (N. Miller, 2002; Turner et al., 2007). In my study, self-disclosure includes informal communication, comments that suggest relaxed interactions, and "getting to know" team members beyond the context of the project, and it was related to the personal interaction when the participant's disclosure extends from a single team member (or friend) to the entire team. For example, Clay explained how important self-disclosure and expressing thoughts were to his team interactions, and how that self-disclosure ultimately influenced his overall team experience.

Self-disclosure contributes to the knowledge about the out-group. In particular, evidence of self-disclosure in the study includes multiple statements suggesting participants were "getting to know" their teammates better as the project developed. Becoming familiar with and learning personal information about teammates beyond the context of the team project, as described in Section 4.4.1, was common across most participants. For example, Harbor mentioned "talking about other things" beyond work that provided the opportunity for self-disclosure, which

impacted his team experience as they became “closer as a group.” Although this self-disclosure may not have reached the depths needed for individual friendships (as described in the next section), most participants were able to share enough personal information to support a generally friendly, social dimension to the team’s overall team functionality. Cognitively, controlling the communication during team meetings can produce new information about out-group members that challenge stereotypes and can lead to reduced anxiety. In other words, self-disclosure can lead to greater empathy for out-group members.

Additionally, researchers have connected self-disclosure to positive intergroup interaction with outgroup members through self-outgroup overlap. Self-outgroup overlap is defined as the projection of positive traits that include out-group members based upon re-evaluation and increased perceived similarity between out-group members and self-concepts (Stathi & Crisp, 2010). In other words, self-outgroup overlap is the perception of positive commonalities between oneself and out-group members, and it reduces the perception of difference. Self-outgroup overlap is mediated by self-disclosure, which can enhance empathy by broadening perspectives, and it emerged in the data in multiple ways. For example, Phil described how he had to learn to engage with teammates and communicate more effectively by “being open” and “less formal,” which in turn increased the positive team climate. Such choices to be more open and less formal are consistent with previous research that suggests that self-disclosure that leads to self-outgroup overlap mediates positive cross-race interactions.

At the same time, not all participants wanted this social team interaction. Zion found that by focusing solely on work during team meetings, his multiracial team was able to avoid bringing up personal issues that could hinder their productivity. In this case, the team moved the location of the team meeting to a more public setting to directly limit the degree to which team

members relaxed and talked off topic. Such avoidance of personal interaction could be linked to intergroup anxiety in that participants who have such anxiety may avoid interaction that required self-disclosure. Zion never mentioned any changes in his perception of the team's personal interactions, which suggests his anxiety during the contact never decreased.

5.3.2 *Lack of Friendship Opportunity*

The second common theme across participants was the lack of friendship opportunity for participants with other members of their multiracial team (i.e. out-group members). Friendship opportunity is defined by social science researchers as familiarity and intimacy with an out-group member that builds over time and provides increased appreciation of the relative attractiveness of out-group members more generally (see Table 8) (Pettigrew, 1998 & Dovidio, 2003). Similarly, friendship opportunity was operationalized in the data analysis as an empathetic personal relationship with an individual out-group team member that develops over the course of the contact situation or team project. Personal friendships with outgroup members can produce several positive interaction outcomes, including increased tolerance for and perceived attractiveness of the outgroup, and multiple recent studies on intergroup contact emphasize the need for members to have the opportunity to develop friendships as a mediating factor for positive contact (Gould, Denton & Troop, 2008; Levin, 2003; Dovidio, 2003; Davies et al, 2011; Gould & Denton, 2011). However, in this study the lack of friendship opportunity emerged as the theme and referred to the diminished prospect of *individual* personal relationships between the participants and their team members over the course of the project.

As a result, the data in this study contradict findings from intergroup contact research that suggests cross-race friendships are essential to positive intergroup attitudes such as relaxing and a pleasurable work environment. Participants identified multiple barriers to building those

relationships. For example, Jake suggests that dissimilar interest prevented him from developing potential friendships with his teammates. Sterling did not perceive any intellectual or social benefit for developing a relationship outside the project. In part, his lack of motivation to establish friendships may also speak to his perception of his social groups. In other words, since Sterling had an established social group he did not feel compelled to expend the emotional energy to develop a relationship with the members of his team beyond the project. Similarly, David described being more willing to take risks in making friends during the first few years of his engineering education, but now has an established social network that is separate from his academic contacts. David's experience in particular is consistent with existing research that suggests that student groups of many races, including African-Americans, select outgroup and ingroup friends during their 2nd and 3rd year of college based on the ethnic attitudes developed by the end of their first year (Levin, 2003). As a result, academic level may be another barrier to establishing friendships with cross-race teammates.

Despite this lack of friendship opportunities, participants still had successful teams and a positive disposition about teamwork. Equally important, participants did not mention internal or within team competitions. This group of African-American males therefore placed less emphasis on cross-race friendships than previous intergroup contact research.

5.3.3 Indifferent Faculty Interaction

Intergroup contact researchers have defined authority or institutional support as the ways in which the social norms of positive contact are affirmed through local cultural rules (authorities), laws, or customs. It can also include explicit socially sanctioned contact where authorities support established norms of acceptance and tolerance for difference (Pettigrew, 1998; Dovidio et al., 2003). Since the academic staff, including faculty and teaching assistants,

establish the social norms and context for the participants' multiracial student team experiences in my study, these individuals represent the immediate primary authority support for the contact situation. But where intergroup contact theory posits that active authority support for positive cross-race interactions is essential to positive intergroup contact, the participants in this study had predominantly indifferent or neutral perceptions of faculty interactions, yet had generally positive team experiences.

One potential mitigating factor is that teamwork was emphasized in all departments included in the study analysis, suggesting a larger social norm outside the immediate contact situation that may have provided a more distant form of authority support. By collectively teaching students that teamwork is important to professional engineering practice, the departments may be providing a cultural norm throughout the college of engineering. Beyond the college level, this emphasis on teamwork is linked to professional learning outcomes, as described in Chapter 2 (Borrego, Karlin, McNair, & Beddoes, 2013). Given these facts, the emphasis on teamwork within participants' disciplines may be providing the necessary supportive norm. Supportive norms are an original condition that Allport's described as essential to positive intergroup contact (Pettigrew, 1998).

Despite this larger departmental/professional emphasis, participants did not describe that emphasis at the local faculty level. In fact, most faculty interactions were described as indifferent and neutral. Participants typically described generic interaction with faculty during their team project such that faculty responded to the team when they had a question, but typically did not engage in personal interactions or discuss topics beyond the course content. For example, David's neutral comment about his TA was that she would help with programming if needed. Sterling also indicated that he spoke to faculty member only "when needed" for technical

questions. Knight Wing saw the faculty member as a last resort for help after discussing problems with his team. He explored his questions with friends and classmates before coming to ask the professor. Interestingly, one reason Knight Wing may avoid faculty interaction is because of previous negative interactions, and he was not the only participant to describe such prior negative interactions. Participants' perceptions of negative interactions with faculty are particularly critical in light of intergroup contact research findings that emphasize authority support as one of the most important factors mediating positive intergroup contact (Pettigrew & Tropp, 2006).

At the same time, while these interactions were generally indifferent, most participants felt comfortable getting help from faculty when they needed it. From a situated learning perspective, such comfort is essential for engineering education, particularly with respect to the communication practices that engineering students must learn as a transferable skill (Paretti, 2008). In situated learning, faculty model the behaviors they want students to mimic in terms interpersonal communication styles, and thus comfortable relationships suggest at least some level of modeling may have occurred. Moreover, research has shown that the personal connection to faculty that Phil and Clay spoke of can significantly impact the learning of African-American students (Lundberg & Schreiner, 2004) and mediate African-American students' academic performance (Cole, 2010). Establishing professional relationships with engineering faculty can be useful for African-American males on a multiracial student team, although only few participants in this study were able to make these connections. Phil, for example, mentioned getting access to tacit knowledge by talking with the faculty member in charge of his course.

Finally, two other glaring absences in students' discussions of faculty interactions bear mentioning. First, the participants did not mention interacting with Black or same-race faculty, so all the faculty interactions were assumed to be interracial. Despite evidence that suggest that Black instructors positively correlate to Black student persistence in STEM (Prince, 2010), these students all were persisting and gave no indication of academic struggle.

Second, none of the participants spoke of receiving significant feedback from faculty; faculty emerged only as a source to answer questions. Yet research on intergroup relations (Gómez & Huici, 2008) found that feedback provided by authority figures significantly improved outgroup interpretations and perceptions of stereotypes. More specifically, Lundberg & Schreiner (2004) found that African-American students' effort was directly affected by faculty feedback and their overall learning was enhanced with better quality faculty interactions. Similarly, according to Cole (2010) faculty interaction provided African-American students the opportunity to receive corrective feedback and most affected their academic performance, specifically their GPA. Therefore, the absence of critical feedback could be an academic hindrance for this group of African-American males as they progress in their engineering education.

As noted above, one possible mitigating factor with respect to the limited role faculty played in these participants' team experiences may be linked to the larger campus climate. Contact situations are embedded in social institutions and societal norms (discourse about race), and these structural elements have direct impact on the contact situation (Pettigrew, 1998). In this context, faculty are perceived as representative of the university, so they directly or indirectly reflect the culture of the university from the students' point of view. Previous research suggest that campus environments that support cross-race interaction (CRI) have educational

benefits to students, including engaging in diversity activities and expanding perspectives on social policies regardless of whether students actually participated in CRI (Chang et al., 2006). Thus, campus norms around race, coupled with departmental emphasis on teamwork, may mitigate the direct lack of faculty support.

5.3.4 Conflict from Unmet Expectations

The final common theme addresses unmet expectations regarding team behavior that led to individual disagreements, but rarely reached the level of team conflict from the participants' perspectives. Previous research has connected team performance to team member expectations (Chen & Klimoski, 2003). Specifically, Chen and coworkers found that initial contact and social exchanges influence expectations that are directly related to team performance measures (Chen & Klimoski, 2003). In general, conflict is broadly defined as a team process where divergent perceptions of task (cognitive) or relationship (socio-emotional) can lead to dysfunctional interpersonal interactions or disrupt to team cohesion (Tekleab, Quigley, & Tesluk, 2009). Within engineering education, researchers have defined five categories of common team conflict including design decisions, personality, and miscommunication (Paretti et al., 2013). Team conflict was operationalized in this study as the way in which conflict materialized from unmet expectations linked to professional behaviors; participants typically resolved these conflicts with direct conversation.

