"Managing by not managing": How gay engineering students manage sexual orientation identity

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“Managing by Not Managing”: How Gay Engineering Students Manage Sexual Orientation

The President's Council of Advisors on Science and Technology (2012) projected that the United States will need to fill an estimated half million job openings in engineering by 2018; however, persistent systemic inequities that affect engineering degree completion impede this goal, leading to an engineering workforce that is majority male and White (National Academy of Sciences, Global Affairs, and Institute of Medicine, 2011; National Science Board, 2014). For instance, although underrepresented racial and ethnic minority students aspire to STEM degrees at rates equivalent to or higher than their White and Asian American peers (Hurtado et al., 2006), these students complete STEM degrees at much lower rates (Hurtado, Eagan, & Hughes, 2012; Maltese & Tai, 2011). Although much research addresses sex and racial disparities in engineering (Camacho & Lord, 2011; Good, Halpin, & Halpin, 2002; Lord et al., 2009; Strayhorn, 2009), only a few studies examine the experiences of sexual minorities within these fields (e.g., Patridge, Barthelemy, & Rankin, 2014).

Among all STEM fields, women are least represented within the engineering workforce (National Science Board, 2014). Women are already underrepresented among engineering aspirants (Lord et al., 2009), and a "chilly climate" for women students in engineering pushes even more women out of the field (Camacho & Lord, 2011; Huang, Taddese, & Walter, 2000; Lord et al., 2009; Tonso, 2006). Factors such as hegemonic masculinity that contribute to the chilly environment in engineering for women may play a role in reinforcing the heterosexism that pervades the culture and climate in engineering programs as well (Cech & Waidzunas, 2011), yet very few studies have explored this possibility. As sexual minorities become more socially accepted (Drake, 2013), and more LGBT people are open about their sexual identities (Gates, 2011), the field of engineering will need to examine the ways LGBT people are welcomed or excluded from the profession.

The purpose of this study then is to explore the experiences of openly gay male engineering students. This study helps fill the dearth of literature on sexual minorities in STEM education in United States universities by exploring how gay men form a sense of engineering identity, navigate engineering academic spaces as gay men, and respond to the expressions of masculinity they encounter within the climate and culture of engineering.

Conceptual Framework

Given how important a sense of belonging to the engineering field is for developing an engineering identity (Allie et al., 2009; Pierrakos, Beam, Constantz, Johri, & Anderson, 2009), and that minority sexual orientations remain stigmatized in engineering (Bilimoria & Stewart, 2009; Cech & Waidzunas, 2009, 2011), I used Troiden's (1989) model of sexual orientation identity development, coupled with frameworks on managing sexual orientation stigma in professional settings, to conceptualize this study. Troiden's model explicitly highlights the internal decision-making process around disclosure of sexual orientation that arises from assessing the potential stigma within a particular environment. This surveillance, as Troiden refers to it, informs people as to the extent to which they need to manage information about their sexual orientations in different environments, such as within an engineering school.

Strategies for managing sexual orientation information within professional environments include "passing" strategies such as counterfeiting a heterosexual identity and avoiding discussions of sexual orientation altogether. People may also come out and integrate their sexual orientations into their professional relationships (Woods & Lucas, 1993). Providing further nuance to integrating, Yoshino (2006), building off Goffman's (1959, 1969) work on impression management, described sexual orientation "covering" as the suppression of identity expression through assimilation to other social norms in one's environment. Yoshino argued that covering is

becoming increasingly relevant as minority sexual identities become more accepted in society and mirrors the identity management processes of women and racial or ethnic minorities. These strategies then result in differing levels of compartmentalization and integration of one's sexual orientation identity in professional settings (Woods & Lucas, 1993).

Literature Review

Sexual Minorities in Engineering and other STEM Fields

Research on sexual minorities in STEM is scarce. In the only prior empirical study of sexual minority engineering students, Cech and Waidzunas (2009, 2011) found that lesbian, gay, and bisexual (LGB) engineering students at one university experienced barriers and challenges, unique to being sexual minorities, that impeded their success in their studies, their participation in professional networks, and their ability to integrate their sexual orientations with their emerging professional identities (Cech & Waidzunas, 2009). For example, one student reported overhearing classmates use the slur "faggot" while another had been told by a peer to keep her sexual orientation to herself. Students also reported gendered expectations within engineering related to stereotypes of gay and lesbian people—specifically, gay men's credibility as engineers was called into question due to being stereotyped as feminine (Cech & Waidzunas, 2011).

