

"WE ARE FIGHTERS": EXPLORING HOW LATINAS  
USE VARIOUS FORMS OF CAPITAL AS THEY  
STRIVE FOR SUCCESS IN STEM

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by  
Emily Tancredi-Brice Agbenyega

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Examining Committee Members:

James Earl Davis, Advisory Chair, Urban Education; Higher Education; Policy,  
Organizational & Leadership Studies

Carol Brandt, Early Childhood and Elementary Education; Teaching & Learning

Maia Cucchiara, Urban Education; Policy, Organizational & Leadership Studies

Jennifer Johnson, Higher Education; Policy, Organizational & Leadership Studies

## ABSTRACT

The underrepresentation of women of color in science, technology, engineering, and mathematics (STEM) remains a critical issue. Uneven academic preparation and lack of interest have been cited as common factors associated with low participation and degree attainment rates among women of color in STEM; however, these factors do not adequately explain why women with academic achievement and interest comparable to their white, male peers pursue and attain STEM degrees at disproportionately low rates. Identity has been found to be a useful lens to understand why and how women of color pursue and attain STEM degrees and subsequent career goals. Viewing the challenges women of color face as a result of being in a “double bind”—both female and non-white—can enable scholars and practitioners alike to better understand how they navigate trajectories towards their career and other personal goals. Specifically, forms of capital that women of color access because of, and not in spite of, their identity have been found to provide means for women of color to successfully achieve their goals. This study uses ethnographic methods to explore the experiences of early-mid career Latina engineers and the forms of capital they have accessed along their trajectories through undergraduate education in engineering and in the early stages of their engineering-related careers. Findings reveal that Latinas draw upon multiple forms of science-related social and cultural capital to overcome obstacles related to being female and non-white in a male-dominated field in a U.S. context. The challenge associated with being a Latina is exacerbated in the workplace where “bro” culture is more pervasive than in college; however, an awareness of one’s social identity, the “Americanness” of the gender/race gap in STEM, and a desire to make the field of engineering more welcoming for

subsequent generations of women motivates study participants to persist. Specifically, women in this study draw strength from personal or inherited experience of struggle along their trajectories through engineering. They face challenges with an awareness that obstacles are part of any journey and have developed both an ability to transform obstacles into inspiration for working harder and an understanding that overcoming them is crucial both to repaying the debt of sacrifice of those who came before and paving the way for those who will come after. “Struggle” is thus a form of capital that women in my study acquired and is worthy of exploration as a distinct theoretical framework for persistence. Overall, findings from this study bear implications for individual supports and institutional transformation required to foster the success of Latinas in engineering as a distinct group as well as women of color in STEM broadly speaking.

Dedicated to EEM

(and other sister-mothers in spirit)

who taught me that you *can* do it all, just not all at once.

Here's to mamas striving to be primary educators of brilliant stars  
while aiming to finish thoughts that will change this world into another world.

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## TABLE OF CONTENTS

	Page
ABSTRACT .....	ii
DEDICATION.....	iv
ACKNOWLEDGMENTS .....	v
LIST OF TABLES .....	xiii
LIST OF FIGURES .....	xiv
CHAPTER	
1. OVERVIEW OF STUDY.....	1
Background .....	3
Problem Statement.....	9
Purpose of Study .....	15
Research Questions.....	17
Significance.....	18
Conceptual Framework.....	21
Positionality .....	24
Definition of Terms.....	26
Women of Color .....	26
<i>La Facultad</i> .....	27
Identity .....	27
Capital .....	28
Summary .....	29

2. REVIEW OF LITERATURE .....	31
Background .....	32
Problem Statement.....	33
Research Questions .....	35
Overview.....	36
The Double Bind .....	36
The Double Bind: The Past .....	37
The Double Bind: The Present .....	39
The Double Bind and Identity .....	47
Science Identity .....	48
Background Research on Science Identity .....	50
Intersections with Social Identity and Structures .....	53
Expansion of the Science Identity Model .....	55
Application of the Science Identity Model.....	57
Science Identity and Capital .....	58
Conceptual Framework.....	62
Capital .....	62
<i>La Facultad</i> .....	64
Summary .....	66
3. METHODS .....	69
Site and Sample Selection.....	72
Data Sources and Data Collection.....	78
Observations .....	79



Interviews .....	84
Documents .....	91
Data Analysis .....	92
Wave 1: Notes from The Field .....	92
Wave 2: Hearing Participants’ Voices .....	94
Wave 3: Open Coding and Codebook.....	96
Wave 4: Axial Coding and Capital Codes.....	100
Rigor in Research Design .....	101
Credibility.....	101
Transferability.....	101
Dependability.....	101
Confirmability.....	102
Limitations .....	102
Positionality .....	104
Summary .....	106
4. THE SETTING .....	109
Hispanic Engineers’ Society (HES) .....	110
Organization .....	111
HES Culture: “HES <i>familia</i> ” .....	112
Media.....	119
Activities—National and Regional .....	121
Activities—Local.....	124
5. HES MEMBERS AND PARTICIPANT OVERVIEW .....	128

Membership .....	128
Women in HES.....	133
Interviewees .....	138
Overview of Primary Interviewees.....	139
Mary .....	139
Camila.....	141
Victoria.....	144
Ana .....	147
Isabel .....	152
Pilar .....	156
Rosa.....	160
Alexandra.....	164
Mónica.....	165
Nicolyn .....	166
Overview of Secondary Interviewees .....	167
Marielena .....	167
Esther.....	168
John .....	169
Summary .....	171
6. SCIENCE CAPITAL AND LATINA ENGINEERS.....	172
Science Identity .....	174
Capital.....	177
Science Capital .....	179

Science-Related Cultural Capital .....	183
Scientific Literacy .....	183
Aspirational Capital.....	185
Science-Related Behaviors and Practices.....	188
Visiting Informal Science Learning Environments.....	188
Science-Related Social Capital .....	188
Parental Scientific Knowledge.....	188
Other Dimensions .....	190
Altruistic Motivations .....	192
<i>La facultad</i> .....	194
Summary .....	198
7. STRUGGLE AS CAPITAL.....	199
Struggle/Challenge .....	199
“I Like Being Challenged...” .....	201
“We Are Fighters...” .....	203
“I’m Going to Show You...”.....	205
Underrepresentation as an American Problem .....	208
“Persistence as Resistance: Giving Back and Being “A Role Model for...the Next Generation” .....	214
Summary .....	219
8. HISPANIC ENGINEERS’ SOCIETY (HES) CAPITAL .....	221
Forces That Shape HESTinas’ Capital Use.....	223
Demographic Reality: “I Guess It Makes Me One of The Few” .....	223
In The Field: “It’s a [White] Man’s World” .....	225

Being a Woman: Not Getting “Asked to Lunch” .....	230
Being of Color: “You Have to Fight Harder, You Have to Speak Louder” .....	231
“In The U.S.” .....	232
HES Capital.....	233
The HESStina Movement.....	233
Interviewees in HES.....	237
HES in College: “If They’re Not Giving Up Then I Don’t Have A Reason to Give Up” .....	237
HES in College & Beyond: Developing “Soft Skills” .....	242
HESStina Capital .....	244
Summary .....	247
9. CONCLUSIONS AND FUTURE RESEARCH.....	249
Summary .....	250
Key Findings .....	255
Limitations of Study .....	257
Discussion .....	259
Emerging Themes.....	267
Implications.....	270
REFERENCES .....	273
APPENDICES	
A. RESEARCH TIMELINE .....	286
B. DATA TABLE.....	287
C. CODEBOOK .....	289

D. PARTICIPANT DEMOGRAPHICS .....	292
E. INTERVIEW PROTOCOL—PRIMARY PARTICIPANTS.....	298
F. INTERVIEW PROTOCOL—SECONDARY PARTICIPANTS.....	300
G. PARTICIPANT CONSENT FORM .....	302

## LIST OF TABLES

Table	Page
1. Participant Demographics.....	76
2. Overview of Data Collection: Observations.....	80
3. Overview of Data Collection: Interviews.....	81
4. Overview of Data Collection: Documents.....	82
5. Data Analysis: Open Coding Code List.....	97
6. Data Analysis: Open Coding for Themes.....	99
7. HES: Activity Overview .....	125
8. HES: Sample Annual Calendar .....	126
9. Forms of Capital Participants Mentioned .....	179
10. Participants' Roles in HES.....	238

## LIST OF FIGURES

Figure	Page
1. HES Tweet February 2018.....	120
2. HESrina Media on Twitter.....	233

## **CHAPTER 1**

### **OVERVIEW OF STUDY**

The issue of underrepresentation of historically marginalized groups in science, technology, engineering, and mathematics (STEM) has persisted into the 21st Century despite huge demographic shifts in undergraduate education. Scholars and practitioners alike have framed the “problem” in various ways, citing factors ranging from individuals’ lack of interest (Hurtado, Newman, Tran, & Chang, 2010) to lack of quality STEM education (Hurtado, Han, Sáenz, Espinosa, Cabrera, & Cerna, 2007). Added to this is the variation in underrepresentation within and across STEM disciplines. What is required is additional scholarship that elucidates the particularities of underrepresentation among specific groups in a variety of STEM fields so we can better understand why individuals from certain groups persist. This study seeks to add to the discourse on persistence in the face of underrepresentation through exploring capital use among Latinas in engineering, bearing in mind the simultaneous localized and generalized nature of underrepresentation in various STEM fields as well as the usefulness of research focused on the experience of individual members from underrepresented groups.