Multiple participants described their teammates not meeting their expectations regarding interpersonal communication. For example, Zion expected professional communication during team meetings, and he interpreted the use of profanity as unprofessional. Unlike most participants, Zion experienced an intense level of conflict that lasted for the majority of the project, which required several conversations, and he had minimal faculty support to manage his

interpersonal conflict. In this case, Zion emphasized his strong religious identity, which his teammate viewed as unprofessional and which clashed with this teammate's use of language. Although not explicitly stated as a race issue, other researchers have suggest that religious beliefs can directly impact Black students' academic experiences and can be essential to their sense of multiple identities (Stewart, 2009).

Where Zion's expectations focused specifically on language, Knight Wing more broadly expected teammates to listen to all other team members' ideas and opinions, an expectation common to most participants. None of the participants supported "shutting down" individual voices within the team, although some participants saw the challenging of ideas as productive rather than unprofessional. Both these listening skills are highlighted as important to teamwork in engineering (Lingard, 2010). Specifically, "listening to views and opinions of others" and "showing respect for other team members" are listed as individual skills needed by engineering students to work effectively on teams (p.35). The expectations of participants in this study regarding professional communication and desired team behaviors are consistent with current literature regarding individual teaming skills students need in engineering (Matusovich et al., 2012). Furthermore, these types of interpersonal conflicts around lack of listening within student teams require faculty guidance even more that task conflicts (Tekleab et al., 2009).

Second, participants described teammates not meeting expectations regarding individual contributions and engagement. In particular, the participants expressed concerns about making sure all team members contributed to the project and stayed engaged during team activities through the completion of the project. For example, Jake's unmet expectation was that team members should be engaged for the duration of a team activity such as a meeting or work session. Multiple participants expressed the expectation that teammates would stay engaged until

a final solution was submitted or the project was completed. Importantly, though these expectations were not always met consistently by all team members, Sterling explained the difference between holding teammates accountable when expectations are not met and actual team conflict, which he termed as “significantly dysfunctional.” In most cases, participants did not perceive individual instances of disengagement as rising to the level of “actual conflict.” These expectations of consistent accountability, too, are consistent with literature that shows that holding students accountable for contributions to the team is important and provides valuable assessment information during team evaluations (Lingard, 2010; Ohland et al., 2012). Other researchers found that having all the members of the team participate in team decisions enhances team effectiveness (Campion et al., 1993). Therefore, providing accountability measures is important on any student team including multiracial student teams.

The third area of unmet expectations was related to the quality of the work by individual team members. Sterling, for example, emphasized performing team tasks at a level that was acceptable to teammates and described how previous teammates had disappointed him with their performance on assigned tasks. This notion is consistent with the literature as both Ohland et al.(2012) and Lingard (2010), who specify completing individual task “with high quality” as a key to teamwork.

In conclusion, the results from most of the participants in my study are consistent with previous literature and add to the complexity of our understanding of the multiple levels and layers of student team conflict in terms of team member expectations.

5.3.5 Summary of Common Themes

In summary, the emergent themes expressed by the African-American males on multiracial student teams contribute to literature and enhance our understanding of cross-race

interactions in higher education. Specifically, unlike most studies of intergroup contact, this study articulated the minority perspective. Given that majority and minority students can interpret cross-race team experiences differently (Ely et al., 2012), this study contributes to intergroup contact research by identifying the concerns and experiences of ethnic minorities and suggest future research to further develop a holistic understanding of intergroup contact from the vantage of both groups.

With respect to intergroup contact, the theme of positive personal interaction was consistent with cooperative learning and intergroup contact theory, but the lack friendship opportunities for this group as well as the indifferent faculty interactions called into question both friendship and authority support as essential to intergroup contact, contradicting prior research. The nature of faculty interactions for these participants also adds complexity to our understanding of cross-race relations between African-Americans and engineering faculty. In particular, the theme in this study exposed nuances about how these students perceive their interactions with engineering faculty, who are typically of a different race, and illuminates potential faculty development and pedagogical interventions (discussed in detail in Chapter 6). Finally, the theme of unmatched expectations adds complexity to our understanding of team conflict, suggesting different levels of conflict that can emerge during a student team experience (e.g. individual vs. entire team conflict).

5.4 Unique Themes

The two unique themes that emerge among half or fewer participants also confirm and extend prior research, as described in the following sections

5.4.1 Stereotype Awareness

Stereotype awareness emerged in the data as all participants noted negative stereotypes (e.g. lack of interest, laziness, and less intelligent) about African-Americans in higher education (Harper, 2012) and engineering, specifically (Riley, 2008, p. 84). In particular, as work by both Harper and Riley point out, the trope of the “ignorant Black man” recurs frequently in higher education and tends to position African American men as incapable of succeeding in academically challenging environments, and particularly in mathematics and sciences courses that dominant engineering.

As noted in Chapter 4, while seven of the eight participants acknowledged these stereotypes at some point during the interviews, half discussed them in enough detail to justify stereotype awareness, coupled with a proactive response, as a theme. Stereotype awareness was operationalized in this study as statements made by participants that indicate their awareness of negative stereotypes about African-Americans in engineering. This definition is linked directly to stereotype threat, which was first articulated by Steele (1997), who developed the theory to explain how African Americans contend with negative stereotypes about their abilities in educational domains. According to Steele, stereotype threat is socio-psychological response to situation in which individual actions could confirm a negative stereotype about one’s group (Steele, 1997; Steele & Aronson, 1995). It is type of social identity threat experienced when a person fears being judged by or confirming a group-based stereotype. Other researchers have defined stereotype threat as situations in which a widespread negative stereotype about a group negatively impacts the performance of an individual who identifies with the group (e.g. African-Americans in engineering) (B. D. Jones, Ruff, & Paretto, 2013).

Empirical research typically relates stereotype threat to task performance in a particular situational context (Steele, 1997). For example, African-Americans and women in STEM may

perform negatively on a standardized math test in the face of acknowledged deficit models of their academic performance – i.e. that they are not “good at math” (Steele & Aronson, 1995). Most studies of stereotype threat use experimental settings in which the control group is explicitly told that the task they are performing is specifically related to the stereotype (e.g. “This test is measuring math performance in girls”), while the control group receives no such information. However, since the stereotype concerns an entire group, an individual may or may not personally experience the bias in a given setting (Cohen, Purdie-Vaughns, & Garcia, 2012). Nonetheless, *awareness* of the stereotype, even if that stereotype is not expressed in a given context, can have a similar impact on individuals based on their perception, regardless of the presence of an actual threat, as was the case with participants in this study. In this case, the participants’ statements expose potential social cues that signal social identity threat to African-American men in engineering. In other words, their statements may indicate organizational features within engineering that suggest that African-Americans may encounter identity threats similar to those experienced by women in engineering (Murphy, Steele, & Gross, 2007).

The fact that stereotype awareness was salient for half of the participants suggests that the perception of inferior academic capability in engineering may be a “Black metastereotype.” Black metastereotypes are defined as Blacks awareness and perceptions of racial attitudes that Whites have regarding Blacks (Torres & Charles, 2004). In this case, the metastereotype around poor performance in engineering is a specific instance of the larger stereotype of Black ignorance identified by Harper (2012) and Riley (2008, p. 84). Metastereotypes can influence social behaviors, especially interactions between people of different races.

Among the participants, Jake by far, made the most comments regarding stereotype awareness and expressed his reservations about asking for help from the members of his

multiracial student team. Together, these two facts suggest that Jake may have been reluctant to seek help specifically because of social-image concerns associated with African-Americans in engineering, which is consistent with current research. For example, Wakefield and coworkers concluded that group members of a stigmatized social identity may be willing to sacrifice accessing available and needed resources to avoid reinforcing negative stereotypes (Wakefield, Hopkins, & Greenwood, 2013). Thus, part of the reason Jake may be uncomfortable asking members of his multiracial team for help may reflect his attempt to avoid reinforcing negative stereotype about African-Americans in engineering.

Other behaviors may also be connected to the awareness of negative stereotypes, including participants' general choice to respond to their awareness with behaviors that explicitly counter the negative stereotypes. The African-American men in this study responded either proactively in response to being stereotyped. For example, Jake described taking the initiative to make a good first impression with his multiracial student teammates. But while Jake perceived his proactive approach as beneficial, his need to make a "good impression" may also be evidence of the additional emotional and cognitive work caused by stereotype awareness, particularly given his expressed sadness about those stereotypes. This indication of added emotional or perceived stress is concerning in light of the impact it can have on physical and emotional health of adults (Luo, Xu, Granberg, & Wentworth, 2012).

Like Jake, Phil took a direct approach to disprove the negative stereotypes by taking a leadership role. His comments suggest that leadership opportunities can reduce the impact of being stereotyped, and potentially enhanced his satisfaction with the team experience. This utilization of leadership roles is consistent with gender studies. According to Settles, having leadership opportunities can moderate female faculty satisfaction (Settles et al., 2006). Jake's

and Phil's actions, as well as those of other participants, are thus consistent with other recent studies on how students react to experiencing stereotype awareness in academic environments (Beasley & Fischer, 2012).

Researchers have suggested methods to support students who perceive themselves being stereotyped. For example, Cohen describes mentoring techniques that can reduce stereotype awareness, including providing specific types of feedback to maintain motivation to persist in a "difficult" field such as engineering (Cohen, Steele, & Ross, 1999). More recent research suggests that engagement regulation mediates self-esteem and positive performance feedback under "stereotype awareness" conditions (Leitner, Jones, & Hehman, 2013). When people are in a situation where a stereotype exists, they may choose to disengage in an effort to maintain their self-esteem. Specifically, these African-American men in engineering who expressed being stereotyped were susceptible to disengaging with their engineering team or department, but the disengagement can be moderated by positive feedback. More importantly, African-American males tend to stay disengaged once they reach the point of disidentification with academics (Osborne, 1997). Research has also shown that engagement with diverse peers is a learned behavior (Hall, Cabrera, & Milem, 2011), and students of color are more predisposed to engage with diverse peers when compared to White peers during the first two years of college. These risks, as well as the identified interventions, suggest that multiracial student teams should be monitored to ensure that negative stereotypes are not influencing interactions that could lead to the disengagement of African-American males.