Participants in Bilimoria and Stewart's (2009) study of LGB science and engineering faculty echoed these findings. Faculty and students in both of these studies described a heteronormative environment where sexual orientation simply was not discussed (Bilimoria & Stewart, 2009; Cech & Waidzunas, 2011). Heteronormativity is the cultural presumption that heterosexuality is preferable to any other expression of sexual orientation and is rooted in a binary understanding of gender (Munday & Chandler, 2012). The result is the normalization of heterosexuality within engineering and a consequent perception that sexual minorities are

incompatible with the field (Cech & Waidzunas, 2009). Many felt a need to compartmentalize their lives and "pass," meaning they continually monitored their interactions with others so as not to inadvertently disclose their sexual orientation to others (Woods & Lucas, 1993; Yoshino, 2006). Unfortunately, compartmentalization led to internal anguish and participants often isolated themselves from their colleagues and peers as a result (Bilimoria & Stewart, 2009; Cech & Waidzunas, 2011). Possibly the silence in the literature on the experiences of sexual minorities in STEM is reflective of a cultural silence around LGBT issues within these fields.

Researchers did note that faculty created spaces of resistance for themselves and their students (hooks, 2009). Bilimoria and Stewart (2009) described how faculty recognized the ways isolation affected their career opportunities, similar to other findings on the career consequences sexual minority faculty face in academia in general (McDonough, 2002; Messinger, 2011; Taylor & Raeburn, 1995). These faculty took steps such as advising LGBT student groups to improve the climate for students. This finding is especially encouraging given more recent evidence that sexual minority STEM faculty may be more likely to be "out" than their peers in other fields, yet also report the highest levels of discomfort within their departments (Patridge et al., 2014).

The body of literature leaves much room for study. For instance, these studies failed to explore students' connections with the greater LGBT community, either within or outside the campus. Toynton (2007) argued that the emphasis on constructivist and postmodern epistemologies within queer communities may dismiss the typically positivist and post-positivist worldviews of queer science students, affecting their sense of belonging in these communities, in addition to the marginalization they face in their home disciplines. This conflict could extend to sexual minority engineering students as well, suggesting they may not feel very welcome within these communities either, but, again, this possibility has not been empirically examined.

Engineering Identity

Understanding students' sense of engineering identity helps uncover the extent to which students have internalized the norms and values of the engineering profession and thus whether they consider themselves to be engineers or not (Meyers, 2009; Meyers, Silliman, Ohland, Pawley, & Smith, 2012). In an ethnography of an engineering school, Tonso (2006) classified campus engineering identities into three types, based on an elicit-and-sort process that prompted students to develop a list of terms they use to describe each other and then to categorize those terms into overarching groups. These terms were first separated into the "nerds" and the over-achievers, with the "nerds" representing computer-savvy students with lower social status. The over-achievers were then further distinguished by the extent to which students emphasized academics or socializing: "academic-achievers" were those who prioritized their studies while the "Greeks" were students who spent more time socializing, consisting primarily of students who participated in fraternities and sororities. Engineering identity was the result of a complex cultural production process that took place through the legitimacy students afforded each others' "performances" as engineers, or engagement in engineering activities (Tonso, 2006). Both Tonso and Du (2006) suggested the process of developing an engineering identity to be gendered based on differences between men and women in terms of understanding their sense of self as engineers. These gendered expectations also affected the experiences of LGB engineering students in Cech and Waidzunas's (2011) study as stereotypically gay men are labeled effeminate and lesbian women labeled masculine.

Development of an engineering identity begins prior to college as students are exposed to engineering as a possible career field, especially for students whose parents are employed as engineers (Lichtenstein et al., 2009; Pierrakos et al., 2009). In fact, one of the primary reasons

people leave engineering programs is a lack of information about the nature of engineering work (Lichtenstein et al., 2009). Watson, Pierrakos, and Newbold (2010) recommended improving first-year engineering students' experience by offering opportunities to explore the variety of career paths open to people with engineering degrees. Other ways students learn about the nature of engineering work is through their courses (Loui, 2005), and through co-curricular experiences like campus chapters of engineering professional associations or internships and cooperative learning experiences (Kotys-Schwartz, Besterfield-Sacre, & Shuman, 2011).

In addition to types of engineering identities and how those identities develop, other scholars view engineering identity as a sign of students' commitment to and sense of belonging within the profession (Allie et al., 2009; Pierrakos et al., 2009). Overall, the development of an engineering identity is similar to the process of socialization within graduate professional academic programs—the outcome being a stronger sense of identity with that profession (Weidman, Twale, & Stein, 2001). Yet little research has examined how sexual orientation specifically may affect engineering identity development.

Masculinity

One of the reasons sexual minorities face stigma in engineering could stem from the over-representation of men in engineering (National Science Board, 2014). Due to this over-representation, hegemonic expressions of masculinity permeate the environment within these programs (Tonso, 2006), likely contributing to the gendered nature of engineering identity development (Du, 2006). Kimmel (2003) described hegemonic masculinity as competitive, driven by a need to acquire status and wealth, and as exclusive to groups considered "other": for example, women, racial minorities, sexual minorities, and other oppressed and targeted groups in the United States context. Kimmel attributed the social construction of this hegemonic definition

of masculinity to the rise of capitalism in the United States, hence the need to acquire wealth, power, and status as "proof" of one's manhood.