The underrepresentation of women of color in many STEM fields has become a topic receiving national attention: in a set of fields requiring increased human resources to fill jobs, the growing demographic of brown girls in particular is viewed as a valuable, untapped resource (National Science Board, 2012). While a programmatic and discursive “buzz” around girls of color in STEM (e.g. Black Girls Code, Latina Girls Code, Code



Like a Girl) exists, reports on the “Double Bind” of being female and of color in STEM reveal that this social identity generates specific challenges that have endured since women first entered STEM fields on a broad scale (e.g. Malcom, Hall, & Brown, 1976; Malcom & Malcom, 2011) particularly related to the “chilly” climates that women have experienced in STEM fields broadly (Hopkins, 1999) and in engineering specifically (Camacho & Lord, 2013a). The experiences of women of color in STEM reflect the "double bind" as much today as they did four decades ago, despite significant policy and structural efforts to foster their retention at the institutional level and their persistence at the individual level (Malcom & Malcom, 2011). As interest among female students of color in the sciences has been found to be comparable to that of their white peers (Ceci & Williams, 2011) yet participation among women in STEM professions in the U.S. generally has been found to be declining (Huyer, 2012), the question remains: what obstacles remain that hinder their potential success and what can be done to eliminate or reduce such obstacles?

Research on women of color in STEM has revealed that those who successfully carve out careers for themselves draw on a variety of forms of capital (i.e. academic and social supports) to succeed (Camacho & Lord, 2013a; Johnson, Brown, Carlone & Cuevas, 2011); what is less understood is how women of color themselves articulate the challenges they face, the relationship of those challenges to their identity, and how they leverage various forms of capital both internal and external in their pursuit of fulfilling careers. In this study, I seek to better understand the landscape of the challenges Latinas in engineering face throughout their career trajectories and the means they develop for transforming potential stumbling blocks into stepping stones toward success. Exploring

science identity in the context of support networks founded on shared cultural identities and common needs enables me to learn more about how identity and career aspirations can support each other rather than exist in conflict. I argue that Latinas tap into various forms of social and cultural forms of science-related capital to enable themselves to succeed in the face of obstacles. Specifically, they attribute their success in part to personal or inherited experience of struggle along their trajectories. They face challenges with an awareness that obstacles are part of any journey and have developed both an ability to transform obstacles into inspiration for working harder and an understanding that overcoming them is crucial both to repaying the debt of sacrifice of those who came before and paving the way for those who will come after. “Struggle” is thus a form of capital that women in my study acquired and is worthy of exploration as a distinct theoretical framework for persistence.

### Background

The impetus behind much of the research on women of color in STEM has been in response to the systemic underrepresentation of women of color and the deficit this creates in terms of workforce supply as well as to the glaring forces of inequity and social injustice that create barriers for women of color in their effort to become STEM professionals (Ong, 2010). Millions of dollars have been poured into programming designed to address the issue of underrepresentation and into research to better understand the complexity of the problem (President’s Council of Advisors on Science & Technology (PCAST), 2010). In recent decades, substantial national policies have been devised to support the formulation and application of comprehensive, evidence-based methods that increase the participation of girls and women of color throughout the STEM

pipeline (e.g. America COMPETES Act of 2007). Despite the combination of programmatic, research, and policy attention paid to increasing the participation of girls and women of color in sciences and engineering, college graduation rates and workforce demographic data reveal that girls and women, particularly of African American, Latina, Native American, and Southeast Asian descent, continue to participate and persist in the sciences at a disproportionately lower rate than their white peers (Ong, Wright, Espinosa & Orfield, 2011). The question of participation and persistence is particularly relevant to engineering as recent research has shown that nearly 40% of women who earn engineering degrees either quit their engineering jobs or do not even go on to pursue engineering careers (Fouad, Singh, Fitzpatrick & Liu, 2012). The question remains: *why?*

Many scholars have explored the causes of sustained underrepresentation and have highlighted the need to foster the interest of girls in science as well as their academic preparation to broaden their participation in the sciences and thus increase the numbers of girls pursuing STEM and women graduating with STEM degrees and entering the STEM workforce (Andersen & Ward, 2014; Barton et al., 2013; Chinn, 1999; Malcom & Malcom, 2011). Much of this research has revealed two key strands of findings that contradict the popular assumption that girls of color may have less of an interest in studying science than their white and/or male peers or, if they do have an interest, they do not have adequate academic skills to succeed particularly at the undergraduate level: First, research on interest in science at the middle and high school levels has shown that interest levels among girls of color are comparable to white, male students—that is, girls of color have just as high an interest in the sciences on average as other groups of students (e.g. Hazari, Sonnert, Sadler & Shanahan, 2010; Ong, 2010);

and, second, studies of persistence in undergraduate STEM majors show that women of color intending to major in STEM are generally as adequately prepared academically as their white counterparts (e.g. Dika & D’Amico, 2016; Espinosa, 2011; Hodari, Ong, Ko & Smith, 2015; Ong et al, 2011). In terms of underrepresentation, this means that, despite relative equity in interest and in academic preparation, girls and women of color participate and persist in STEM at disproportionately lower rates than their white peers. The question thus remains: *why*?

A caucus of women of color in science convened by the American Association for the Advancement of Science (AAAS) in 1975 consulted on the issue of persistent underrepresentation despite comparable interest and preparation and highlighted a key aspect:

Minority women represent a disturbingly small part of the total scientific manpower pool, but are a significant component whose needs seem not to have been addressed by existing programs for minorities or women. They have traditionally been excluded because of biases related to both their race or ethnicity and gender, constituting a double bind. (Malcom et al., 1976, p. 11)

This statement marks the start of the well-known AAAS publication “The Double Bind: The Price of Being a Minority Woman Scientist,” spearheaded by Drs. Shirley Mahaley Malcom, Paula Quick Hall, and Janet Welsh Brown—three leading minority women scientists in their respective fields. One could read the same statement today—in fact, in a report to be explored in greater depth in Chapter 2, Dr. Malcom and her daughter, Dr. Lindsey Malcom-Piqueux, Associate Director for Research and Policy at the Center for Urban Education in the USC Rossier School of Education, found that 35 years following the inaugural Double Bind report, minority women still compose a “disturbingly small part” of the scientific community and, despite programs aimed at fostering their success,

matriculate into graduate school and professional science roles at disproportionately lower rates than their white, male peers. Despite programmatic and funding efforts to foster their persistence, women of color, including Latinas, are still caught in a “double bind” that shapes their participation and persistence in STEM.

Furthermore, as lack of interest, academic preparation, and programmatic efforts do not adequately explain the failure of Latinas to realize equity in degree or career achievement with their white peers nor does the presence of one of these factors seem to “solve” the issue of underrepresentation, additional research is needed that looks at alternative factors that impact the experience of Latinas. The weak explanatory power of the aforementioned variables lends itself to the need for analyzing other variables such as identity, which seems to be at the crux of the issue of systemic underrepresentation of this particular demographic group defined by lines of race/ethnicity and gender. Given the persistence of underrepresentation along lines of race/ethnicity and gender, it is logical to explore the role of identity as it pertains to STEM participation. The obstacles women of color face as they navigate through their studies in STEM and the means they may employ to transform these obstacles have been shown to be strongly linked to their identities as STEM students as well as their sociocultural identities as women of color (e.g. Carlone & Johnson, 2007).

Such research can shed light on the skills, attitudes, and habits that enable women of color to navigate a career path often characterized by a lack of fitting in or sense of belonging at best or explicit discrimination and exclusion at worst (i.e. the “chilly climate,” Hopkins, 1999). Research on women of color who have succeeded in becoming STEM professionals has found that having such skills/attitudes/habits, or *la facultad*, has

enabled them to stay in STEM environments that have all but “chilled” them out of their desired, chosen career (Johnson et al., 2011; Ko, Kachchaf, Ong, & Hodari, 2013; Rincon & Yates, 2018). Additional research can reveal those assets that women possess and structural factors that aid or hinder women of color in STEM who have a strong interest and adequate academic preparation in graduating with STEM degrees and moving on to pursue careers as scientists, technologists, engineers, or mathematicians.