5.4.2 Interdependence

Interdependence was the final unique theme presented in Chapter 4. It is defined as mutual cooperation among team members where goal attainment requires intergroup collaboration, not

just individual efforts (Pettigrew, 1998). Similarly, cooperative learning researchers define positive interdependence as individuals perceiving that they can only reach their project goal when their cooperatively linked team members also reach their goals, and thus they support each other in reaching individual goals to attain group success (Johnson et al., 1983; Johnson et al., 2007). Other social scientist have identified positive (cooperative) interdependence as a defining group characteristic (Campion et al., 1993) and an attitude mediator that produces more favorable mind-sets and empathy for outgroup members (Dovidio et al., 2003). As a result, the emergent of this theme is consistent with the current literature on interdependence in multiple ways.

The operationalized definition of interdependence in this study combined the definitions from cooperative learning and intergroup contact studies. Cooperative learning research defines interdependence based on social interdependence theory (Johnson et al., 2007), where cooperation was essential for cross-race relations within an academic environment, whereas intergroup contact theory defines it as intergroup cooperation that supports the achievement of a common goal through interdependence (Pettigrew, 1998). Such interdependence emerged as major theme for the three participants in computing fields (computer science or computer engineering), suggesting that it may be a site specific instructional approach. All three stressed interdependence as essential to the nature of the work in programming projects.

Moreover, the positive benefits of cooperation described by the participants within their multiracial student team are consistent with the learning gains described in cooperative learning studies (Johnson et al., 1983; Johnson et al., 1998; Johnson et al., 2007). For example, David specified improving his program by “looking at” his teammate’s screen while programming to

learn different approaches and identify techniques to overcome program bugs, while Harbor mentioned cooperating with teammates to minimize mistakes.

Participants' descriptions of interdependence are consistent with cooperative learning in other ways as well. For example, Clay emphasized being physically collocated with teammates while working through project tasks as a means to support team interdependence. Similarly, cooperative learning research suggests that physical proximity is key in promoting cross-race friendships within academic settings such as classrooms (Johnson et al., 1983). More recently intergroup contact research has shown positive benefits for extended contact with out-group members (Dovidio et al., 2011). Accordingly, Clay's emphasis on the ways collocation facilitated his direct contact with his teammate suggests that physical proximity supported the cooperation within his multiracial student team.

Interestingly, Clay connected the level of interdependence within a team to the size of the team, suggesting that interdependence is harder to achieve with larger group size. Group size is not directly addressed in cooperative learning research; however, it has been used to explain intergroup contact research. For example, empirical research on intergroup contact found that perception of larger out-group sizes increased sensitivity to group threat and in turn led to negative attitudes toward the out-group (Schlueter & Scheepers, 2010). While Schlueter and Scheepers' study focused on the majority perspective, and thus stressed lower numbers of ethnic immigrants, Clay was the racial minority on his team, but the conclusions are similar. That is, for Clay as a racial minority in engineering, a larger outgroup size (i.e. a bigger team with more white students) could negatively impact intergroup contact and cross-race relationships. In both cases, larger out-groups represented a potential hindrance to positive intergroup contact.

Finally, my study supports social science researchers' notions of the different types of interdependence within a group or team environment (Campion et al., 1993): task, goal, and outcome. David, for example, addressed task interdependence when he explained that "some things you can't really split." In this case, task interdependence did not allow students to apply the divide-and-conquer approach in which tasks are divided among team members. According to Campion, task interdependence was not related productivity, but has been related to motivation that is mediated by a sense of responsibility for others' work (Campion et al., 1993), which was reflected in David's team experience.

5.5 Team Experience Related to Multiple Identities

The team experience was related to the participants' identities in specific ways. One key aspect was the fact that teamwork was emphasized as central to professional practice in all departments represented in the study. This collective emphasis on teamwork as important to professional engineering practice can be interpreted as a supportive cultural norm throughout the college of engineering. As discussed in Section 5.2.3, supportive norms were designated by Allport as among the original conditions essential to positive intergroup contact. As the participants learn teaming skills, they are learning skills that are important to engineers and the professional practice, which can provide a foundation for their engineering identity. Therefore, the emphasis on teamwork may be a key factor in these participants' multiracial team experiences that supports their engineering identity development.

Participants' comments bear out this possibility. For example, David made statements indicating that he acknowledges the importance of teamwork to engineering practice and feels confident that he will be able to perform on a professional engineering team. Other participants made similar statements, but also recognized that the team experiences in their courses were not

comprehensive. For example, one participant desired experience working with students from other majors in an interdisciplinary project, while another never experienced team conflict and was thus unsure about how he would handle conflict professionally. Combined, participants' comments suggest a general confidence in their teaming skills, but also clearly defined areas for growth and professional development.

5.5.1 Racial Identity and Team Experience

Racial identity has been defined from a phenomenological approach that considers African-American perceptions of the meaning and significance of their race (Shelton & Sellers, 2000). This definition includes both the qualitative and structural nature of race from the perspective of the participants. Racial identity in the current study included statements about race relative to family background, previous and current cross-race relationships, and racial isolation. For example, participants made statement about being one of two Black students in their engineering department or course, which represented awareness of their racial identity as it intersected with the engineering dimensions of their identity.

Notably, although racial identity was salient to at least some degree for all participants, most did not think race impacted their peer interaction within their multiracial student team experiences. At the same time, half demonstrated detailed awareness of and response to negative stereotypes about African Americans in engineering. The variance among participants' racial identities is consistent with the conclusion of Shelton & Sellers' (2000) study of African-American racial identity. As that study and others have shown, not all African Americans, or even African American men, experience their racial identities in the same way, and those differences are important to remember when we develop strategies for supporting these students.

A second shared facet of racial identity among several participants was the desire to disprove negative stereotypes of African-Americans in engineering. This result is consistent with the Strayhorn (2009) study of high-achieving Black college students who felt burdened to “prove themselves” academically to their White counterparts. Other researchers labeled the notion of Black scientists having to “prove themselves” as a racial double standard (B. A. Brown, Parsons, Miles, & Henderson, 2013). Strayhorn’s (2008) study also identified faculty interactions as possible contributors to experiences of stereotype threat among high-achieving Black students. However, participants in this study provided little evidence of such contributions, with the exception of Knight Wing, whose negative experiences with faculty prior to the team experience may have influenced his reluctance to seek faculty help.

This commitment to disproving negative stereotypes was one instance of participants’ larger personal resolve to complete their engineering education. Several participants saw themselves as “persistent to solve a problem” and talked about persistence across the interviews. Such persistence and personal commitment to continue in engineering can be interpreted as “grit.” Grit is defined as the tendency to maintain perseverance and passion during the pursuit of a long-term challenging goal like being the first in your family to earn an engineering degree (Strayhorn, 2014). Reynolds and colleagues found that students of color with less extrinsic motivation for success were able draw on such grit to persist toward their academic goals and were less susceptible to deterrents (Reynolds et al., 2010).

Despite the salience of racial identity and the evident grit of several participants, most did not explicitly identify conflicting identity dimensions. That is, even when they were aware of negative stereotypes, they did not necessarily see their racial and engineering or academic identities in conflict, nor did they describe conflicts between family and academic identities,

even though some were first generation college students. This result suggests the participants perceived their identities as integrated or coherent, which is consistent with research showing that Black college students tend to perceive the multiple identity dimensions as coherent (Stewart, 2009). However, other researchers found that boundaries still exist between Black engineers and the scientific community (B. A. Brown et al., 2013) that can prevent identity integration between racial and professional (engineering) identity dimensions. Both Jake and Zion may illustrate these conflicts. Jake experienced what he perceived was significant stereotyping and Zion expressed his concern about his religious beliefs; both concerns can be interpreted as an identity conflict rather than integrated or coherent sense of self. Previous research suggests that such conflicting identities can negatively impact psychological well-being (Brook, Garcia, & Fleming, 2008), particularly for African-American males (Osborne, 1997). Thus, although most participants presented a generally coherent sense of self, the traces of conflict that did emerge suggest that this finding should be further investigated.

Finally, while most participants enjoyed their multiracial student teaming experience and considered it “race-free,” they often expressed concerns about the larger community, which could impact their sense of belonging. The team experience itself provided a positive social experience for these African-American men, and previous research that found that positive social experiences for African-American students can buffer their academic motivation, increase engagement, and enhance academic performance (i.e. grades) (Purdie-Vaughns & Walton, 2011). Such positive perceptions of teamwork may provide an opportunity to create an “identity safe place,” or an environment that effectively reduces the risk of stigmatized groups experiencing stereotype threat in that domain (Purdie-Vaughns & Walton, 2011). That is, the

positive team experience may be a critical site for African-American students to experience identity safety as they try on engineering roles and try to solve engineering problems.

However, participants' underlying concerns about belonging in the larger community (e.g. engineering departments and university), were expressed by implicit in statements about their racial isolation and explicit in statements linked to stereotype awareness, may reflect internalized situational cues. According to Murphy et al. (2007), this awareness may be a situational cue that alerts the participants to the possibility of a psychological threat such as exclusion or isolation. As a result, the impact of the positive team experience on African-American students may be diminished due to a chilly climate in the larger community or engineering departments. Furthermore the symbiotic relationship between the participants' self-concepts from a department perspective and their racial or engineering identity suggests that the intersection of those identities are experienced simultaneously and are context dependent.

5.5.2 Leadership Identities

As described in Chapter 4, one of the primary ways participant's countered negative stereotypes associated with their racial identity that conflicted with their professional identity as engineers was through leadership. This group of African-American men perceived leadership as important to engineering teams in order to "get work done," and they were all comfortable taking different types of leadership roles. The participants associated the leadership with stepping up or being assertive to ensure quality contributions or "setting the mindset," and for several, leadership roles represented a proactive means to counter potential stereotypes from the very beginning. Their overall awareness of the importance of leadership aligns with team research broadly, such as a recent study by Xu et al. (2011) that found the team climate and leadership style impacted team member's behaviors, specifically knowledge sharing. At the same time, the

fact the African-American men in this study considered it important to fulfill different leadership roles as needed (e.g. being second in command and sharing leadership responsibilities) is also consistent with previous research. For example, Erez et al. (2002) found that rotated leadership was statistically significant and positively predicted voice, cooperation, and overall team performance. This variation of leadership roles is also consistent with the “shared leadership theory” developed by Pearce and coworkers (Pearce, 2004). More recently, meta-analytic research found that shared leadership had a fairly strong positive relationship to team effectiveness (Wang, Waldman, & Zhang, 2014). Within engineering education specifically, researchers have found that shared leadership is dynamic and fluid and emerged from discussions and interactions (Feister, Zoltowski, Buzzanell, Oakes, & Zhu, 2014). Participants’ willingness to take on different leadership roles may thus be a reflection of fluid professional identities that allow them to move back and forth across roles, even as leadership itself provides a means to counter negative stereotypes associated with their racial identities.