In engineering practice, this "proof" of masculinity is demonstrated through technological mastery or prowess, as opposed to the accumulation of material wealth (Faulkner, 2000). Faulkner argued that engineering is characterized by dualistic thinking arising from the orientation of the engineering field toward solving problems, or deriving certainty out of uncertainty, although dualistic thinking itself is not essential to engineering practice. Dualistic thinking then manifests itself as cultural binaries, where one aspect of each binary is privileged over the other. An example Faulkner provided is the technical/social binary: technical work and expertise in the field tends to be valued over the social aspects of engineering practice.

Binaries and dualisms also arise out of heterosexist thinking, including the organizing assumption that gender operates as a binary (male/female) and that the two sexes necessarily and essentially complement each other (Sedgwick, 1990). Faulkner (2000) further argued that the technical/social binary easily maps onto the male/female binary given the association of masculinity with instrumentality and femininity with expressiveness, and thus the devaluation of women's contributions to the field of engineering. Dualistic thinking may thereby contribute to the gendered nature of engineering identity development. Accordingly, engineering inevitably becomes invested in the heterosexist gender binary. Kimmel (2003) also argued that the repudiation of femininity is fundamental to hegemonic masculinity, leading to a deep-seated fear of being revealed as not a "real man" by one's male peers. As a result, homophobia becomes a fundamental organizing principle for contemporary masculinity (Coston & Kimmel, 2012). In other words, heterosexism and homophobia within engineering likely arise from fundamental aspects of the culture of engineering due to its penchant for dualistic thinking and the over-

representation of men in the field, but this assertion remains mostly unexamined and untested.

Methods

The purpose of this study was to explore the experiences of openly gay engineering students and understand how, if at all, they made sense of the intersections between their engineering and sexual orientation identities. As a result, this study is concerned with uncovering multiple interpretations of reality and is thus grounded in a social constructivist paradigm. Social constructivism assumes that knowledge is socially constructed and arises out of a general consensus of multiple constructions of reality (Merriam, 2009; Patton, 2002). I chose a narrative analysis approach for this study because of the focus of my theoretical framework on meaning-making associated with stigma management pertaining to the decision to disclose one's sexual orientation (Creswell, 2012; Troiden, 1989). People make sense of their experiences, and by extension, their development, through the construction of narratives that give meaning to their experiences (Mishler, 1995; Rossiter, 1999). Rossiter specifically points out that a narrative approach assumes that development has a storied nature—stories are *contextual* and have an inner coherence; the telling of personal narratives is *interpretive* in terms of values, intentions, and purposes; narratives are also *retrospective*, constructed following their constituent events, which suggests development to be an unfinished task; and stories assume a flow of time and are thereby *temporal*. By eliciting stories through individual and focus group interviews, a narrative approach allowed me to capture the influence of students' experiences prior to college as well as their expectations for the future to situate their college experiences within the broader developmental narratives of their lives.

Data Collection and Sample

The primary method of data collection was in-depth, semi-structured, one-on-one

interviews with study participants. These interviews covered a range of experiences in the students' lives, including their engineering identity development, the coming out process with friends and family, what the climate is like for gay men in the engineering school, and places where they felt a sense of belonging (emphasizing engineering and LGBT spaces). Examples of questions asked were, "Are you out to your family? What was coming out to your family like?" and "When do you feel most like you are an engineer? When do you feel it least?" I frequently prompted participants to provide stories and experiences as examples throughout their interviews to help shed light on how they made meaning through the telling of stories. These interviews took place throughout the summer and fall of 2013. A follow-up focus group took place in the spring of 2014 to dig deeper into their experiences as gay engineering students and to return to themes that had emerged from the interview data.

Seven students participated in this project. These students were enrolled in engineering programs at a large, public research university in the Southwest United States. Four of the seven agreed to participate in the follow-up focus group. As no campus organization existed for LGBT students in STEM or engineering to systematically recruit participants, students were recruited through emails sent through the campus LGBT center and student engineering club listservs, and flyers posted throughout the engineering school and campus LGBT center. Engineering majors represented included electrical, mechanical, civil, chemical, and bioengineering, and a demographic breakdown of the sample is located in Table 1.

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Coding and Analysis

I transcribed all of the interviews, including the focus group interview. As the seven initial one-on-one interviews took place over several months, I transcribed and then line-by-line

open coded each interview as they were completed using primarily *in vivo* and process coding, or coding for actions using gerund phrases (e.g., "feeling being gay and being an engineer as unrelated"), to ground my analysis directly in the participants' words and meanings (Charmaz, 2006; Saldaña, 2013). This detailed coding scheme also assisted with utilizing the constant comparative method when organizing the codes into broader themes.