Before exploring the precise problem at the core of this study, it is important to situate Latinas in engineering in the broader context of underrepresented women of color in STEM. Starting with STEM (now, as of the write-up of this study, morphing into “STEAM” to include the arts): it is an umbrella term widely used to refer to the sciences, technology, engineering, and mathematics, each of which are distinct disciplines with their own disciplinary cultures and norms. In the U.S., perceptions of engineering as a desirable career have been growing over the past 50 years (Camacho & Lord, 2013a). While distinct from science and at times viewed as not as prestigious, as part of the “STEM” movement that has re-surfaced following a 2005 National Academies of the Press (NAP)-authored report on the one million vacancies predicted by the year 2020 in the science, technology, and engineering industries, engineering features a prominent role. Thus, to explore underrepresentation in the field of engineering is distinct from comparable studies in other STEM fields insofar as engineering has a unique culture and history (Camacho & Lord, 2013a); yet it is akin to science, math, and technology in that it is part of the same wave of policy and curricular change that resulted from the recent national call to action for schools and other educational institutions to focus efforts on increasing the number of qualified STEM graduates to remain internationally competitive

as far as scientific and technological advancements (National Academy of Sciences (NAS), 2007). As a STEM field in which underrepresentation is particularly acute (Huyer, 2016), engineering is a key STEM space in which to expand the participation of women of color.

As far as trends in underrepresentation within engineering in particular, these vary according to subfield and underrepresentation manifests itself in relation to the presence of women in highly technical roles vs. management/executive positions within engineering. The trend in women being overrepresented in management roles obscures the comparable engineering-related knowledge they possess in relation to their male counterparts. Regardless of the nature of a given engineering-related job, ranging from industry jobs in civil, mechanical, or chemical engineering to jobs in computer science, acquiring a B.S. in an engineering field requires an in-depth study of mathematics and science. Furthermore, attaining a management-level position requires demonstrated technical expertise in one's specific engineering sub-field. To become a manager thus requires technical knowledge even if daily management tasks do not consist of technical tasks to the same extent as explicitly technical and field-based roles.

Engineering remains the STEM field with the lowest participation rates among women (Corbett & Hill, 2015; Huyer, 2016). As statistics show: despite making up over half of college graduates, women earn only 20% of Bachelor's degrees in engineering while underrepresented women of color (Black, Hispanic, and Native American) earned only 4% (Rincon & Yates, 2018). Within engineering, underrepresentation is most extreme in more technical subfields such as electrical engineering (11.5% Bachelor's degrees earned by women) or computer engineering (10.9%) compared to environmental

engineering (49.7%) or biomedical engineering (40.9%) (Meiksins et al., 2017).

Underrepresentation within engineering is uneven and needs to be expounded upon accordingly.

The distribution of women, including Latinas, within the engineering profession, has been found to be skewed toward the management, as opposed to technical, side of the scale (Cardador, 2017). While management is often associated with salary increases, it is also viewed as more closely related to “soft skills” and as less technical, and thereby somewhat removed from actual engineering that carries with it a revered sense of requiring “technical chops” that women are perceived to lack (Cardador, 2017). Thus it is useful to remain aware of the management vs. technical tracks that typify the engineering profession and locate Latinas’ professional roles accordingly to better grasp the intersections between social identity and occupational status in an engineering context.

### Problem Statement

What women of color in STEM need to succeed is clear:

Once enrolled in STEM programs at either the undergraduate or graduate level, women of color should be provided [the] support to engage in rigorous research, benefit from student-faculty mentoring relationships, and access professional development and publishing opportunities—all of which only come from intentional institutional policy and practice designed to support the advancement of underserved populations in science and engineering (Ong et al., 2011).

This vision has yet to be realized on a broad scale. Women of color in STEM overall and Latinas in particular have yet to receive adequate support for engaging in research, to experience nurturing student-faculty relationships as a norm, or to access professional development including internship opportunities to the same extent as their white peers (Espinosa, 2011). Institutional policy and practice have yet to evolve to sufficiently meet



the needs of women of color in science. My study helps to address this gap by generating insight into how Latinas perceive barriers to their success, how these barriers relate to their identity and how they navigate barriers; as a result, findings provide essential information related to fostering the success of a group poised to meet STEM workforce needs and to provide the diverse insights necessary to address the scientific exigencies of this age.

The problem of underrepresentation or the exclusion of certain groups of students from higher education generally and STEM in particular is most often framed in terms of scarcity and shortage of well qualified scientists and engineers to address not only our nation's workforce needs but also the scientific development that our nation needs to achieve social and economic success (PCAST, 2010). In recent years, researchers and policy makers have increasingly framed the issue of underrepresentation in terms of equity, in the case of policy makers, and in terms of social justice in the case of academic researchers and practitioner-scholars (Hurtado, Cabrera, Lin, Arellano & Espinosa, 2011; NAS, 2010). Despite increased policy and research attention over the past two decades, persistence among underrepresented students remains ill-understood.

Descriptive statistics describing the participation of Latinas/Hispanic women in engineering reveal the absence of Hispanic and Latina women from engineering. Among the undergraduate engineering degrees earned in 2010, 18.4% were awarded to women, 1.5% of whom were Latinas (Ohland et al., 2013). As far as numbers, data generated by the National Science Foundation's (NSF's) National Center for Science and Engineering Statistics (NCSES) reveal that, as of the data release in 2012, 1,611 Hispanic or Latina women have earned a Bachelor's degree in an engineering field (National Science Board

(NSB), 2012). Of these, the majority have earned chemical (363) and “other” engineering degrees (328) (NSB, 2012). The smallest numbers of earned degrees were in materials science (21) and aerospace/aeronautical/astronautical engineering (45). To put these statistics and numbers in perspective: growth in women’s representation has slowed in engineering since 1990 (Landivar, 2013). The US Census Bureau cites that, as of 2011, women comprised 13% of engineers whereas in 1970 they were only 3% but in 2000 they were approximately 12%. These statistics are alarming given that women comprise at least 48% of the workforce at large. Following a similar pattern of underrepresentation along lines of race/ethnicity: as of 2011, Hispanics/Latinos held 7% of STEM jobs although they comprised 15% of the general workforce (Landivar, 2013). The National Science Foundation cites that, as of 2015, Hispanic women made up 2% of the science and engineering (S&E) workforce (NSF, 2017). These statistics are made even more concerning when juxtaposed to two demographic realities: First, as America’s largest ethnic minority group and a group that is growing quickly, Latinos are in a position to fill jobs in engineering. Second, Latinas in particular have been shown to persist once they enter undergraduate engineering programs; thus they are “a unique pocket of potential in the landscape of engineering education” (Camacho & Lord, 2013a; Camacho & Lord, 2013b). I thus claim that the experiences of Latinas in engineering education and employment are critical to explore to learn about the factors associated with their choosing engineering and remaining in a field in which they are simultaneously underrepresented and needed.

A small yet growing group of scholars have turned to an exploration of science identity as a way of gaining more insight into the role that identity plays in the experience

STEM students and professionals (e.g. Carlone & Johnson, 2007; Espinosa, 2011; Chang, Eagan, Lin & Hurtado, 2011). These scholars have focused primarily on women who have a high interest as well as competence in the sciences and who have been “successful” in either persisting in STEM through high school, college, or through graduate school and into their early careers as STEM professionals (e.g. Johnson et al., 2011). Two strands of research have been carried out (and often overlap): the first is the interaction between students’ other (i.e. non-science) identities (e.g. race, class, gender) and their science identity (Carlone & Johnson, 2007). Intersectionality theory (Crenshaw, 1989) has played a major role in the theorization and description of the specificities of female students’ of color experiences in STEM as distinct from other groups of students who are marginalized on the basis of one form of difference (i.e. race, gender, socioeconomic status etc.) (Carlone & Johnson, 2007; Diaz, 2012). A second, related strand of research has revealed the formulations of science identity that women of color in STEM create in response to the structural constraints they very often experience over the course of their careers in STEM as students and then as professionals (Johnson et al., 2011; Rosa, 2013). This research has shown that girls and women of color have been able to successfully create science identities for themselves—a dynamic phenomenon wherein identities are continually created, enacted and re-created once again—that look different than the dominant definitions of who does STEM and how science ought to be done. A central related finding is that many successful girls and women of color have been able to actually transform structural constraints into opportunities for development, that is, they are able to take oppressive forces around them and translate them into sources of liberation (Ceglie & Settlage, 2016; Johnson et al., 2011). For these students, the primary

meaning and purpose of their education is not derived from their immediate (often hostile) surroundings. Instead, the successful students studied explain that they derive their sense of meaning in and connection to science from a set of meaningful others outside their schooling context – often their families and local communities (Johnson et al., 2011; Tran, 2011). Thus, individuals who have managed to succeed in a system that has been historically unjust have created new cultural productions of science that not only meet their needs for recognition and support but address the immediate physical needs of others as well as the broader social needs for transformation and justice in their communities (Carlone & Johnson, 2007; Tran, 2011).