5.6 Conclusions

In conclusion, there are three major findings from my dissertation based on the data analysis and the literature context of my study results. First, the common themes across participant were moderately consistent with previous research on intergroup contact theory. However, the counterexamples and nuances added complexity to some of the concepts found in the cooperative learning and intergroup contact literature. For example, both the indifferent faculty support and the lack of friendship opportunities were not consistent with the conditions previously deemed central to positive intergroup contact. With respect to cooperative interdependence, the findings were more mixed. Though present for some participants, nuances in the theme challenge previous research that specified cooperative interdependence as essential

in cross-race interactions, especially in academic contexts. Interdependence was emphasized primarily by computing students as an efficient means to do programming work; these participants saw the nature of the coding work as something that requires a high level of collaboration. The benefits of interdependence expressed by the participants were consistent with cooperative learning and intergroup contact research, though again, these benefits were limited to the computing students. Importantly, however, in terms of both the areas of agreement and the areas of disagreement, participants' stories explored positive intergroup contact for African-Americans, who represented the minority in the contact situation. This minority perspective has rarely been covered in ICT research, and thus the current study provides a distinctive contribution to intergroup contact research.

Second, stereotype awareness was captured in my study as the perception and emotional reaction to the awareness of negative stereotypes about African-Americans in engineering. The participants applied a variety of strategies to address this awareness, but generally were proactive in dispelling the myth of diminished intellectual capacity among African-American males in engineering.

Finally, the African-American men in this study identified several salient identities, as well as intersections among those identities. Most participants were sensitized to their race by being the only or one of a handful of African-Americans in their department, and certainly the only African-American male on their multiracial student teams. Despite this sensitization, no participants made explicitly statements that indicated any identity conflicts, and all generally enjoyed their multiracial student teaming experiences. Importantly, though, they also expressed their desire to see more African-Americans in the larger community or department, which may indicate latent conflicts that merit further investigation – especially since, as noted in Section 4.8,

the method of recruiting participants may have excluded African-American students who were uncomfortable discussing race or engaging in discussions that highlighted their minority status.

Chapter 6: Implications and Future Work

6.1: Overview

The goal of this chapter is to provide recommendations for ways in which the discussion of the results in Chapter 5 can better support African-American men on multiracial teams in engineering. Although the participants had a generally positive disposition toward teamwork, which allowed them to experience positive interracial contact situations, the discussion in Chapter 5 highlights several opportunities to enhance relationship building with peers and faculty. After providing recommendations for researchers, students, and faculty based on the study results, I articulate the contributions my dissertation makes to the literature regarding student teams and interracial interaction in engineering. The chapter then concludes with limitations of this work, lessons learned, and potential future work.

6.2: Recommendations

6.2.1 Faculty Recommendations

Indifferent faculty interaction was an emergent theme of study, where the faculty had a diminished role in the common interactions that occurred within the participants' multiracial student team experiences. As a result, engineering faculty likely can do more to support team dynamics, show interest in the success of students of color in the program, and enhance the opportunities for mentoring relationships to develop (formal or informal) within department, when possible. Key recommendations are as follows:

1. Given the indifferent relationship most participants had with the faculty responsible for their teams, engineering faculty may want to set goals to intentionally interact with students of color during team projects, rather than allowing those interactions to happen

serendipitously. These interactions might include spontaneous checks on team dynamics or progress and team informal feedback opportunities during team activities.

2. Similarly, faculty can regularly choose pedagogical activities that require student interaction. For example, faculty can require regular meetings with student teams in which each team member reports on his or her work over the past week.
3. Faculty can establish supportive norms for positive intergroup contact through team contracts, conflict management strategies, and projects that require team interdependence.
4. Given the importance of informal social interactions for most participants, faculty can include team building activities within projects that provide scaffolding for students who are not comfortable with interracial interaction. These activities can be addressed through direct instruction as well as specific assignments.
5. Finally, faculty can initiate conversations with students of all races where they communicate a diversity statement or philosophy to support identity safety for students of color as defined by previous research (Purdie-Vaughns & Walton, 2011).

Beyond direct interactions with teams they are responsible for, faculty may also wish to consider their relationships with students of color outside the team environment. Recall that one participant, Clay, had a close relationship with faculty mentor with whom he regularly engaged in technical dialogue. This participant described this relationship as positive and influential, and the student's experiences are supported by the broader literature discussed in Chapter 5. As a result, faculty should regularly engage students of color in technical conversations to ensure these students have the confidence to ask questions and gain access to essential disciplinary knowledge. Such dialogue allows students to articulate their thinking regarding technical content.

Similarly, another participant described being singled out because of his race by a faculty member during a class lecture and the negative emotions he felt as a result of the experience. Consistent with the literature discussed in Chapter 5, faculty should avoid classroom management behaviors (in or out of classroom) that suggest or reinforce negative stereotypes about students of color in engineering.

6.2.2 Student Recommendations

The results of my study also have implications for students of color participating on multiracial teams. Based upon the study results, African American men on multiracial student teams may wish to consider the following recommendations:

1. Be open to interracial social and personal interactions; get to know team members and students of all races on a personal level outside of project. Learning about people of a different race can help reduce the anxiety of working on a team with someone from a different racial group.
2. Students can get to know students of different races informally. Students can self-disclose personal information they are comfortable sharing with teammates knowing. For example, if students are interested in a design project because it has impacted their hometown that could be something to share with teammates to expose contextual factors that could benefit the team. Specifically, share personal information that can enhance the team project functionality, approach, analysis, or final deliverable.
3. At the same time, while getting to know students of different races, find ways to effectively communicate when an interaction becomes uncomfortable. Articulate team member expectations as they become relevant to the team experience. Don't fear conflict,

but view it as professional development and discuss unmatched expectations. However, seek help when strategies to manage conflict prove to be ineffective.

4. Similar to managing team conflict, proactively and directly address any stereotyping issues or interactions perceived to be racially motivated to create an opportunity to understand and be understood. Be authentic and contribute to the team with skills and talents.
5. Strive for interdependence, after the team is functioning well. Interdependent teams function more efficiently and support the learning of all members of multiracial student teams. Specifically, based on a common goal, identify teammates' strengths and weaknesses to identify the best team member for individual task that contribute to the team progress. Also, make team decisions collaboratively where all team members have a voice. Furthermore, stay engaged with project to support the team interdependence.

6.2.3 Research Recommendations

Multiple researcher recommendations emerged during the execution of this study. The research recommendations provide insight to those who may wish to conduct a similar study or replicate the current study in a different context.

1. Identity construction is a fluid and dynamic process, which can be unique to each participant. Two key aspects of racial identity emerged from the participants in this study. First, literature on Black racial identity construction and development are useful starting points to understand students' racial identity. However, the complexity of racial identity can be more complex than anticipated based upon the level of self-awareness and personal reflection. How the participants understood and expressed their racial identity was a dynamic construct that make obvious why essentializing an identity dimension is a

mistake. Also, the participants expressed their desire to discuss their identity exploration as they matriculate through their engineering education and struggle in negotiating the different dimensions of their identity. Therefore, the combination of these expressions suggests that researchers should consider that the level of identification for participants varies among identity dimension. Researchers should be intentional about the role of identity in connection with the phenomenon.

2. When the study investigates a very personal experience, the participants tend to have very strong opinions or perceptions of the experience, as well as thoughts they are unable to articulate. Establish the best rapport as possible and plan for critical probing because the participants' comfort with identity or socially unacceptable behaviors (e.g. stereotyping or cross-race avoidance) can be a barrier during the interview process. My ability to build rapport with the participants enhanced the quality of the examples they shared and the resultant data for my study.

6.3: Contributions

This work contributes to multiple areas of engineering education and social science research. First, this study contributes to research practice in two ways and has the potential to inform future research on multiracial student teams. The phenomenological perspective and study design is not common in engineering. However, my dissertation indicates phenomenology is an effective method of inquiry to investigate the experiences of specific student group, including underrepresented students, within the context of engineering. The effectiveness of phenomenology in studying the experiences of African-Americans in engineering is topic of a forthcoming journal article. Additionally, this study indicates Intergroup Contact Theory is a

productive means to investigate interracial interactions within STEM. In particular, the study shows that ICT is useful tool to investigate interracial relationships in engineering. As result, my dissertation contributes methodologically to engineering education research and broadens theoretical perspectives that are applicable to interrogate the engineering culture.

Additionally, this study contributes to intergroup contact theory in multiple ways. The results challenged and nuanced our understanding of the required conditions of the contact hypothesis that are widely accepted in intergroup contact research. First, the results of this study identified a lack of friendship for the African-American men, which is counter to friendship opportunity described by previous research (Dovidio et al., 2003; Page-Gould & Mendoza-Denton, 2011; Pettigrew & Tropp, 2006; Pettigrew & Tropp, 2008). Participants frequently had positive informal team socializations, but few friendship opportunities, yet had consistently positive team experiences. Second, the indifferent faculty interaction challenges the notion of authority support as critical to positive intergroup contact. The participants described a positive experience on their multiracial student team despite minimal interaction or support from the faculty responsible for their team project. This result directly contradicts the findings of intergroup contact research that specifies authority support as an essential mediating factor to support positive intergroup contact (Binder et al., 2009; Gómez & Huici, 2008; Pettigrew & Tropp, 2006). As suggested by the discussion, “authority support” may be linked to the overall university climate, which at least nominally supports a culture of inclusion and diversity, but given that the campus climate did not generally emerge in discuss (except to highlight lack of diversity), even this explanation seems weak. Last, the majority of intergroup contact studies focused on the privileged or majority perspective and not the stigmatized group (Pettigrew, 2008; Rattan & Ambady, 2013). However, this study investigated intergroup contact from the

perspective of the minority population and thus adds to the complexity of the theory. Therefore, the results of my study challenge and nuance the current understanding of intergroup contact.