I then reread all of the transcripts several times to identify broader patterns across all seven interviews and developed six broad themes through pattern coding to further organize the detailed coding scheme developed in the first stage (Saldaña, 2013). I then used these themes in the development of the follow-up focus group interview protocol to test my interpretations with participants to further refine my understanding. Finally, to aid with constant comparison and to understand the interrelationships between different variables and themes that emerged from this study, I organized data into matrices to understand similarities and differences between individual narratives and developed a concept map to depict connections between the data (Miles, Huberman, & Saldaña, 2014). These last steps helped me construct a more generalized narrative that captured the essence of what I learned across all seven students' individual narratives. Throughout my analysis I wrote analytic memos to elaborate my understanding of each individual student's narrative as well as the themes emerging from the data as a whole.

Trustworthiness

To ensure trustworthiness in this study, I employed several strategies to ensure the credibility, consistency, and transferability of the study findings (Merriam, 2009). Credibility was ensured through member-checking and the involvement of key informants; I sent a draft of my findings to all the study participants for review, as well as an engineering professor and the director of the campus LGBT resource center. Only one student neglected to respond to my

communication, and no one raised any significant disagreement with or concern over my interpretations of the study phenomena. I ensured consistency throughout the process by following established analysis procedures, maintaining a database of all study data using MaxQDA version 11 analysis software, and documenting each step of the analysis process. Finally, I ensured transferability through thick description of the findings and a sample consisting of a diverse group of students in terms of engineering field, race/ethnicity, and undergraduate/graduate student status.

Positionality

I also reflected on my positionality in relation to the study participants and the phenomenon at hand, especially how my experiences informed my own understanding of the data. At the time, I identified as a White, gay male doctoral student in higher education who also completed a bachelor's degree in engineering. While I was aware that my identities as gay and as a former engineering student helped develop trust and rapport between the students in the study and me, I also acknowledged that my undergraduate experiences took place in a different context and at a different time. A power dynamic also likely existed between the participants and me due to my role as a doctoral student. I worked to mitigate any detrimental effects of these power dynamics as well as my own bias by emphasizing to the students the important role they played in this research process, especially by providing my analysis to them for further feedback and comments. Nonetheless I am aware my perspective provided me a unique sense of understanding of and empathy toward their experiences, which I tried to capture via the memoing process. Since qualitative research tends to be a co-construction of knowledge, with meaning constructed by both researchers and participants in a dialogical process (Patton, 2002), the reflexivity these analytic memos provided helped illuminate my position within the process of co-constructing

meaning out from the participants' constructed narratives.

Limitations

This study has a number of limitations that the reader should take into consideration when interpreting the findings and conclusions. First, I only interviewed gay men for this study; thus the results of this study are limited in their transferability to lesbian, bisexual, or queer engineering students. Although the experiences of sexual minority engineering students are nearly invisible in the literature in general, and thus this study makes an important contribution to the field, future research should either capture a wider range of gender and sexual orientation diversity, or focus on the experiences of sexual minority women engineers in particular. Second, although the sample is fairly racially diverse, race or ethnicity were not explicit criteria in the sampling design, and thus the experiences of students from groups underrepresented in engineering are also underrepresented in the sample, with African American and American Indian students most notably absent. However, the findings are suggestive of the role of intersectionality in participants' experiences. As the experience of sexual orientation is necessarily informed by one's race and/or ethnicity as well as other identities (Bowleg, 2008), an examination of the intersectionality of race/ethnicity and sexual orientation for engineering students is a second important direction for future research (Crenshaw, 1991). This study is also limited by its small sample size, from a single institution, and that the findings were gathered retrospectively, rather than from direct observations of the climate.

Findings

Overall, these seven students' narratives pointed to the ways the culture and climate within engineering, moderated by norms regarding masculinity, affected their experiences as gay men within the academic engineering context. Three themes emerged from the interweaving of

the participants' narratives. First, the climate played an important role in their assessment of how safe and welcome they felt in the school. Second, although all of the students had a strong sense of engineering identity, being gay posed unique challenges not faced by their heterosexual peers. Finally, students' encounters with masculinity prior to college and within the engineering school affected perceptions of the climate as well as their own internalized homophobia.

The Climate in Engineering for Gay Men

Students' perceptions of the LGBT climate in the engineering school can be best represented as a set of epistemological binaries that reflect the dualistic thinking that pervades engineering culture. That is, students described the climate in terms of binaries that either represented two alternative interpretations of the climate within the school or opposite ends of a spectrum along which their experiences were located.

Neutrality versus silence. The first of these binaries relates to the sense students make of their own "surveillance" of how open and welcoming the engineering school is for sexual minorities. Most of the undergraduates felt similarly to Ramon, in terms of his description of the climate during his interview:

> I don't feel like it's welcoming, I don't feel like it's unwelcoming. I feel like it's just neutral in that there's—I've seen no help for like LGBT people in engineering, in the program. I've seen none, no student organizations for, in the engineering department.