Recent scholarship has revealed that many successful girls and women in STEM in fact have been successful at a level that transcends their individual paths: they have transformed their particular conception of their STEM field, as a system that has in many ways limited their opportunities historically, into a tool for their own liberation and the transformation of others. Calling this ability “*la facultad*,” Carlone and Johnson (2007) draw from Chicana social theorist Gloria Anzaldúa’s conception of the ability of those who live “between worlds” or cultures (i.e. related to Crenshaw’s intersectionality theory) to see deeper meanings below the surface of their interactions with others in an effort to successfully navigate a world not their own but upon which their personal success depends. (Anzaldúa, 1999).

New conceptions of science identity and the theory of *la facultad* illuminate means of success for a select group of women of color in STEM who have succeeded throughout their trajectories as students and into their professional careers. Additionally, the notion of science capital most recently articulated by Louise Archer, Jennifer DeWitt,

Amy Seakins, Emily Dawson, and Billy Wong (2015), illuminates how science identity and articulations of *la facultad* in STEM may well be understood in terms of capital. While the concept of science capital and its potential role in students' trajectories through science has been explored primarily among school-age children (e.g. Archer et al., 2015; Claussen & Osborne, 2013), it offers a useful conceptual framework within which to analyze how women of color in science may articulate their science identities using various forms of capital, including *la facultad*. In this study, I claim that framing *la facultad* as a form of capital that women of color in STEM take up and apply in their career trajectories proves useful in seeing *how* and *why* women of color strive to succeed in their chosen career field.

While *la facultad* and science capital have been explored among a small group women of color in STEM and a wide variety of young students in STEM, respectively, such findings have yet to be explored among a substantial pool of women of color in engineering specifically. While prior research has highlighted the role of science identity among “successful” women of color in STEM, it has done so among a very small number of women and predominantly within biomedical fields (e.g. Hurtado et al., 2007). Given that underrepresentation among women of color in engineering is particularly extreme, and especially so among Latinas, I suggest that research on capital use among Latinas in engineering adds to knowledge about how and why women of color participate in STEM fields and choose to stay. Engineering-specific phenomena such as mid-career drop-out among women due to perceptions of a “chilly climate” (Fouad et al., 2013; Walton, Logel, Peach, Spencer & Zanna, 2014) and a shift among women away from technical positions to management positions in the workforce (e.g. Cardador, 2017), are

particularly productive to explore through the experiences of professional Latina engineers who have chosen to stay in the field after more than five years post-baccalaureate and who occupy a variety of managerial and technical roles.

### Purpose of Study

In this study, I employ ethnographic methods to explore the formation of science identity among Latinas in engineering – as a less-researched group of women of color in STEM – and examine how Latinas who identify as engineers navigate personal circumstances and institutional contexts in their effort to achieve their career goals. Interviews with a criterion-based sample (defined below) of Latinas in engineering and observations of a Hispanic-serving professional engineering organization to which they all belong generate a deeper understanding of *how* Latinas, as women of color in STEM, use various forms of capital to achieve their professional goals in contexts including their workplaces and other structures aimed at fostering their success. Findings shed light on the nuances involved in Latinas’ striving to thrive in potentially hostile (i.e. “chilly”) work environments while having access to culturally-relevant structural supports. Findings regarding social and cultural capital that Latinas utilize as well as a perception of struggle as a critical aspect of their success gives scholars and practitioners alike a better understanding of the meaning-making Latinas engage in as they progress along their trajectories in engineering.

In this study, I look at a sample of Latina engineers defined by certain criteria that reflect a level of identification as an engineer and visible markers of “success”: identification as professional/academic engineers, attainment of at least a B.S. in Engineering five years prior to the study’s start (2016), current employment or

postbaccalaureate schooling in engineering-related fields, and strong interest in science as indicated by engineering organization membership and active involvement. As the organization's membership comprises students and professionals of color in engineering, a STEM field in which underrepresentation is particularly extreme: ~9% as of 2013 compared to ~14% of overall college population as of 2012 (NSB, 2012), it is a useful site for gathering rich data on the experiences of a group of women of color who may experience the "double bind" along their trajectories toward attaining a degree and beginning careers in engineering-related professions. Additionally, because the mission of the organization of focus is to build a community or network of support for scientists of color through conferences, professional development, mentoring, and community service/volunteer opportunities, it is likely to attract individuals seeking such support. Exploring science identity in the context of support networks founded on shared cultural identities and common needs lends itself to learning more about how one's identity and career aspirations can support each other rather than exist in conflict. Interview data on women of color's experience of attaining a degree and pursuing a career in a STEM field in which they are severely underrepresented (i.e. where degree attainment and mid-career status represent symbols of success) set a strong foundation for learning more about women of color in science, including the obstacles they face and the means they develop to transform those obstacles into opportunities for success.

Carlone and Johnson's 2007 model of science identity development constitutes the foundation for operationalizing science identity in data collection tools (i.e. interview protocols) though there was room for participants to articulate their own sense of their science identity and how it related to other aspects of their social identity (i.e.

race/ethnicity, gender etc.). Interviews, observations, and document data combined to reveal specific relationships between barriers and skills used to overcome them, adding to the growing literature on agency and capital use among women of color in STEM.

### Research Questions

As the cornerstone of an ethnographic study, my research questions investigate how Latinas navigate their trajectories through their chosen field of engineering as they strive to attain their academic and professional goals. In focusing on Latinas who have attained at least a Bachelor's degree in their field, I am able to gain insight into the challenges and successes they face on account of their gender, race/ethnicity or other features they identify in college and their jobs. Generally, this study seeks to shed light on the complexities of science identity construction among Latinas from a range of subfields within engineering and how they navigate any personal and structural constraints they encounter in the course of their trajectories through engineering.

The precise research questions are:

1. What forms of capital do women of color utilize as they strive to succeed?
  - a. What currently existing structures facilitate/inhibit capital production and use?
  - b. What other forces play a role?
2. What role does the organization play in women's access to various forms of capital and how they use capital?
  - a. What other forces play a role?

Interview data collected in response to the first question was analyzed in the framework of prior research that has revealed the obstacles that many women of color face on account of their gender and race/ethnicity during their careers as scientists. Observation



data also address the question, thus expanding on prior research on the relationship between possession of capital (e.g. science/cultural/social) and persistence in STEM (e.g. Archer et al., 2015; Claussen & Osborne, 2012; Yosso, 2005) and provide context for exploring the phenomenon of *la facultad* as well as other forms of capital found to be positively associated with persistence among female students and professionals in engineering and STEM generally (e.g. Tate & Linn, 2005; Samuelson & Litzler, 2016). Observations and document analysis address both research questions as well.

### Significance

Research on the significance of science identity among women of color in science is growing (Eagan, Hurtado, Garibay & Herrera, 2012) and reveals associated factors ranging from essential personal traits to structural supports (Chang, Eagan, Lin & Hurtado, 2011; Griffin, Pérez, Holmes & Mayo, 2010; Hurtado et al., 2007) that can enable greater numbers of women of color to succeed in achieving their STEM career goals. Especially heartening are the glimmers of insight that research has shown women develop as they transform challenges into means for success (Johnson et al., 2011; Tran, 2011). Such a faculty (*la facultad*) – the ability to become metacognizant about one’s social position and utilize such an awareness to one’s benefit especially in the sciences, notorious for its innate difficulty for all those who pursue a terminal degree (Espinosa, 2011) as well as its hegemonic cultural norms (Camacho & Lord, 2011; Wilson & Kittleson, 2013) – is a vital concept to better understand. This study adds to prior research through generating further qualitative data on the relationship between strong science identity and persistence, shedding light on the dynamic, complex nature between one’s identity and one’s decisions to continue to pursue one’s chosen career.

Expanding upon their prior research on science identity, Johnson and Carlone and two of their students followed up with prior research participants to learn more about their experience as science professionals (Johnson et al., 2011). A key finding was participants' ability to navigate racism through recognition of injustice and the subsequent decision to persist because of it – to work even harder in the face of difficulty. Johnson and her colleagues defined this ability using feminist Latina scholar Gloria Anzaldúa's concept of *la facultad*, the faculty of being able to read one's social reality, to see beneath the surface and to see oneself as others see you (Anzaldúa, 1987). Having done this, *la facultad* also entails being able to channel that perspective towards ones empowerment. For example, an experience of any form of prejudice could trigger an internalization of racist views and thus, internalized racism, perhaps paralyzing an individual; alternatively, discrimination can fuel ones efforts. The latter is a reflection of *la facultad*, wherein there is complete acknowledgement of an unjust system – an acknowledgment that manifests itself with renewed, strengthened action (Anzaldúa, 1987). In the case of the prior research that forms the foundation for this study, research has shown that one of the factors that have enabled women of color in STEM to persist is this very ability to transform their experiences with injustice – both racially motivated and gender-based, both individual and structural – into opportunities for their success. This capability is invaluable for women seeking to succeed in a potentially hostile environment even as they strive to transform the environment itself with the awareness that the environment – and the pervasive gender inequality that defines it – needs to be changed.