Finally, my study contributes engineering education research on student teams by describing the experiences of African-American men on engineering teams. The results of my study indicated the importance of social interactions to team dynamics. In particular, this group of African-American men generally desired more personal interactions with teammates to get to know them. Furthermore, the positive personal interactions with members of their student team required self-disclosure or the voluntary communication of personal information to increase knowledge of out-group members. In addition, my study exposes the benefits of African-American men being proactive and direct during team activities. Interestingly, the participants in my study successfully used proactive strategies to mitigate team dynamics and had positive team experiences. This study also contributes to the engineering education literature regarding stereotype awareness as previous research suggests the importance of African-American college students having the ability to navigate negative experiences in the absence of faculty of color to teach them (Harper, 2013). These participants enacted this approach by proactively navigating the stereotype awareness, which may be coping mechanism, with limited access to African-American faculty advising them take that approach. Therefore, my study provides important information for engineering faculty who manage multiracial student teams.

6.4 Limitations

Despite the multiple contributions this work makes, as with any project, there are also limitations.

1. The study focused on a single site and looked across years and majors, which reduces the generalizability and broader impact of the study results. Some results may be site specific, which could influence students' experiences on multiracial teams differently in a new context.
2. Data was collected for a single semester (even when team experience spanned two semesters). Some social scientist researchers suggested longitudinal studies can effectively explore intergroup contact as some positive outcomes typically develop over time and after reflection. Therefore, future work can look at the experience of African-Americans over multiple years of their engineering education in a longitudinal study.
3. The study participants included a portion of African-American males, and not all the potential informants within the college of engineering. In other words, the participants had to self-identify as African-American and choose to participate in the study; one participant chose to discontinue his participation. As a result, not all perspectives may be included in the study sample or data analysis; additional perspectives could expand the phenomenological statement or provide more nuanced examples.
4. The analysis includes only the participants' perspectives of their interactions and experiences on multiracial student teams. To gain a more accurate and objective perspective of the team interracial interaction, I could have interviewed other members of the multiracial team or observed team dynamics to provide more context for the participants meaning making and interpretations.
5. Stereotype awareness emerged as a key theme for many participants, but I did not collect any performance measures. Stereotype threat is typically linked to a performance measure in previous research, and the lack of the data in the current study does present a

limitation in that the stereotype awareness can only be understood qualitatively, in terms of the emotions the participants described when experiencing the psychological phenomenon.

6. Similar to stereotype awareness, the participants spoke about multiple dimensions of their identity (e.g., racial, engineering, or intersecting), but there was no direct identity measure in the study.

6.5 Future Work

The results and implications of this study can provide the basis for several areas of future work. One set of studies concerns the current data set. One immediate project to follow the completion of my dissertation is to repeat the analysis procedure for the female participants not included in the current analysis. A second project could expand the analysis to explicitly link background experiences and previous interracial contact to current contact situation. According to Troop (2003), a greater emphasis is needed on how group members' accrued histories of social experiences contribute to their feelings toward cross-group interactions.

A second area for future work concerns new studies that articulate which types of interactions that are specific to African-Americans to support their social and intellectual development during their engineering education. First, it would be useful to repeat the entire study for a longer data collection period (e.g. entire academic year) and at other sites with a potential multi-institution project, with closer attention to difference across years and/or across majors. Another approach would be to apply a mixed method approach where I survey students about their multiracial student team experience with follow-up individual interviews. A final possible future study would be to repeat the study with critical race theory (CRT) as the theoretical framework to identify institutional structures that support or inhibit positive

intergroup contact. Social science researchers have called for research on strategies to transform intergroup contact theory into an easily applied remedy within specific institutional settings. Specifically, future work can identify what are the practical applications and institutional context policies that support intergroup contact (Pettigrew, 2006). Furthermore, specify concrete institutional characteristics controlled by administrators that can support optimal contact situations (Pettigrew, 2008).

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Appendix A: Data Collection Documents

A.1 Solicitation email

Subject: My Engineering Team: Your participation is requested!

Hello [insert name here],

I am writing to invite you to participate in a study of African-American students' experiences on engineering teams and each participant that completes the data collection will be compensated with a \$50 gift certificate.

Your participation would involve three (3) interviews over the course of the team project to talk about your team experience. The interviews will take place at a time and location that is convenient for you. The 1st interview will happen at the beginning of the project, the 2nd interview will take place near the middle of the project, and the 3rd interview will happen at the end of the project. Each individual interview will last approximately 45-60 minutes, and the 2nd interview can be broken into two (2) shorter 20-30 minute interviews, upon request. Finally, the interviews will be audio-recorded and upon request you can review the transcript from the interview.

If you are over the **age of 18**, are *interested in participating* in the “My Engineering Team” study, and **understand the information** presented in this letter, please click on the link below to provide your name, email address, and a phone number where you can be reached. You will be contacted with further instructions and to schedule the 1st interview.

[Link to Demographic Survey]

Thank you in advance for your participation!

Sincerely,

Kelly J. Cross (kellyc5@vt.edu)

Contact Information: If you have any questions or concerns about this study or if any problems arise, please contact Dr. Marie C. Paretti at (540) 231-1812 or mparetti@vt.edu . If you have any questions or concerns about your rights as a research participant, please contact the Virginia Tech's institutional review board at irb@vt.edu.

A.2 Demographic survey

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Key Informant Demographic Survey

Engineering Student Team Experiences at Virginia Tech

This questionnaire is needed to help us understand the people participating in the study. For this reason it is very important information. Remember that all the information you provide is confidential and that you will not be singled out or identified as a result of this study. Please check the box to answer each question.

1. What is your name? _____
2. What is your cell phone number? _____
3. What is your email address _____
4. Contact preference (email or phone) _____
5. What is your gender?

Male

Female

6. Which of these racial/ethnic groups do you identify with? (Check all that apply)

#	Answer
1	White/Caucasian
2	African American
3	Hispanic
4	Asian
5	Native American
6	Pacific Islander
7	Other

7. What is your engineering department?

#	Answer
1	Aerospace Engineering
2	Biological Systems Engineering
3	Chemical Engineering
4	Civil and Environmental Engineering
5	Computer Engineering
6	Computer Science
7	Construction Engineering
8	Electrical Engineering
9	Engineering Science and Mechanics
10	Industrial and Systems Engineering
11	Materials Science and Engineering
12	Mechanical Engineering
13	Mining and Minerals Engineering
14	Ocean Engineering
15	Undecided

8. What is your current academic level?

#	Answer
1	Freshman
2	Sophomore
3	Junior
4	Senior
5	Graduate

9. What is your age? (Please fill-in): _____

10. Have you ever worked on a multiracial team (i.e. team with students of more than one race or ethnic group)? (yes / no)

Appendix B: Clusters of Meaning Tables

Notations

() = Deleted text from quote

(text) = Added by peer reviewer

() = Topic clarification (e.g. it (team role) was hard)

B.1 Clay: Team Experience Clusters of Meaning

Common Cluster	What	How
Friendship Opportunity	Yeah, I've had the same partner in every project, throughout the semester. He's been my partner since like, earlier CS classes so.	Yeah, so we're really comfortable working together. I have, I have gotten to know, 'cause I hang out with my partner a decent amount outside of just working. So just, I mean just getting to know him better and but we, yeah, no I've never, I mean we've never had any issues, on uh, one of us not doing what we need to do
Faculty Interaction	I would say I probably go to the teacher more often than to the TA, just because his office hours are at a more, are in a more convenient time, Not because I dislike the TA or anything. Just like, their office hours are kinda conflicting	Oh, umm, they're really nice cuz he's umm, a very nice laid-back guy. So it's really easy to talk to him and ask him questions and for help. So he's not, someone who's going to not answer your question or call you or like look down on you for not having something so, he's definitely very easy to talk to."
Interdependence (CS work)	at least with coding, you can be both working on the same part at the same time, if you're both like on the same, like you can both be working together on the same computer, like bouncing ideas back and forth so it's not necessarily important to do it that way (divide work by task)	I think you can be a little more efficient if you do it that way. I think that can be a little more efficient. But, then if you do divide it up, you might have a little bit of difficulty combining code, so, they both have their benefits and downsides
Personal Interaction		I think that it really helps, you to like get more comfortable around each other and get to know each other better. So, I think it is important for a team to be able to just step back and hang out without, without just doing work

Unique Cluster	What	How
Experience Description	(implied what)	I never really had a bad team experience luckily, overall just going very well.
Engineering Identity		Uh, so I guess like how I am as a student right now? I, I'm an engineer who loves coding, um, figuring out ways to fix things with programs, figuring out like new ways to, try to figure out new ways to do things, yeah, that's really what it comes down to.
Racial Identity		I've never, I don't really see like, I, race has never been a big thing to me. Like I just see people, like each person's their own unique individual. And so, and I have tons of different like my friends are all different kinds. So I would say for me personally, no, I don't, I haven't seen any kind of effect that my race has had on it (team experience)."
Unique: Help Seeking Strategy	On most projects, at some point I asked, you know, I have to ask some kind of assistance	I'm never afraid to ask for help cuz I, I know, I know I am not like the smartest person out there, so. (personal identity) So, I've never been, I used to not really ask for help. Pretty much since I have come to college, I've gotten good about not being afraid to just like, step up and say, "hey I don't really know this you know, could you help me out.
Unique: Trust		I think trust is definitely a large, a very important, plays a very important role in teams.