In general, undergraduates used the word "neutral" to reconcile their observations on the omission of sexual orientation from the engineering school's priorities regarding diversity with their experiences of very little homophobic harassment among their peers. Jeremy described this climate as satisfactory because he had not experienced any homophobia in the engineering school.

The graduate students, on the other hand, had a more critical perspective on this perceived neutrality when they described the climate. Christopher, in his interview, instead used the word "silent" to describe the climate:

> Silent. It is completely silent. Just by listening to them talk you would never know if people, like, were gay or lesbian or transgender or anything queer at all, like in this major, in the school of engineering. But it's just…I wouldn't say it is welcoming at all. It isn't anti-welcoming, or "no gays at all," but silence is pretty bad too.

The omission of sexual orientation from the school's definition of diversity was more salient to the graduate students than the undergraduate students, which led them to a different conclusion about the climate for the LGBT community in the school of engineering. As a result, they determined that the state of the climate for sexual minorities could not be deduced from the lack of harassment since a norm was present within the school that acknowledgment of LGBT identities and experiences was irrelevant to the field of engineering.

Technical versus social. One of the sources of the perceived "irrelevance" of sexual orientation to engineering is the technical/social binary that is fundamental to engineering culture. As Christopher said, "There's this pretend objectivity where it's like, if we don't talk about that we're doing the experiment, then, all of a sudden, it's objective, and there's no human influence." As a result, students felt the only unique strengths they might bring to the engineering field as gay men were social in nature:

> Personally, I think I'm more eclectic, and I take, I like taking [humanities] classes too. And yeah, I like taking writing class, and everything. I'm more creative…maybe it's very beneficial for engineering, for boring engineering life, for the boring engineering projects, things, just use fancy ideas to make things, make a project really attractive to the

person you are presenting. (Liang)

Jeremy also mentioned being gay might lead to better interpersonal skills, but that technical skills were what were valued by the field. Contrary to these assertions, after I asked them further about the separation of the technical and social aspects of engineering work, they asserted that both social and technical skills were important, as evidenced by the amount of group work utilized in the classroom and the team-based nature of most engineering work. Tariq responded, "Very important, especially for engineers, because most our classes are project-based." So even though they initially perceived technical skills to be more highly valued, the students recognized that both technical and social skills were imperative to succeed as engineers.

Compartmentalizing versus integrating. One final dualism that arose through the interviews was the extent to which students were out as gay to their peers and other colleagues in the engineering school, or the extent to which they integrated being gay and being an engineer, as opposed to compartmentalizing these two identities. Although I perceived the prior two dualisms to be more discrete in terms of how they manifested within the students' experiences, compartmentalization and integration appeared to be experienced more as a continuum, with every student falling somewhere in between rather than either completely compartmentalizing or integrating. My interpretation rested primarily on the ways students described being out to their friends in the engineering school, and not being concerned if others found out about their sexual orientations in unintentional, inadvertent, or indirect ways:

> So with my friend, I talk to her, and I tell her, "Oh, my boyfriend…," and things like that. And then other people heard me that I'm talking about my boyfriend, and I just don't care, right? So, it's, I manage by not managing them. You know, like, I manage by not having to actually be discreet or anything. (Jorge)

Unfortunately, no students reported having disclosed to faculty, staff, or other authorities, and only Jeremy mentioned having his graduate student lab supervisor find out, also inadvertently.

Overall, the result of this climate is the persistent invisibility of sexual minorities within the engineering school. This invisibility led to feelings of discomfort and awkwardness around sexual orientation, which students expressed within the focus group. Tariq mentioned about his experience as an undergraduate, "Like, I once said, 'Oh there was this hot guy,' accidentally, and everyone were like, their eyes were rolling as if I said something awkward." He went on to describe his comfort spending time in the LGBT Center where he did not have to be cautious about language. Ramon added, reiterating the importance of environmental surveillance, "I tend to first kind of study the person, see how they react to hearing news about certain things, and stuff of that nature, and then I decide whether it's safe for me to come out to them." Even their body language during the focus group session demonstrated a great deal of unease speaking about the topic. Although they did not say it directly, for these students, the invisibility of sexual orientation within engineering masked potential hostility.

Unique Challenges Being Gay in Engineering

One of the most significant findings was that all of the participants had a very strong sense of identity as engineers, which was important because gay men are often stereotypically associated with non-technical careers. For instance, Tariq stated, "We always think of gays are very artistic and creative, and not like very technical or like, you know, science geeks and stuff."