Exploring how women of color read their social realities in relation to their social identities and see the deeper, hidden meanings of their interactions with significant others generates additional knowledge on capital development and application among increasingly diverse students in STEM. While prior research has shed light on the agency-structure dialectic that shapes the trajectory over time among a small group of individual women of color in science (Johnson et al., 2011), the role that capital plays in aiding Latinas at both the collegiate and professional levels remains less understood. Intentionally applying the lens of capital theory, which prior research has identified as critical to the success of Latino/Hispanic students in engineering (Camacho & Lord, 2013a), illuminates the ways in which the structure-agency tension frames study participants' experiences throughout their trajectories. Learning more about how Latinas in engineering use various forms of capital and the role that structures play in facilitating their capital use offers a vital contribution to the discourse on the role of identity in engineering, the social production of what it means to be an engineer and the ways in which structures enable or hinder the ability of women of color in engineering to thrive in their chosen life paths. Additionally, knowledge generated about the forms of capital used by particular group of individuals in STEM provides a lens through which researchers can strive to understand the role that social identity plays in the experience of any given STEM aspirant or professional. Thus, learning about forms of capital found to be critical to the success of one group bears implications for capital use among individuals in STEM broadly speaking.

## Conceptual Framework

Given the dynamic, multi-faceted nature of being a female of color in STEM, any conceptual framework aimed at understanding their experience must be comprehensive accordingly. The relationship between identity and agency, as seen in the phenomenon of *la facultad* under study, can well be understood in terms of capital. Connected to Bourdieusian conceptions of culture as a field in which one's identity is constituted and at times caught in conflict between one's agency and structural constraints, identity is potentially a space in which individuals may enact aspirations that seem incongruent with their immediate circumstances and may embody improvised ways of being that go against cultural expectations (Holland, Lachicotte, Skinner & Cain, 1998). Thinking of such enactment in terms of capital is useful for it explains the potential value and impact of individuals' attempts to redefine themselves in spaces designed to limit their potential, such as in the case of Hispanic/Latina women in engineering. While the potential explanatory power of capital, and science capital in particular (Archer et al., 2015), in understanding the underrepresentation of Hispanic women among engineering degree recipients is explored in greater depth in Chapter 2, it is important here to note that it conveys the (scientific) knowledge, skills, and attitudes women of color may take up and apply as they aspire to and succeed in their efforts to become scientists (Archer et al., 2015; Harper & Newman, 2010).

The primary conceptual frameworks that inform this study are, as noted earlier, *la facultad* (Anzaldúa, 1987; Johnson et al., 2011) and the related concept of the “double bind” (Malcom et al., 1976). In the following section, I first briefly define each concept and then highlight its relevance to the study at hand. The ability to be aware of one's

social position and apply this awareness to better understanding the challenges one faces is an invaluable mindset. Looking at the experiences of women of color in science through the lenses of *la facultad* and the “double bind” can shed light on the specific dynamics involved in choosing to transform a given challenge into a means for success—challenges including, but not limited to, individuals’ perceptions, contextual factors, and the tensions between individual agency and structural constraints.

Briefly, *la facultad* is that ability to see beneath the surface of a given situation, to be meta-cognitive about one’s experience. Chicana scholar Gloria Anzaldúa first developed the concept of *la facultad* in her work *La Frontera/The Borderlands*, originally published in 1987. Anzaldúa refers to *la facultad* as “the capacity to see in surface phenomena the meaning of deeper realities, to see the deep structure below the surface” (Anzaldúa, 1987, p. 60). Such a faculty is innate in each person yet is developed in those who live between worlds and who thus have the need to navigate around others’ perceptions of themselves in order to succeed in both worlds. Developing *la facultad* arises from the need to survive if not thrive in hostile environments characterized by grave injustices that exist and that are perpetuated simply because of the social positions that those living between two worlds occupy. Anzaldúa articulates *la facultad* in relation to a “new Mestiza” consciousness:

The "new Mestiza" is a kind of border woman who is able to negotiate between different cultures and cross over from one to the other and therefore has a perspective of all those different worlds that someone who is mono-cultural cannot have. And because she has that kind of perspective, tiene conocimiento: she has an understanding of what's going on in all these different terrains. And so her interpretation is based on perceiving more about the different realities in this world than someone who is just mono-cultural.

What I was trying to do [in *Borderlands*] is set up an ideal—this woman is a superhero, a superwoman and she doesn't exist. Yet if just one aspect of the new Mestiza is in us, then we can say, "I have that quality, too; I'm not so bad. This is a strength in me. This is a facultad. " So these are all facultades: abilities, capabilities that a person that crosses cultures and shapes/shifts identity may have in the future. (Anzaldúa, 1991)

The notion of a “new Mestiza” relates directly to Latinas in engineering both because of possible literal cultural congruence and because many Latinas may have personal experience with navigating the borders Anzaldúa speaks of (engineering/non-engineering; STEM/non-STEM; Latinx/American; female/male etc.) as they negotiate between the different cultures they occupy (i.e. profession, family, peers etc.) The possibility of Latinas in engineering possessing facultades innate in the “superwoman” of the new Mestiza is indeed quite high. This study is designed to learn from participants their own conceptions of their identity and careers as well as the forms of capital they’ve accessed to persist; the concept of *la facultad* may assist in understanding their experience in relation to a culturally-relevant theoretical framework rooted in an awareness of the capabilities that a “border woman” requires to successfully navigate between cultures.

Taking account of the “double bind” therefore constitutes another key aspect of the theoretical framework as it too conveys the challenges involved in ascribing to multiple identities, especially when those identities are not rooted in the dominant culture. Being female and of color bear unique structural consequences with historical specificities that need to be explicitly acknowledged. Indeed, the “double bind” itself reveals is a third layer, or bind, that being in STEM may itself become for women of color. To be black/brown and female in the sciences is to be in the minority not only in one’s chosen field but among one’s peers or family (e.g. Camacho & Lord, 2013a;

Malcom et al., 1976). As a result, the identity of being a scientist itself constitutes a third bind. While it may not be a force of oppression, it can be a source of exclusion from one's home community when aspiring to a career in STEM or living a life as a STEM professional is not seen as an ideal or even viable life path among those whose opinion one may value and among those with whom one is most familiar. In this sense, while being a STEM professional doesn't bear the weight of oppression in terms of power or domination, it is another layer of social identity that could be disempowering within one's home community when one's home community doesn't generally identify a STEM professional as "one of their own" (Malcom et al., 1976). The study of the "double bind" reveals the socially constructed nature of being a STEM professional and the culturally-rooted meaning of what it means to be in STEM, as well as the overall tendency towards the dominant association of STEM with white, male norms. At the same time, study of the "double bind," particularly through the lens of capital, bears strong implications for new conceptions of being in STEM that may transcend cultural boundaries and leave space for multiple epistemologies such that females of color in particular can readily identify as STEM professionals and STEM professionals can readily identify as whichever social identity they choose (e.g. as in the development of science capital [Archer et al., 2015]).

### Positionality

As a student in urban education, I seek to understand issues of access and equity and how they relate to students' social positions in terms of race/ethnicity, gender, and socioeconomic background, among other social traits. Based on an understanding that education is often a stratifying force that produces social inequality, I analyze social

phenomena in terms of who benefits and why as well as unintended consequences of a given educational project. In the case of professional Latina engineers, I aim to frame their persistence in terms of their social positions as well as in terms of the structures that circumscribe possibilities for individual and collective progress.

As a woman of color in the social sciences, I can relate to some extent to the “double bind” in the context of my schooling experiences both in college and graduate school. The sense of questioning my abilities despite adequate academic training and a strong interest in the subject matter based on a sense that others may perceive to be less prepared or to have gained access to my educational opportunities due primarily to my race in combination with my gender – and not necessarily by merit – is a familiar one. I can only imagine such a sense being heightened in the sciences, a space much more typically characterized by competition and exclusivity and by white, male norms. I have also witnessed the mentality that fellow women of color in varied fields have developed as they’ve navigated their trajectories through their undergraduate and graduate studies – a mindset characterized by grit, determination, and safeguards up, ever ready to overcome a socially unjust, race/ethnicity and/or gender-related obstacle that may cross their path.

My training and my social position combine to give me an awareness of obstacles my research participants may face even as they may blind me to elements of their experience I may not expect to find. Especially as a woman who is not Latina, I need to remain vigilant of the multitude of culturally-related experiences and perspectives that I do not know even if there’s a shared sense of being brown and female in the 21<sup>st</sup> Century U.S. context. In triangulating my observations with participants’ perspectives, it is my



hope that their voices are heard even as I take responsibility for any insights that may have been lost in translation between their intended meanings and my interpretation of their experience.