B.2 Harbor: Team Experience Clusters of Meaning

Common Cluster	What	How
Task or work division	Well, we had to choose what our team was good at. And I know three people in our team including me were good at the mechanical side, less of the programming, uh side, so we worked on the mechanical, the mechanism we're going to use. Which we built in a day or so. We all participate(d) in the programming in some way or another.	I think we had good chemistry 'cause all, 'cause of course all of us are engineers, but we're all of the same type of engineering, so, I think we had a good split between ECE which is more mechanical side and like CPE/CS side, which was like programming, so the we were able to uh, choose what we're best at and we, there wasn't, uh, we wouldn't have like a lot of overlaps between things. So, if people were good at one thing, they would mainly stick with that thing. If other people were good at another thing, they'd mainly stick to that. So we wouldn't have conflicts between like who should do what or who else should do another thing. Everyone basically knew which position they were going to take.
Personal Interaction	for the six of us, probably during our first meeting, where we're just like, started discussing what we're going to do. How we're going to do things.	I think we got sidetracked, started talking about other things, then we just, yeah, just became closer as a group.
Conflict Resolution	yeah we normally talk it out, (pause) especially in the programming if someone's not getting anything, we can look through it and then talk it out amongst us. Then when something makes sense, like someone says a keyword, then someone else will get it. Then we understand what the person was drawing, and were able to help each other	Yeah, I think it will help in finding ways of best working with groups so that you don't clash too much. 'Cause that's something our group did really well. Trying not to clash with each other. Try and do, discuss things and make sure everyone was okay with the decisions that were being made.
Interdependence	No, I've always thought teamwork would be pretty important in engineering work, because doing the work alone, leaves a lot of mistakes even though they can be minor, but it will still hurt in the end. I like separating out the parts, but I am more of a hardware side, so you still need to work as a group, to do it (complete project). It really helped with finishing the project and working together as a whole. And we were able to finish our project ahead of time.	I'm more used to one of our team members, is a really good programmer then, the other one is good at flowcharting and stuff like that. And then I normally do, the writing stuff, like discussion questions stuff like that. And we normally finish all of our work in class, so we don't ever have to do anything during the week, or meet up. So, most of our interactions happened during class. That's not the same with most of the other groups, but that's how ours normally works out.

Unique Cluster	What	How
Experience		I think the team, has worked out pretty well for us (pause) um, we've taught each other like, cuz after each assignment, one person turns it in and he emails everyone the different programs that we wrote, (ok) and we can see, from everyone else's work, what they did, or how they chose to solve it. It helps you, when you're like, thinking about the exam and stuff like that. How you can do this type of problem, if it came up. Or different methods, cuz people program in different ways or how they think about it.
Engineering Identity		Uh, I'd see myself as more of a logic based and uh, more hands on type engineer. With like circuits and things like that. Over sit down and program type engineering. I would say I want to do more programming, but I don't like MATLAB as a programming language.
Racial Identity (high ICT)		Uh, I'm okay with it. 'Cause I've lived most of my life, a lot of my life in the last couple years around uh, non-like African American people or, so I'm used to it. But I also decided to try joining like, there's a group called NSBE, National Society of Black Engineers, so, probably going to try joining outside communities. If I can't find any in my classes.
Unique (maybe): Conflict	If you have someone who is really good at something and like they've been doing it a long time and they think they can go faster than everyone else... That person person will just keep trying to take over all the project work and yeah, take all the focus of it. Or, if someone thinks their idea is better than the rest of the ideas and doesn't consider any other ideas	Team conflict, just when ideas clash probably on how things are meant to be done. I'd just go for a straight discussion. Like with the entire group. Like, we all talk about what we feel should happen, or and just basically go down to a vote on what should happen

B.3 Jake: Team Experience Clusters of Meaning

Common Cluster	What	How
Friendship Opportunity (lack of)	<p>I mean we've only, I mean, no. I think everybody's acquaintance. If I can be blunt, yeah, everybody's, everybody's an acquaintance. I mean, we all everybody has different personalities. I mean, I didn't really find any common ground between them. But, I found things that they do interesting I mean like one guy's a cadet that's no different, one guy plays the guitar, that's why we're doing the project.</p>	<p>Just cuz, it's not like, I don't like them or anything. It may sound kind of mean but it's just that, my crowd I guess, they're like, it's just. I noticed early, that there's certain people who you can, you can consider friends because of how you joke or how you talk or how, like your likes and dislikes. And I just saw from, what I saw from their, their personality made me, this doesn't fit in with my, I guess you would say.</p>
Conflict	<p>And there's another guy, who, I wanna say, but like he, even during the first meeting, he was working on his, umm, homework, I guess. Or whatever, for math and he wasn't really, he would contribute stuff with the group, but it was like, it was a little distracting, because he would be doing his homework like while we're talking. The first team meeting, all I saw was him putting his homework before the group's</p>	<p>Yeah, it could, it definitely lead to conflict, cuz if I'm putting in 100% and your only putting in 50%, and we're getting the same grade, I'm not gonna, I don't like that. Cuz I mean, I want you to know, I want my grades to reflect the work I put in. If I put in B effort, then I am not going to like it but, B effort, B is what I'm gonna get. And it's gonna push me the next time, to put in "A" effort, cuz I want that "A." So yeah, basically, just put in the effort, put in the effort you want. Put in the effort you want the outcome to be, I guess.</p>
Personal Interaction	<p>This group is just a pretty straight forward ta- group project doesn't require too much of us, if we all work together, so let's just get it done and be on our way, so. Everybody, if anybody feels like this idea's not the best idea I guess they will voice it and I, we all try to make sure that everybody's input is valued in the, like the final decisions.</p>	<p>Yeah, everybody's, I don't feel like, nobody, I don't feel like, they put me in any lower, or anything like that. so, yeah I feel comfortable with my team members. I mean, everything, everybody's fairly cool. They ask me for inputs on like, what should we do, I mean, I'm kind of like make sure that everything is like the best it could be at, I like to proof read stuff, I like to make sure things are in order, things are we get the things done. I guess, just 'cause maybe you have the same, we have the all same, we all have the same mentality going through the group project as we all want to get it done and get it out of the way.</p>
Stereotype Awareness	<p>That's why I say, it's like, I really initially, started off strong. So that they already know, okay, we can count on this guy. He's not going to be a dead-weight. I can count on this guy to actually contribute (intergroup distrust)</p>	<p>I already feel like I have to prove myself, being a Black person, and then you know, first being Black male, because of the stereotypes of people from the high school. Yeah, it's, it hurts sometimes, like just thinking about it but, it's true. I do, I always do feel like I have to like, can I prove myself, just cuz of being a Black male and stuff like that. It just (big sigh), is just tough sometimes, cuz you always, I always feel like I'm judged. It's just, I feel like it's just stereotypes really, do, do a number on us. I</p>

		don't really how to put it in words, I just know it's good feeling after, make sure that, I'm not, I'm not looked down upon before I get myself to prove myself. Stuff like that. Before you go, you put me, if you're gonna write me off, at least let me show what I got and if I'm written off, then I want to know why I'm written off.
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Unique Cluster	What	How
Experience		I think, we will, I feel like as a team, we all bring different things to the table. Like we all, we're all going to contribute, I can see that happening. Everybody's going to contribute. Everybody wants to get the project over with as much as the next person. So we all wanted to be done smoothly, without any problems, umm, we all, (pause) are willing to do, everybody's willing to do their work load. I can tell that right now, everybody's willing to make sure that the project is beneficially, and that nobody, nobody gets more than, I know that everybody wants to finish the assignment in the workshop.
Engineering Identity		I would describe myself, I would say that I'm, I'm a thinker and, I'm someone who, who basically, I'm a problem solver, as well as a thinker, somebody who, will find the most, who found, who will find the easiest route as well as the best route, or the maybe the best route, the, the easiest route as well as the I guess this is a third grader, I can't use big words, but the funniest route, maybe I would say to him, but this, find the easiest route. Just, I'm, I'm, I'm a problem solver, I'm a thinker, I'm a, I'm a route finder, and I'm a do what's best for you, I'm just do something that's the best for you.

<p>Racial Identity</p>		<p>I am an African that was born in America. And then there's the, that's what brings the other categories of, there's Africans that were born in America, there's Africans that was brought to America, then there's a Black person that was brought here. Cuz I don't, I was not brought here, I was actually raised and born here and I say that because, they don't have, they don't have umm, any other language other than English in their vocabulary. that's why, I wanna say Black, because of what people say African, I kinda also assume okay, they have a, there's a country in Africa where your parents, or like maybe, not too far from the generation where you. your parents, your relatives was in Africa. So that's why, I consider myself as African-American and like, I would say you would be a Black person. But then at the same time, (pause and big sigh) we're all still African-American at the end of the day.</p>
<p>Unique-Personal Identity</p>	<p>(counterexample of help seeking strategies)</p>	<p>when it comes to, you see, now that's, I'll say I'll never asked the help. It's not because, I don't like them or anything. It is just because, I've noticed on this pride thing, where I don't like asking for help, unless I am absolutely, don't know what to do. Because I feel like, I told my dad this earlier this semester, I told him how physics, I'm not struggling in physics, but like some of the concepts, which I need to spend more time, that I need to ask for help. And he was like, "yeah, you should ask for help." And I don't know, I don't really like asking for help.</p>
<p>Unique-personal value</p>	<p>(emotions)</p>	<p>I just wish there were more Black people, Black African Americans, or just more people in our major. Or just in our school. It's depressing sometimes, walking, just seeing, the same people over and over again. It's just like it's, where we at? Do we even go to school? Sometimes that's what I think like, I realize there's not a lot of upperclassman or the Black African Americans, and they live off campus, so I had to keep that, take that into account, but it's, like said it's depressing, not seen your own kind around, around school. I mean, I was the only Black guy.</p>

B.4 Knight Wing: Team Experience Clusters of Meaning

Common Cluster	What	How
Team roles	Yeah, like try to attempt the task together. () Because sometimes we focus so much on who's in what position that we kind of forget the whole reason we're there. Sometimes we'll be like, oh, who's the leader. Who's you know, vice president, who's treasurer? But in the end like, we're all there for the same purpose. So, what we really need to focus on is you know, what to make ends meet.	Yeah. I think that's what it is. They always say, like, two heads make you know, think better than one, so why not use four, instead of trying to like split it all into different positions.
Conflict	Areas of conflict, umm, mostly scheduling. There was never, really any, like you didn't do this part. It was more of, like we need to meet up before next week. So we can do it and then, that would be a little difficult, but we'd get it done.	Basically, I feel like it's when one person like proposes an idea, and then one person takes it too seriously, and shuts them down. So then, like the proposer is offended, so now they're already at odds. And then from there it just escalates, till, until there's of fever pitch, or they just like resolve it.
Faculty Interaction	Yeah, I need to work on that. But I don't really interact enough with my professors.	It (interacting with faculty) was respectful. I mean, I've definitely been in faculty positions where, in conversations where just like, 'oh, well, you know, you do this'. Like, 'you're stupid, it's this'. Yeah, you know. Yeah, just like, I'm stupid, oh man, oh man.
Personal Interaction	If you're working on your project, you hear booms, you're like what is this and you know, fireworks and it was like, oh cool, it's cool. You know, kind of thing. It just, usually that's how it does for me. Like it just grows. Over time. You know at first it's weird but then after a while, it's like 'yo, what's up'. 'How you doing?'	I feel like it's kind of like acquaintance to a friendship, you know? Like, it kind of just grows, from there.