Students' strong sense of engineering identity was evidenced through the excitement each expressed when asked about projects they were involved in. Aram vividly recounted a summer internship experience helping develop a computer model of a sculpture under restoration, and Tariq spoke at length about his senior design project developing an infrared music streaming

device. These experiences pointed to aspects of the culture within engineering that had the strongest influence on students' sense of engineering identity.

Sense of belonging in engineering. Students' strong sense of engineering identity was tied to their sense of belonging in the engineering field. This feeling resulted from friendships with other engineering students and being involved in engineering student organizations. Jeremy stated, "I've made a lot of friends through [the biomedical engineering club], so, it's helped me connect with other engineering students." Most of the students' friends also knew they were gay, and this knowledge did not negatively affect those relationships.

However, being gay was perceived as a potential threat to a continued sense of belonging in engineering after entering the workforce. Two of the undergraduates indicated their biggest fear was entering the workplace, not knowing how LGBT people are treated in the engineering field. Fortunately, Ramon's internship experience demonstrated this fear to be unfounded, stating he felt a stronger sense of belonging within the LGBT affinity networks at his internship sites than any campus organization, where he encountered few engineers: "It's reassuring to see someone that's also an engineer and LGBT being successful at the company."

Problem solving and working hard. When asked to identify the essential qualities of professional engineers, all of the students pointed to at least one of two characteristics: engineers solve problems, and they work hard. With respect to problem-solving, several students provided examples of the ways engineering work takes ill-structured problems, applies a set of professionally accepted procedures, and designs a solution, as summed up by Ramon, "…to me an engineer is a person who is given a problem and is challenged in how to solve that problem."

Tariq and Liang also provided examples of the ways engineering academic work follows this pattern. A student's professor or advisor may assign a project for which the student is not

completely equipped in terms of skills or knowledge. The student then seeks out resources on her or his own, learns the material independently, returns to the professor with further questions, and ultimately arrives at a solution. Jorge mentioned learning the C++ computer programming language in that manner, seeking out a textbook online or a class on campus, and then returning to his project. In that sense, even with accepted methods and procedures, engineering problem solving can also be described as a process of "trial and error," as Jorge called it, analogous to the experimentation these students' peers in the sciences would employ in the lab.

The other aspect of engineering work that students cited as essential to the field was working hard. Working hard was defined both as mastering difficult math and science concepts, including their application to engineering problems, and working long hours in order to complete the requirements of their projects. In asking students about their expectations when they entered engineering, and what the reality was like in their programs, nearly every student spoke about how the workload either met or exceeded their expectations. However, as Jorge mentioned, working hard was not necessarily unwelcome: "The thing is like, I really like math, so, engineering, my expectations were like, kind of like, like when you say, 'It hurts good.'" Jeremy mentioned in his interview that others outside engineering also recognized how hard engineers had to work, which afforded these students prestige among their peers.

Working hard had unforeseen consequences for these students, though. Many of their friends who were not in engineering did not understand how much time they needed to devote to their academics, and several students spoke about the workload causing strains on their friendships. The long hours devoted to engineering work meant that students had little time to participate in LGBT communities or experience LGBT culture in particular, as Tariq mentioned, "That's kinda my fear, you know: I'd be too consumed within research, you know, like, working

too much that I miss out [on] a lot of, you know, being gay." In a sense, for Tariq, becoming an engineer "competed" with being gay.

Homophobic Consequences of Hegemonic Masculinity

Even though both culture and climate directly affected students' experiences navigating the school of engineering as gay men, through the students' narratives I was able to see the ways these processes were moderated by their "encounters" with hegemonic masculinity. First, as all of these students were gay men, several spoke about how they learned what it meant to be a man through messages from their backgrounds, cultures, and families. For instance, Ramon and Jorge indicated how *machismo* influenced their understanding of masculinity as Latino men, though with different outcomes for each. Ramon told a story about how his father often used teasing and even bullying to assert masculinity while Ramon was growing up:

> I want to say it was in Mexico…all the men were…outside collecting herbs, collecting, just doing, like, what men do, and the women were preparing the food and everything. And I was preparing the food because I like doing housework. And then the electricity goes out. …and then I was helping [the men] out, I was helping out the men. And then my dad tells me, "You go inside, help out the women, just like the woman you are." And I was furious. I was furious.

Ramon is still not out to his father. Jorge, on the other hand, was also concerned that his male relatives may take issue with his being gay, but his coming out was received much better than he anticipated. Tariq spoke about cultural expectations around masculinity as well having grown up in a Middle Eastern country, pointing to examples of the ways his behaviors are monitored by his family and peers for any expressions of gender-nonconformance, such as the ways he sits, speaks, or generally carries himself. He mentioned his family loves him, but he

fears they might be deeply disappointed were they to find out he is gay. Definitions of masculinity learned while growing up contributed to students' own internalized homophobia as well as their comfort disclosing their sexual orientations to their family and friends.