## Definition of Terms

### *Women of Color*

Using the term women of color is simultaneously safe and dangerous. It is safe because it is a blanket term for any women who self-identify as “of color” and is thus quite general; the danger lies in the generalization itself, as the distinctions between the groups of women – and the individual women themselves – are numerous and significant. In the case of this research, I use the term to describe women from the non-majority (i.e. non-white) ethnic group in society who have been historically excluded from higher education generally and STEM in particular. These groups include Latinas – with Chicanas forming a significant and distinct group within Latinas, Native American women, African American women, and southeast Asian women – a relatively “new” group that researchers have found to be grossly underrepresented in the sciences as well as other fields (Ong, Wright, Espinosa & Orfield, 2011). The focus in this study is on Latinas/Hispanic women (these terms are used interchangeably here as they are in the organizational context in which participants are situated) yet language around “women of color,” and “minorities” arose during interviews and so “women of color” as a category remains relevant. As the Latino community is racially/ethnically diverse with roots in European, African, Asian, and indigenous groups, clearly not all individuals are technically “of color,” as defined in a U.S. context; however, because all women in my

interviewee pool identified as “minority,” “of color,” or “Latina,” and appeared to use these terms interchangeably as well, I found this label useful.

As prior research on participation and persistence in STEM uses the term “women of color” consistently, this study likewise employs the term. In this sense “women of color” is intellectually useful and productive, even with its generalized nature. Prior research has found that enough intragroup commonalities – associated primarily with experiences of oppression and discrimination yet also with collective empowerment and thirst for social justice – exist among women of color who are underrepresented (i.e. who have been historically excluded) in STEM to constitute it as constructive for research purposes. I thus employ it here.

### *La Facultad*

To reiterate, *la facultad* is “the capacity to see in surface phenomena the meaning of deeper realities, to see the deep structure below the surface” (Anzaldúa, 1987, p.60). Such a faculty is innate in each person yet is developed in those who live between distinct, at-times opposing social worlds and who thus have the need to navigate around others’ perceptions of themselves in order to succeed in both worlds. Developing *la facultad* arises from the need to more than survive – rather, *thrive* in hostile environments characterized by grave injustices perpetuated by discrimination and prejudice against those occupying the social positions that exist in the space between two worlds.

### *Identity*

Identity is often framed as an ego-centric process (Erickson, 1968; Heilman, 2001); however, as an active process, identity in this study is defined as much by what

one *does* as by who one *is* (Carlone & Johnson, 2007). Additionally, *la facultad*, with its emphasis on identification as an individual-structural process, reframes traditional notions of identity such that both individuals' perceptions of themselves as well as their sense of agency in changing structures around them are equally critical aspects (Johnson et al., 2011).

The focus throughout this study is science identity as defined by Carlone and Johnson, 2007: individuals' recognition by others and themselves as scientists and demonstrated ability in the sciences. The role that other aspects of identity – race/ethnicity, gender, social class, and culture – plays in individuals' trajectories through science is also explored. I thus simultaneously keep in mind the challenges involved in using identity as an analytical concept (Brubaker & Cooper, 2000) and focus on conceptions of identity that are processual, that is, processes of identification rather than static notions of specific identities (Brubaker & Cooper, 2000)

### *Capital*

As capital is a term used in the research questions, it may be helpful to note here that I use the term broadly to include forms of cultural and social capital that Latinas of color possess, create, and apply in their lives as engineers. As such, science capital is a science (and thereby STEM)-oriented form of cultural capital (Archer et al., 2015) and thus features prominently; however, just as identification is a process involving dynamic identities, capital use is also a dynamic process wherein what constitutes capital varies according to the different social spaces women of color in STEM occupy (e.g. Samuelson & Litzler, 2016).

Also, although science capital is not theorized within the broader Bourdieuan framework from which the notion of capital is drawn, it is critical to note here that the value of science, and other forms of, capital is itself defined by the social space, or “field,” that Latina engineers, as social actors, occupy (Bourdieu, 1990). Moreover, Latinas’ social position in a field critical to their success (e.g. workplace, HES, community) is determined through the interaction between the norms of that field, Latinas’ habitus (i.e. their embodied dispositions and tastes that may or may not align with the norms of the field), and the extent to which they have access to capital and use their agency to use that capital to advance within the field (Bourdieu, 1990). Social positions are thus shaped by the dynamic of power in maintaining fields in which capital is unevenly distributed and differentially accessible. That is, a dynamic relationship exists between the social positions Latinas in engineering occupy and the forms of capital they have access to. This relationship is shaped by power and the extent to which their habitus aligns with the norms of a given engineering-related space. In this study, HES provides a “field,” a critical space (as explored in Chapter 8) in which Latinas are empowered to access and leverage capital for their career advancement in other fields (i.e. college, job, family) in which their access to capital is more limited. I argue that the Latina engineers in this study not only draw upon forms of capital prior research has identified that they have been empowered to access but have cultivated capital in the form of “struggle” or “challenge” they have experienced in their trajectories.

### Summary

This study builds upon prior research that highlights the significance of science identity to the experience of women of color in STEM and supports women of color draw

upon in college or in their professions and explores how a particular group of women of color use various forms of capital to strive for and achieve success in their career (e.g. Carlone & Johnson, 2007; Eagan et al., 2012). Through an ethnographic approach this study reveals the complex relationship between identity and persistence and identifies specific skills, habits, and attitudes that Latinas employ to succeed in engineering, their chosen career. Building directly on prior research and expanding on it through the use of capital as a theoretical framework, findings from this study add to the discourse on fostering the persistence of underrepresented women in STEM.

## CHAPTER 2

### REVIEW OF LITERATURE

While women of color have never been proportionately represented in science, technology, engineering, and mathematics (STEM), or in higher education generally, the past two decades have witnessed a rise in policy and research attention paid to the issue of underrepresentation as the result of seminal reports including “Rising above the Gathering Storm” authored by the National Academies (NAS, 2007), “Rising above the Gathering Storm, Revisited” (NAS, 2010) and “Engage to Excel” authored by the President’s Council of Advisors in Science and Technology (PCAST) (PCAST, 2012). The National Academies’ forecast of over 1 million STEM jobs that need to be filled by 2020 and the related call for increasing access to STEM education for underrepresented minorities – an untapped, growing demographic among college students generally and within STEM specifically (Rodriguez et al., 2012) – have resulted in the generation of policy and scholarly research focused on the experience of minorities in STEM and innovative methods for fostering their success. Heeding this call as well as recognizing the need for broadening participation in STEM with an aim toward equal access and equitable outcomes, researchers have shone a spotlight on the factors that contribute to persistence in STEM among women of color, including individual-level traits and structural supports (e.g. Hurtado, Cabrera, Lin, Arellano & Espinosa, 2009; Hurtado, Eagan & Hughes, 2012; Litzler & Samuelson, 2013). Research on persistence among women of color in engineering parallels that on persistence in STEM more broadly as similar factors have been found to typify their experience: experience of stereotypes related to their race/ethnicity and gender (Browner, Camacho, Lord, Long & Ohland,

2012); identity conflicts between their identities as engineers and their social identities (Tate & Linn, 2005); and “chilly” classroom climates that may inhibit their desire to pursue engineering degrees (Hughes, Garibay, Hurtado & Eagan, 2013). Thus, the literature on persistence among women of color in STEM is explored in addition to scholarship on engineering specifically.

## Background

A significant pool of research focused on factors related to the persistence of girls and women of color in STEM centers on issues of identity. Whether related to interest among middle and high school students (Barton, Kang, Tan, O’Neill, Bautista-Guerra, & Brecklin, 2013) or background characteristics such as social identity (Hazari, Sadler, & Sonnert, 2013) and academic preparation (Oseguera, Hurtado, Denson, Cerna, & Saenz, 2006), science identity has been identified as a key factor shaping the trajectories of women of color in their pursuit of STEM degrees and careers (Carlone & Johnson, 2007; Eagan, Hurtado, Garibay, & Herrera, 2012). Importantly, while interest can be cultivated and academic preparation can be improved, one’s social identity as it relates to science is an intrinsic, if socially constructed, attribute. Particularly in relation to others’ perceptions, race/ethnicity and gender are two at-times visible characteristics susceptible to the judgment and subsequent differentiated treatment of others. As a result, it is vital that we better understand the role of race/ethnicity and gender in the experience of women of color in STEM to make evident the construction of barriers that women of color in STEM face related to their social identity and the possibilities for deconstructing those barriers. Additional research on science identity in relation to social identity may

enable scholars, practitioners, and students alike to better understand the persistence puzzle among women of color in STEM fields.

Situated among other qualitative studies that analyze persistence from an assets-based perspective (Griffin, Perez, Holmes & Mayo, 2010; Harper & Newman, 2010; Samuelson & Litzler, 2016), this ethnographic study explores the various forms of capital (i.e. personal and structural assets) women of color draw upon in their efforts to overcome obstacles as they pursue their careers in STEM. Prior research shows that women of color possess and/or access various assets (e.g. altruism, sense of meaning rooted in community/cultural knowledge, and *la facultad*) that enable them to persist in STEM despite obstacles they face (Tran, Herrera & Gasiewski, 2011). Maintaining focus on such assets and framing them as forms of capital within a science identity framework generates further knowledge on how successful women of color in STEM transform obstacles in their path into opportunities for success.