Unique Cluster	What	How
Experience	(implied what)	<p>Team, it's probably teamwork. Like, if I can get along with people um, 'cause I feel like that's a valuable, like an asset. If you can get along with people as well as you know, work with them, that's, that's a good trait to have. Rather than just being like, solitary, like 'give me my work, I'm going to go to my cubicle and be quiet for the rest of the day and do it'. Like, that's lame. Yeah, it's definitely a skill.</p> <p>Teams are, they're definitely a good experience. You, umm, as someone who is gonna enter into the workforce eventually; you're need to be able to work with other people. And see how, basic understanding of how people work. And how, like they, it's not just your schedule that you have to work, it's other people's, basically, like get a little involved, in their life, as well as them getting involved in yours.</p>
Engineering Identity		<p>Well, as an engineer in training, I'd, I'd say, I'd say I, I like working in teams, but sometimes that will hinder your learning to the point where, like, you can do it together but when you get alone, like, you'll be like, oh, no, how do I do this? So, what I prefer to do is to usually I struggle and then like I'll, you know, sleep on it and then I'll wake up and be like, okay maybe this will work, and then it'll work and I'll be like oh, that makes sense, 'cause blah, blah, blah, blah, blah. You know, then, sometimes one of my friends will be like, 'hey, is this right?' and they'll be like, 'yeah, that works' and I'll be like, 'yes'.</p>
Racial Identity		<p>Me and the other person would only we were the two Black males in the class. Like we just, we just kind of sat, we kind of knew each other through people. And then one day, like 'hey'. () It's just I want to represent us in the best light, if that's possible.</p>
Unique	Stereotype Awareness	<p>But you have to once you, you know, present yourself, then it's, you know, then it's you. But, but if you see someone I don't know, stereotype society, that stuff, it just like plays to a bigger role. Then it, then it all like phased out, you know yeah. (stereotypes phased out once they got to know him) They say, I mean, I heard somewhere like the human brain judges people in like two seconds. So, I mean, that's just how it is. But, like I said, I want to represent us in the best light possible, but then again, that means I've seen some of the worser ones, so it's like, huh, yeah. Sometimes it's just like just I don't know.</p>

Unique	Positive ICT	A lot, a lot of my friends have told me, especially the girls, like, they'll be like you know, when I first met you, I was kind of scared of you. 'Cause like, you're like this big Black guy, and but they're like 'after I get to know you, you're just a really, really fun teddy bear'. They're like a hug. And I was like, 'cool'? Okay. Yeah. Yeah, but um, yeah, it's kind of just like that initial fear, like stranger danger thing. And then after a while, it's like, oh, you know, we're cool. What's up? You know.
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B.5 Zion: Team Experience Clusters of Meaning

Common Cluster	What	How
Personal Interaction	Uh, yeah, there's certain things. Little things um, location could be one of them. Um, we tend to work out in the middle of the open.	Which I think is good, 'cause we're going to be ourselves, no matter what. And the peop- and by open I mean, we're working inside of our building. So everybody in there knows us. But it, it tends to keep out, um, I guess a little bit more, our personal, personal selves. So that because we're in the open, we're interacting as a group in front of the public, um, we can act a little bit better or we act a little bit more professional I guess, in front of each other. Um, so it's not like tight knit, business meeting every single time, 'cause we're getting into the nitty and gritty and stuff like that, but we don't let loose 100%.
Work Division	Yeah, I would say there is that level of we share responsibilities, even though it's all the majority of the same thing. That's to, it's more or less to make sure that that one person, hasn't been doing everything or even if it's just three people in a meeting at a time we don't want to sit there and just do the entire thing. We'll do as much as we can but then we'll get to a point where were like, okay let's just leave this for the other three.	Something like that, umm, because, it can end up being, we get tired of doing everything and it happens some days where it's like that, you know, everybody doesn't show up, but then we just say, let's stop for the day, and leave this.
His Role on Team	I was like co-leader. There are two of us who really, kind of, went behind the eight ball. I'm not the smartest kid in the group, but am the one that trust is say, hey let's get things done. That's who I was this semester, umm I don't think anybody's really, really that leader anymore	I think it's something that I think I had to learn. Um, because I really do enjoy knowing that kind of trait now. How to look at somebody. Because before, I think in my life I was just more or less take the lead kind of guy. If you take the lead and you don't know who you're leading, you could really hurt some people, really make some people upset. So I learned um, not necessarily on this project, but in college I kind of learn how, sometimes on certain traits you got to take the back seat on certain traits, you got to speak up 'cause nobody else will. Um, and that's I think that would be establishing leadership and stuff like that. Um, so I learned, um, so I think it's a really good trait to have, to know your teammates
Conflict	'Cause last semester, we had a lot more, letting loose and it really um, it set off a very bad vibe between a couple of team members, a little bit of arguments going on, and anytime you spend a lot of time with somebody, that can be an option. But because it was too much personal inside the work environment, it got really bad, so.	As the year went on, I knew what not to do, what buttons not to push and certain locations. And it was a hard thing for me. You know, to learn how, what professional really meant. Um, separating my personal beliefs from my work experience. Um, we had a discussion outside of the project, just when we were

	<p>Um, one's religion conflicted with one's mouth. 'Cause I was talking about you know, I just tend to sing, or tend to talk about (religion) a lot, wherever I am. And um, the other individual tends to curse, a whole lot. That kind of stuff just got washed out.</p>	<p>doing a homework together.</p>
<p>Faculty and Department Support (Lack of)</p>	<p>It was poor because we tried to meet, once a month, when we should have been meeting every two weeks, at the least. umm, she was very busy and points in time, and so a lot of us, we had to communicate through email and as the semester went on, especially after funding it started out fantastic, like Junior year second semester when we chose her she was telling us all the plans that she had and it sounded great. Summer came back, umm, came back after this summer, started out very well. She told us the goals that we were expected to achieve and as soon as the funding was lost you could tell, for her, it really didn't mean much anymore. Because she was pretty much looking for the publication, I'm guessing. Not that she was a mean person or anything, it was just, like that was what she was looking for out of it.</p>	<p>And so now, the only obligation that she had towards our group, was the fact that, she knew that it was a project that we had to do. So she tried to help as much as she could, as far as her concerns were, after that point. So it really wasn't a big deal to her anymore. It was more or less she just didn't want to really leave us high and dry, I guess and that's where things started going downhill. Because we lost touch, umm, communication wasn't as good, and the project was just going downhill fast. And then she left (the university).</p>

B.6 Phil: Team Experience Clusters of Meaning

Common Cluster	What	How
Faculty Interaction (classroom environment)	I missed the second to last, the last class actually because I was at a job interview (company), and I came back and it turned out we had a final that day. I didn't hear about it. I was like 'oh no'. So I asked the TA if I could retake it and he was like, I really doubt it. But if you go ask the professor, I can't give you any more time. So I went and asked the, uh, head guy. He was like, 'oh sure. Come retake it. It's not that big of a deal'.	The instructor and I were actually on pretty good speaking terms. Yeah, I might even call him a friend. It was pretty cool. Yeah, we talked about programming and life stuff.
Conflict Management	(personal identity) The one dude that got an attitude in our group had like an attitude thing somewhere near the end of the group project. I don't know if was because he didn't want to do things or he was like didn't see why we were doing, I don't know. And then I just kind of talked to him and I was like, 'hey man just get it done, send it to me when it's ready and he kind of got over it'	I think he might have had something going on at home or something. Just a bad mood. Talk it out yeah. But I'm not usually that blunt. But at that time I felt it was like, this is, this is what needs to happen. Just do it. Um, no it was more, I kept talking to him and I guess trying to gauge the situation and in the end, I was like yeah, just do it and get it sent to me. And the other team member was like, 'Yeah, I'm done' but he hasn't sent me his other part and he had like the middle part, so we needed that to actually finish. So. Yeah, in the end we just kind of had to get him to do work.
Team role	(personal identity) (his team role) kind of coordinator (team role) and writing a bunch of stuff.	I was always really good at English and writing. It's one of my strengths and I try to use that. Um, I was kind of the leader that organized the meetings. It wasn't like a formal thing. Um, guess it was just 'cause I stepped up. Everyone else we kind of set up a date to meet up, okay we'll text each other and we'll get to know each other better later, and no one actually got on it. So, we're just kind of waiting for someone to do something and I was like, alright fine, I'll do it. I called the people and set stuff up.
Personal Interaction/Work Distribution	it's like we give each other, like little jobs to do. And then they all get it done, so when we come together it's like, "oh, we didn't TALK about what we were doing." But it's all finished, we just gotta put it together. Yeah, they changed each report. (Okay) We split it up there're usually about eight parts to each report, we go okay, I'll do one through three, and somebody else will do like five through eight or something like that	And, because we've never actually met up, I don't think we met up at all, like not a single time, this whole semester. We all just did separate ones and just said okay just turn it in. (pause) We really have not met up yet. Like not even, a single time.