In addition, as engineering is a male-dominated field, each of the three students who reported having an engineer as a parent (Aram, Jeremy, and Liang) indicated that parent was their father. Since engineering students often learn about the field through their parents, not having access to female engineering role models could contribute to the continued perception that engineering is a "man's field," as stated by Aram and detailed in the next section.

"Engineering is a man's field." Nearly every student spoke about the gender imbalance within their engineering programs. Accordingly, many of the students attributed the instances of homophobia they experienced to this imbalance and the likelihood that many of their male peers had little prior exposure to sexual minorities. However, underneath their assessment of the consequences of engineering being a male-dominated field was the perception that, despite identifying as men, being gay meant they were not included in the hegemonic definitions of masculinity that pervaded their engineering programs. Aram spoke about this when I asked about stereotypes that might prevent gay men from entering engineering:

> I personally know I wouldn't necessarily be afraid, but I could see why that would necessarily be a valid sort of like thing for somebody to be concerned over, mainly because I feel like engineering is, at least, because engineering itself is such a male-dominant field. Women are a minority in and of itself. I feel like throwing gay men in there as well is sort of like, might have the same stigma of, and engineer is a man's sort of a field.

In addition to their own internalized homophobia, expressions of masculinity in the

culture and climate of the engineering school informed students' perceptions of the safety of their environment to be open about their sexual orientations with their peers. This consequence was primarily due to the ways their peers' expressions of masculinity were homophobic or heterosexist. However, Christopher even spoke about feeling uncomfortable with classmates who expressed masculinity in manners he associated with homophobia, "…into sports, and very more traditional…more like a 'jock type,'" regardless if those students were themselves homophobic. Therefore, encounters with masculinity both prior to and during college moderated these gay men's experiences with the culture and climate in engineering by influencing their perceptions of safety, their inclusion within definitions of masculinity, and their own internalized homophobia.

Discussion

The purpose of this study was to examine the ways openly gay engineering students construct their identities both as professional engineers and as gay men, and to explore their experiences of the intersections of these two identities in the college environment.

In comparison to the studies by Cech and Waidzunas (2009, 2011) and Bilimoria and Stewart (2009), students did not perceive the climate to be quite as hostile. Although students cited individual instances where they overheard slurs, they felt comfortable enough to be open with their friends about their sexual orientation to the extent where inadvertent disclosure was not a concern. However, one of the reasons I portrayed their perceptions of the climate as epistemological binaries was to reveal how students' capacity for meaning-making about their environment could be influencing their experience.

For instance, one important factor in the ways students made sense of their intersecting identities as engineers and as gay men was their perception of the relevance of being gay to working as a professional engineer. Social identities tend to be considered irrelevant to

engineering work due to the belief that merit, skill, and ability are the sole determinants of professional success (Bilimoria & Stewart, 2009; Cech & Waidzunas, 2011; Tate & Linn, 2005). The undergraduate students also felt a strong sense of belonging in their engineering program, but most had little connection to LGBT communities. As a result, the relevance of their social identities was not as apparent, and they tended to describe the climate for LGBT people in the engineering school as neutral. These students also found compartmentalizing their sexual orientations to be less problematic when interacting with others in the school because of the perceived lack of relevance in that environment.

On the other hand, both graduate student participants described the environment for LGBT students as silent. They also may not have fully integrated their sexual orientation and engineering identities, but they were able to step outside of their experience and identify how compartmentalization was a problem, likely because both of these students had taken courses on critical subjects, like women's studies, as undergraduates. Ward and Winstanley (2003) argued that sexual orientation is made relevant in the workplace *because of* silence surrounding the topic: LGBT identities constitute the "negative space" throughout workplace discourse in which heterosexual identities and experiences are freely discussed. Evidence of this negative space was even observed in the experiences of the undergraduate participants as most of them spoke about discomfort or awkwardness when their sexual orientations were revealed within the academic environment. Although participants may have not been actively "managing" their sexual orientation identities, these feelings of awkwardness suggest their use of "passing" or "covering" to be subconscious (Woods & Lucas, 1993; Yoshino, 2006). This awkwardness likely resulted from that silence being broken and the negative discursive space being revealed. Thus through portraying students' experience as falling between compartmentalization and integration, and

their perception of the climate as neutral or silent, my findings revealed students' depth of meaning-making and critical reflection on their academic environment.

A second finding was how significant experiences related to masculinity were to students' constructions of their sexual orientation identities, especially within the engineering context. For students like Ramon, his sense of belonging in LGBT communities was affected by his discomfort with gender nonconformity. This finding suggests that integrating sexual orientation into academic and work environments can be especially complicated for gay male engineers because of the influence of masculinity on sexual orientation identity development and the culture and climate in the engineering field (Faulkner, 2000; Kimmel, 2003). Hegemonic masculinity in engineering influences the hostile environment women encounter in engineering (Camacho & Lord, 2011; Faulkner, 2009; Tonso, 2006); it's no surprise then if some of the hostility faced by openly gay engineering students results from being stereotyped as "feminine."