### Problem Statement

Current research shows that conformity with the status quo is not the sole path that ensures the success of women of color in STEM; transformation of the status quo of what it means to be a STEM professional and to do STEM-related work is also positively associated with underrepresented women of color attaining their STEM career goals (e.g. Johnson, Brown, Carlone & Cuevas, 2011). The relevant literature to be explored in the following review reveals that many students of color in the sciences are motivated to pursue STEM careers for a variety of reasons: an altruistic desire to serve one's community and address exigencies therein, to define oneself as a STEM student/professional according to one's own adaptations and interest despite



discouragement from others in the STEM community, and to tackle each systemic obstacle through actively transforming it into an opportunity for advancement—turning crisis into victory. While not all of the studies explored here focus exclusively on women of color in engineering, they each add to the discourse on how the success of those who have been historically excluded from or marginalized within STEM show glimmers of possibility for “warming” presently “chilly” climates, for creating inclusive STEM environments welcome to all who desire to pursue careers in STEM fields. My study draws from the growing assets-based approach to studying the persistence puzzle and frames assets in terms of forms of capital women use: human capital manifest in the aforementioned assets of an altruistic desire to give back to one’s community, to define success and what it means to be a scientist on one’s own terms, and transforming challenges into a means of career advancement. Additionally, structural supports (i.e. family, school etc.) constitute forms of social and cultural capital that Latinas, and other women of color, draw upon as they pursue their career goals (Samuelson & Litzler, 2016). This study thus expands upon current research with its focus on how Latinas (as a representative group of women of color) in engineering (as a field in which women of color are severely underrepresented) perceive the obstacles they face and the means they access to transform stumbling blocks into steppingstones along their trajectories as engineers. Building upon prior research and expanding the boundaries thereof to include a focus on Latina professional engineers broadens the discourse on persistence among women of color in STEM while also shining a spotlight on a particular demographic group therein.

Given that many of the U.S.' most critical social and economic problems are intertwined with issues of race/ethnicity and class, it is vital that STEM professionals are equipped with the academic and cultural knowledge to perform research on and devise solutions for these critical issues. Prior research has shown that scientific research on communities of color is a primary concern among STEM professionals of color generally (Carlone and Johnson, 2007; Tran, 2011). Additionally, altruistically-oriented scientific endeavors motivated by a desire to better one's community is a motivating factor for persisting in science among women of color specifically (e.g. Brandt, 2008; Johnson et al., 2011). It is in the interest of the nation's workforce to foster the success of women of color in STEM because the impact of their success is not limited to a specific community or demographic group. Research that provides insight into what drives women of color in STEM to persist despite the many obstacles they face and the capabilities they've developed to overcome these obstacles is thus pertinent to the continued social advancement of U.S. society.

### Research Questions

The questions I ask regarding the persistence of women of color in STEM include: What forms of capital do women of color utilize as they strive to succeed in STEM? Also, recognizing the crucial role that structures play in mediating capital use, I also need to ask what role organizations may play in the forms of capital women utilize and how they use capital. For each of these lines of inquiry it is useful to inquire as to which other structures facilitate/inhibit capital use among study participants and what other forces (i.e. social, economic, cultural etc.) may play a role in how participants take up and apply capital along their trajectories through engineering. Asking these questions

with a focus on individual women of color in engineering generates knowledge about how identity shapes the experiences of women of color in engineering and how various stakeholders can foster the persistence not only of individual girls and women in engineering and STEM but transform STEM spaces according to expanded notions of what it means to do STEM and be a STEM practitioner.

### Overview

The following literature review explores several exigencies at stake: The unique social position women of color in STEM occupy – the “double bind” that women of color often experience as they face discrimination based on either their race/ethnicity or their gender or a combination of both; an overview of science identity as it pertains to the persistence of women of color in STEM; and the capital that women of color have been found to possess and apply as a result of the hostile climates they continually inhabit. A growing number of studies have explored how students of color actually enact or apply capital to challenges they face, thereby transforming those challenges into opportunities for success (e.g. Archer, Dawson, Dewitt, Seakins & Wong, 2015; Carlone, 2004; Dika & D’Amico, 2016; Gazley et al., 2014; Hodari, Ong, Ko & Smith, 2016; Johnson et al., 2011). Additional research is thus needed to shed light on *how* women of color have persisted throughout their trajectories as STEM students through to being mid-career STEM professionals.

### *The Double Bind*

The “double bind” that women of color in STEM experience has been a topic of scholarly inquiry for at least four decades (Malcom, Hall, & Brown, 1976). The term was

coined in a report published in 1976 describing the experience of women of color in science. While the constraints characteristic of the “double bind” have improved to some extent over time, research shows that the “double bind” persists today (Malcom & Malcom, 2011; Ceci & Williams, 2011). The following section is divided into two sub-sections: An overview of the “double bind” as it was first outlined the seminal American Association for the Advancement of the Science (AAAS)-sponsored 1976 report exploring the status of women of color in the sciences and the persistence of the “double bind” in present day; and the implications the “double bind” bears for fostering the success of women of color in STEM.

#### *The Double Bind: The Past*

The term “Double Bind” originated with the 1976 AAAS publication, a report spearheaded by Drs. Shirley Mahaley Malcom, Paula Quick Hall, and Janet Welsh Brown – three leading minority women scientists in their respective fields. Malcom et al.’s report, “The Double Bind: The Price of Being a Minority Woman Scientist,” outlined the predicament of being a minority female in the sciences during that era. The report was the result of an historic gathering convened by the AAAS in 1975 of approximately 30 women of color in science from a variety of subfields. The purpose of the gathering was to survey the experience of minority women in science and draft recommendations for structural supports that could foster the success of greater numbers of women of color in the sciences. The general findings were clear, as Malcom et al. explained:

Minority women represent a disturbingly small part of the total scientific manpower pool, but are a significant component whose needs seem not to have

been addressed by existing programs for minorities or women. They have traditionally been excluded because of biases related to both their race or ethnicity and gender, constituting a double bind. Programs for minorities and women have generally been assumed to include minority women, but in fact minority women fall in the cracks between the two. (Malcom et al., 1976, p. 11)

Facing exclusion on account of both their race and their gender, women of color in STEM are caught in a “double bind.” Highlighting the unique social position that minority women occupy, one in which exclusion occurs on the bases of both ethnicity/race and gender, Malcom and her colleagues emphasized the gap that women of color often fall through wherein programs targeted at the success of either women or minorities do not adequately address the needs of women who *are* racial/ethnic minorities who experience discrimination due to both their ethnicity/race *and* gender and not one or the other. By virtue of being of color and female, women of color in STEM may experience challenges at two levels: discrimination/exclusion and a lack of programming designed to foster their success. The “double bind” is thus a force that significantly shapes the decision of women of color in STEM to stay or leave (e.g. Eagan et al., 2012; Brickhouse, 2001; Seymour & Hewitt, 2000).

Also of note is the collective nature of the struggle that women of color in the sciences face:

Distinguished in their respective fields, they [the participants in the gathering of women of color in science that contributed to the “Double Bind” report] had overcome many obstacles in their attempts to obtain education and employment in science. Despite the fact that they personally had been able to surmount monumental barriers, the conferees expressed concern for the hundreds of thousands of minority group members, especially minority women, who have been excluded or systematically “tracked” out of the pool of potential scientific and technological humanpower. (Malcom et al., 1976, p.12)

Of note here is the conferees’ recognition of individuals’ success in surmounting obstacles they face along their trajectories as scientists as well as their concern for the

“hundreds of thousands” of their minority peers, male and female, who had been “excluded or systematically ‘tracked’ out of the pool of potential scientific and technological humanpower” (Malcom et al., 1976, p.12). The “double bind” is thus not a phenomenon to be analyzed simply in terms of individual struggle and success but requires an acknowledgment that collective transformation is needed to effectively empower all those for whom the “double bind” in fact binds their aspirations for pursuing STEM careers. To acknowledge the reality of such a range of experience among women of color in STEM is an empowering act that was a remarkable product of the 1976 report and has the potential to enable greater numbers of women to achieve the success they pursue. In 1975, the call was raised that an inordinate number (i.e. hundreds of thousands) were being systematically excluded and there was a need for change at the collective level.

#### *The Double Bind: The Present*

A 2011 follow-up report to “The Double Bind,” “Unraveling the Double Bind: Women of Color in STEM” reveals that minority women still compose a “disturbingly small part” of the scientific community (Malcom & Malcom, 2011). Despite programs aimed at fostering their success, minority women matriculate into graduate school and professional science roles at disproportionately lower rates than their white, male peers (e.g. Espinosa, 2011; Gibbs, McGready, Bennett & Griffin 2014). Ong and her colleagues at the Higher Education Research Institute (HERI): Carol Wright, Lorelle Espinosa, and Gary Orfield, all noted scholars on issues of diversity and persistence in higher education, outline in detail the research on women of color in STEM spanning forty years, from 1970 Through 2008. While they acknowledged that many strides have been made

regarding overt discrimination based on race and sex, they also expressed concern that many obstacles remain for women of color as they traverse their trajectories through schooling and professions in STEM. Obstacles they cited reflected the pervasive nature of structural barriers: a common experience of a hostile climate in which they felt discouraged or not actively encouraged as women of color in their respective subfields in STEM (Ong et al., 2011). While access has increased, and interest has been found to equal or surpass that of their white peers, their achievement often lags behind (Espinosa, 2011; Hurtado, Eagan & Hughes, 2011).