Friendship Opportunity	The way we interacted. We actually talk a little bit outside the class, too. He was one of the original members of the group.	I consider him to be a friend. I definitely prefer having a friend on a team. Because it's a lot easier to talk to him. You can uh, relax with him, you can do work while at the same time enjoy yourself. It's a lot easier. Um, I could, and can, do I guess. But, it's a lot more enjoyable to be relaxing with a friend than trying to pretend with someone you don't really enjoy being around.
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Unique Cluster	What	How
Experience		They went pretty well. All the groups I was in worked together pretty coherently. I can't remember any big problems with them, so. They worked really well. Oh definitely. (still thinks teamwork is important) 'Cause you have to work in multicultural diverse teams all the time. Yes, definitely. Like over the summer when I worked at (company name), carpenters, plumbers, electricians, painters, mechanics, everybody.
Engineering Identity		I guess up and coming. Still proceeding forward. Actually I got an internship at, a pretty big aircraft company this summer. It's called (company name). So yeah. It's in (University). kind of how I'm going to stay up there. But yeah. I'm kind of excited about it
Racial Identity	(Stereotype Awareness)	I don't really know exactly. It's not simple to answer it correctly, 'cause a lot of the teams I get on, there are kind of like a preconceived notion of how like a Black person will act in class. So when they see me they're already kind of surprised. So they spend like a lot of the time trying to figure me out. So they constantly try to like be around me to figure out like what my plan is. What I'm doing. Kind of who I am in a way. They're already watching me, so I'm like okay let's do this and they're like alright, we'll go along, see how it is. I got to be on my toes.
Unique-	Added team member	I think it was 'cause me and one of the other group members I think it was (name), we got along really, really well. Which was good. We kind of like offset this other group member we had, who came in the class a little late, was a little awkward, kind of hard to talk to, so it was a little bit difficult to actually communicate with him
Unique	Positive ICT	Ok, so the conversation got started, we were on the bus, and I know this kid pretty well, I mean we were decent friends, at that point. We didn't really hang out outside of school too much. But

		<p>pretty cool, and he was wearing like this big Confederate flag on his shirt, and I looked at it, I was like hmm. "What does that mean to you, in a way? And he just, like started talking about it. "it's like I know a lot of people take it to mean this, but I always saw it as, like a Southern pride or something like that. Like I didn't see it as having anything to do with racism or like hating on Black people." So after that conversation, I went okay, I guess some people could see it, in that sense and not take it like angrily</p>
Unique	Stereotype Awareness	<p>I was telling you there is like before, the teachers and whenever I walk into a class and they give me this look of, he's expecting me to be a troublemaker, like the bad kid and I give them the look of like of just "Ha, you goin regret that look!"</p>

B.7 David Team Experience Clusters of Meaning

Common Cluster	What	How
Friendship Opportunity	I would say they were good. Maybe it helped because I knew one of them before so, we were already on good terms before the other group member, was easy to work with also yeah so. I guess the fact that like, we are trying to I guess we, I'd say we are all friendly I would say we're all like trying to be like in a good mood so that so that just collectively makes it good.	I mean like, like I'd say he's my friend, but I wouldn't like go out of my way to like schedule to do something with him. But, like, if we're like passing, if we see like like, let's say, like, if I'm at the dining hall and I see like he's by himself and I'm not eating with anybody, I'd like join them. I think it'd happen more often for me younger in college than like, now. Or earlier in college I guess. When you're trying to make friends, like, that's kind of your goal. And then like, I guess at this point people are more established, and so who like, they hang out with, so.
Interdependence	A lot of it had to be done together. There were some things we can do separately, but a lot of it, had to be done, like together. To be understood, to be real, you couldn't really separate it, as far as that.	It was fine. I mean we just meet up together, and we just, all like, struggled together, I guess, with the problem. Like we do use this program and we just all like, look at one person screen and try to like, mess with different things, to improve or yeah, for our experiment
TA Interaction	Like, since a lot is done together, you know like , come up with a question and I guess she'd come over and like mess with our program, and try to like help us out explain concepts if we need it, that kinda thing. Uh, like if part of our model wasn't working ask him to help us like trouble shoot it. Or if we're unsure of something or the meaning of something we'd ask him to clarify. We never talked to him about that.	Yeah, yeah. I would feel comfortable talking to her. There's no tension. I don't feel, yeah there's nothing. I'd say, it was overall a smooth experience. Uh, just uh as far as like trying to help us out with the problem. Answer the question. But nothing really extra. But she was like she, she seemed like she was positive. Like she was like fine being around. Like, she, wasn't like negative, she wasn't like cold to us. She was always like, friendly and like willing to help out, so
Personal Interaction	He was just like, he was pretty knowledgeable and like, (pause) we were, I don't know I guess we just like, didn't really have any problems while we were working, like we were all on the same kind of level, as far as the project went	it went pretty smoothly, is what I'm trying to say. Uh, I mean, we got along fine we were just I mean, as people. When we're not working on the project at the time, we can still like appreciate each other's company, so it was a good environment, I'd say in that sense.
Unique Cluster	What	How
Experience		Uh, because like everything that's done that I see like in the working environment and at school, it's uh, they're big projects and you need multiple people to have it done. Uh, just more time being spent with different people and getting to know them and

		still like, being able to get our work done. So I feel like that was a good experience, I feel like that's going to have to be done in the work place in the future
Engineering and personal identity		Um, I think I'm a good listener. I'd say I'm persistent in trying to solve problems. Uh, yeah, I feel, I feel confident. That I'll be able to do it. (work on professional engineering team)
Racial Identity		Uh, yeah. I'd say it has an impact (race impacted overall engineering not team experience). Like, maybe just vibes I get from other people. Of different race I guess I'd say the white race. Just small things like that. Nothing that I can say definitely, but it'd just be having a feeling. Yeah, there's a couple others (AA students in his department).
Unique	CS coding dynamic	Uh, I think I'm more comfortable somebody with me, because like, as far as code like, it's uh, it's usually on a program that it wouldn't be typing direct code, it'd be kind of like dragging and dropping different things, do you understand what I'm trying to say? Like, it wouldn't be straight writing on like, a CS class wouldn't be like just typing code.

B.8 Sterling Team Experience Clusters of Meaning

Common Cluster	What	How
Personal Interaction	Like, sometimes people didn't do like their thing just because I think just because of the way their day was going, um, they didn't do things and then some days I wasn't really active, but I think it all evened out and it was, we had a pretty good interaction. It was like support, like a support. It was a good supporter, you know. We were supporting each other.	It was pretty good we were mostly at the same level and I mean sometimes I had to um, take action on my own.
Work Division	So, that was basically like divide and conquer. Yeah, I found out we were efficient, because everybody would participate. At least, know what's going on. If I was assigned a question, if I was assigned number 1, if I didn't get to look at the rest of the questions.	So, I think this is more efficient, and it really worked out yeah, we come there to work. Yeah, well, I mean, we um, divided the work up evenly and they all performed well to, like with whatever they had to do, so
Team Role (his role)	I kind of organize it. Like the meetings and getting people to work on the papers because last night, I was actually doing that. I sat down and I looked at whatever we did, I kind of edited, I went over at one time. Then I edited everything that we did. Then I texted everyone, to tell them to check their, to check the work we've done. So I think I'm like, that factor, that organizes everything kind of, and I think that's it so far.	I mean, we didn't officially say that I was the leader. But I think everybody knew that I kind of organized, like, the meetings, I organized every meeting we had, like every submission, I submitted every assignment and everybody I assigned most of the things we needed to do, but apart from that, I don't think there wasn't anything set in stone and official. So, it's hard to say if there was other roles. Apart from that, there's no clear cut positions.
Faculty Interaction	So far, he looked at like our progress and how far we got. And he, we had to prove that the issue we chose, like how we chose the, to make a prosthetic arm that replaces tools. He had to approve that. And he did.	And I think, that's mostly what he does so far, because we don't really need his help, except his approval. We just asked him how to do things or like, explanations on the questions on the worksheets, but apart from that, there wasn't really a close interaction with the workshop leader.
Friendship Opportunity (lack of)	Yeah, I didn't get to know them well enough. I didn't, I didn't really put that, that was, yeah.	I was, there's no motive to get to know them past the professional level for our work.

Unique Cluster	What	How
Experience		<p>I'd say so far from everyone meeting, in class, my team experience has been pretty good, personally. I think we did an effective job in finishing the assignment, the assigned worksheet and I think it should go smoothly pass this point and personally I have no complaints, personally. It (his team experience) was pretty good. Um, it was effective. It was efficient. And I was, I kind of, I expected some sort of stereotypical like things. But, no, it was, it was race-free. I mean, it was pretty chill. Yeah, I liked it because I did not, the fact that I'm Black did not mean anything in our team dynamic. At least as much as I know of, it did not mean anything. I expected something, but no, nothing.</p>
Racial Identity		<p>I'm the only Black kid in my class actually. Yeah, I don't think about it. It doesn't matter. But two of my friends, two of my really good friends, are in the class with me. Everybody's just nice (pause) are most people. I mean, but, the fact that I'm the only Black, I just thought about, right now. It doesn't really, it just never crossed my mind.</p>
Engineering Identity		<p>I don't know, just think about it sometimes. I mean, I want to be an engineer. It's something I truly want to do, and I think about what that means. And um, I think that's the best explanation I've come up with. To, even to explain to, I've never had to explain it to anyone, actually. That's the first time people, but, that's how I explain being an engineer to myself. That's how I, that's what I think I want to do with my life. So, that's what I, that's the concept I use to explain to myself what I'm going to be doing for the rest of my life. I'm learning to be an engineer. My dad tells me I am, but he's like you're, he tells me, he asks me these, he asks me a question or like tells me about a, like a situation and then he um, expects me to answer it as an engineer. He tells me that I'm an engineer so I should know that. But I really am not. I'm a (class). That's what I am. So, um, I don't consider myself as an engineer. I think I'm a student. I'm, I'm an engineering student, and I'm comfortable with that.</p>
Unique	Previous personal experience with conflict	<p>I don't know. I mean, I interact with a lot of people. Like, family, friends, and some, some things you just can't talk out. And you got to give it up. I mean, it's, it's been a cause of, like I've</p>

		<p>gotten, I've gotten, like fights, not like literal fights. yeah, um, 'cause I've gotten in conflicts with other people because I wouldn't give something up. And then, it's not yeah. So, I think and then I have solved those same conflicts with, by like giving, giving something up. By seeing them give something up. We have, I've solved a lot of conflicts. So, I think that's a very important thing. In general, in human interaction as well. 'Cause not everybody should, or could get whatever they, everything they want. If that was so, then it would be a different world</p>
<p>Unique</p>	<p>Life-long learning</p>	<p>That's one thing, that's probably the most important thing I learned, my freshman, is that there's lots of things, there's so many things in this world that we all need to learn, and you can never learn enough. I don't think there's a lifetime, there's, there's not one lifetime where you could perfect everything, you know, you can't be perfect. You can't know everything. And I want to. Not just in engineering, but in general. I want to know a lot of things about a lot of different things. But, there's just not enough time.</p>