Third, being gay posed unique challenges to finding a sense of belonging in the engineering field, especially when the climate for gay men was difficult for students to assess due to silence around sexual orientation. Developing a sense of belonging in engineering is an important aspect of the process of developing an engineering identity (Allie et al., 2009; Meyers et al., 2012). For this group of students, despite feeling a strong sense of belonging in engineering, being gay was perceived to be a possible barrier to success in the field. Previous research has pointed to the ways gender and racial/ethnic identities intersect with engineering identity (Du, 2006; Good et al., 2002; Tate & Linn, 2005); understanding how sexual orientation can affect finding a sense of belonging in engineering is also critical to developing frameworks for engineering identity. In addition, the engineering course load and norms around working long hours meant students sacrificed opportunities to engage in LGBT communities, a challenge that

was also not explored by Cech and Waidzunas (2009, 2011).

Implications

Academic advisors and faculty in engineering schools may not be aware of the ways their LGBT students perceive the climate. Given preconceptions that sexual orientation is irrelevant to engineering work, faculty and administrators may feel similarly to Jeremy in this study: "There is no reason to bring that up." The findings from this study suggest that sexual orientation does matter with regard to engineering practice, especially in terms of concerns about feeling welcome in industry or having to sacrifice opportunities to find community. Efforts to improve the climate should be inclusive of sexual minority experiences, and faculty, staff, and administrators can attend Safe Space trainings and post placards in their offices to demonstrate their support for students. Sexual orientation needs to be explicitly included in the diversity priorities of schools of engineering, especially if LGBT faculty and staff in the engineering school feel uncomfortable themselves.

Several of the undergraduate participants were concerned about homophobia in their post-college job search because of their uncertainty about what it would be like to be an openly gay engineer. However, Ramon found that the work environment was in many ways more welcoming to LGBT people than the engineering school itself. Career counselors can work with engineering students to better understand what it means to be openly gay in the job search, especially by highlighting how many large companies are devoted to LGBT inclusion, and how in several states people are legally protected against discrimination in employment on the basis of sexual orientation, and sometimes gender identity. In spite of this, 29 states still do not include sexual orientation and 32 do not include gender identity in their nondiscrimination laws (Human Rights Campaign, 2014).

Engineering degrees require a significant investment of time and energy to complete, and several of the students in this study reported having little time to participate in activities that supported their sexual orientation identity development. The dearth of LGBT-related engineering activities means students either have to find those opportunities outside of engineering school, or possibly forgo them altogether. Student affairs professionals may want to consider developing outreach programs geared toward engineering students and other STEM majors to provide LGBT programming that both supports these students' career aspirations and encourages deeper exploration of their sexual orientation identities. Nationally, colleges and universities have begun establishing chapters of oSTEM, an organization dedicated to supporting LGBT students in the STEM disciplines (www.ostem.org). These programs provide an entry point for STEM students to start exploring their LGBT identities and what it means to be an LGBT STEM professional, possibly leading to involvement in LGBT advocacy or leadership.

Finally, encounters with hegemonic masculinity both prior to and during their engineering programs appears to negatively affect the experience of openly gay engineering students in addition to women engineering students. Faulkner (2000) argued that the technical/social binary was a reflection of hegemonic masculinity in engineering; helping engineering students dissolve this binary through increased emphasis on the social skills essential to engineering work, such as through group projects or increased opportunities for involvement in organizations, could emphasize the value of collaboration to the field of engineering in relation to competition. Faculty and student affairs officers in engineering schools will also want to be cognizant of—and actively counter—ways that students perform hegemonic masculine norms and ways such performances are rewarded or tacitly encouraged.

Conclusion

LGBT engineers contribute to the diversity of creative innovations needed to drive our nation's increasingly technology-based economy. However, the silence pervading the field of engineering about the issues faced by gay engineers may be driving many of these bright problem solvers away from the field. If the United States engineering workforce needs an additional estimated half million engineering graduates to fill anticipated job openings over the next decade, colleges and universities must play an important role in ensuring all potential engineering talent is developed. Understanding the experiences of gay engineers contributes to transforming the culture of engineering to better respond to an increasingly diverse society.

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Table 1

Sample Demographics

Pseudonym	Race/ethnicity	Age	Class
Aram	White/Caucasian	22	Undergraduate
Christopher	White/Caucasian	22	Graduate
Jeremy*	Asian/Pacific Islander	19	Undergraduate
Jorge	Latino	21	Undergraduate
Liang*	Asian/Pacific Islander	20	Undergraduate
Ramon*	Latino	21	Undergraduate
Tariq*	Middle Eastern	22	Graduate

Note: * denotes students who participated in the focus group.