Obstacles frequently cited include a lack of streamlined content and pedagogy that manifests itself in women finding that their prior school experiences did not prepare them for the next stage of their schooling (e.g. Hurtado, Newman, Tran & Chang, 2012), a hostile environment that dampens their desire to pursue a STEM degree (Gibbs et al., 2014), and an unwelcoming environment among faculty and peers alike (Fries-Britt, Younger, Hall, Harper & Newman, 2010; Griffin et al., 2010). Conferees at both AAAS conferences as well as current scholars also cite a lack of support from faculty and/or peers that revealed itself either in the absence of support that was needed to succeed academically and socially or in the presence of negative interactions with peers and faculty (Griffin et al., 2010).

Drs. Shirley and Lindsey Malcom's "The Double Bind: 35 Years Later," published as part of a Harvard Educational Review Symposium in 2011 explores the state of under-represented women of color in the sciences now, as compared to in 1976 when Shirley Malcom and her colleagues wrote the initial report. The primary distinction they noted, or rather the initial distinction they noted was that unlike the overt racism that

women experienced in 1976, women today experience racism in its more subtle forms. For example, latent bias and exclusion now manifest as inaction on the part of institutions and rather than the extreme distinctions between students' rights and wrongs committed against them, the tension that characterizes women of color in science now is between support and neglect. One major gain that the authors note, is that the interest of women of color in science, of girls of color in science has significantly increased and they attribute this to the proliferation of programs and the increase in the success of programs in fostering this interest among girls and women in STEM. They also attribute this to groups such as the minority women in science network, founded in 1979, which connects women of color and science "together for the purposes of mentoring and advocates efforts" (Malcom & Malcom, 2011, p.163). Research on middle and high school girls of color in STEM corroborates such findings (e.g. Barton et al., 2008; Brickhouse & Potter, 2001)

The issue now, they explain, is "institutions' lack of response to this growing interest [in STEM among girls and women of color], specifically their failure to take advantage of it and retain this pool of talent" (Malcom & Malcom, 2011, p.163). Another key difference that has occurred over the past 35 years relates to students' multiple pathways to and through STEM debunking the pipeline metaphor that assumes that one goes through high school, college, and graduate school, earning a STEM degree and then getting a job in STEM. The Drs. Malcom explained that the entry points into STEM are more varied particularly for women of color; they name community colleges and masters' degree granting institutions and even for-profit institutions as, if not primary, common entry-points for women of color gaining access to STEM degree programs and STEM jobs. In fact, Malcom and Malcom say that these educational spaces that tend to offer



associate degrees in less prestigious STEM careers are often spaces in which the numbers of women of color are disproportionately high, spaces in which women of color are over-represented (Malcom & Malcom, 2011, p.164-5). Such a finding complicates the notion of a uniform pipeline through which all STEM career aspirants flow once given access. The reality of multiple entry points as well as raced and gendered stratification within STEM subfields requires that researchers reconsider the status quo of STEM career trajectories particularly as they pertain to women of color and ask *why* women of color are overrepresented in certain spaces even as they are grossly underrepresented in the majority of STEM subfields.

Another key point that Malcom and Malcom explored was the disciplinary stratification that occurs regarding STEM degree attainment and the raced, gendered patterns of stratification within STEM disciplines (Malcom & Malcom, 2011). They acknowledge that although there have been gains in the numbers of women of color in science, the distribution of these women across science disciplines is uneven: while there has been significant growth in numbers within social and behavioral sciences, “minority women’s share of doctorates in computer science went from zero in 1975 to only 2.1% in 2008...[which] translates to just 14 minority women” (Malcom & Malcom, 2011, p.166). A similar percentage was cited for engineering: 2.9% (p.166). They noted significant underrepresentation in physics, geo-sciences, mathematics and statistics and explain it is likely due to the barriers that minority women pursuing science and engineering degrees face and that these barriers are likely “department and discipline specific and originate from the rigid culture, structures, and a lack of faculty diversity in these fields” (Malcom & Malcom, p.166). In the case of engineering, prior research has shown that the history

of engineering is heavily gendered: “Because men make up 82% of those receiving engineering bachelor’s degrees, a masculine homogeneity defines the character of engineering” (Camacho & Lord, 2013, p. 32); as a result, engineers’ professional identities in the United States have historically been shaped by this hegemonic masculinity dating back to the 1890’s (Frehill, 2004). The “rigid culture” that Malcom and Malcom refer to is thus over a century in the making. They acknowledge that, while programs targeted at addressing the underrepresentation of minority women in science have proliferated and interventions have resulted, these are often focused on “fixing” a student and leave unaddressed the chilly climate (e.g. Hall & Sandler, 1982; Hurtado, 1992). As a result, they warn, strategic approaches to give minority women the knowledge and tools that they need to persist in such inhospitable climates, as well as policy changes and targeted programs, will remain ineffective in addressing the inhospitable climate that persists. In their words, “a great deal of empirical research suggests that until such cultural and structural changes at the institutional and departmental levels take place, minority women may continue to be stuck in the “double bind” in a number of STEM fields” (Malcom & Malcom, 2011, p.166-7). Research that highlights women’s perceptions of the “chilly climate,” the causes thereof and their suggested solutions can be a useful step to take in the direction of further problematizing the cultural and structural conditions in need of change and intensifying the call to make STEM spaces welcoming to all.

For Hispanic women in engineering specifically, gross underrepresentation is particularly acute (i.e. they earn a disproportionately small percentage of degrees

compared to their male and white counterparts<sup>1</sup>) and scholarship has identified several key trends in the persistence of those who earn a B.S. or higher in an engineering subfield: family/parental and community support (Peralta, Caspary, & Boothe, 2013); perception of usefulness of degree as means of getting a job and supporting family and/or community (Barton, 2003); and having access early on in their undergraduate careers to support programs (Trenor, Yu, Waight, Zerda, & Sha, 2008). Additional research focused more broadly on women of color in STEM highlights similarities in the experiences of African American and Hispanic/Latina women who often experience barriers to their success on account of their race/ethnicity to a greater extent than their gender (Williams, Phillips, & Hall, 2015). Also, to further complicate the persistence puzzle, it is critical to note that some research has found that underrepresentation of women in engineering is just that: they do not opt out at rates higher than men or than their peers in other fields; rather they persist at similar rates (Lord et al., 2009). As Hispanic/Latina women in engineering have been selected for this study as a cohort within women of color, findings related to their experience – however distinct they may be in relation to other groups of women of color –add to the growing scholarship focused on persistence patterns among Latinas in engineering in particular as well as provide a more nuanced understanding of the relationships between identity and success in STEM on a broader scale.

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<sup>1</sup> Although, as a composite, underrepresented women of color earn Bachelor's degrees at higher rates than their male counterparts. I make this point not to digress but to complicate the picture of underrepresentation as it relates to race and gender – clearly, further research needs to explore the college-going and degree attainment patterns among men of color in STEM and other disciplines to better understand the role of race and gender in shaping the postsecondary outcomes among black men and Latinos.

Most recently, the “double bind” has been explored in terms of gender bias. In “Double Jeopardy? Gender Bias Against Women of Color in Science,” a report published in January of 2015, law professors Joan C. Williams and Katherine Phillips and business professor Erika Hall found that women of color in science do experience gender bias and that, out of the 60 scientists they interviewed, a hundred percent reported encountering at least one pattern of gender bias. The authors of the study identify four main patterns of gender bias, two of which connect directly with science identity: “prove-it- again” and the “tight rope” (Williams et al., 2015). The other two – the “maternal wall” and “tug of war,” also warrant further study. Briefly “prove-it-again” has to do with women needing to prove that they are smart as their male counter parts, this often entails feeling the need for working twice as hard to prove that they are equally smart and able and capable. The tight rope has to do with prescriptive stereotyping and the concept that competence in science is often associated with masculine rather than feminine qualities and so women find the need to act more masculine to prove their competence or fear that if they act feminine they often find themselves taking “dead end” roles, from acting as administrative assistants to being expected to mentor everyone else’s students in addition to their own (Williams et al., 2015). And if they do decide to behave in masculine ways, they are seen as been too assertive; thus they walk along a “tight rope” of acceptable science identities. Their gender acts here truly as a boundary that circumscribes acceptable ways of being scientists – an identity in which the masculine is valorized over the feminine yet that masculinity itself is exclusionary so if women act *too* masculine then they are likewise not accepted. One can see in both the prove-it-again and tight rope patterns insights that overlap directly with Carlone and Johnson’s identity model which is

explored in greater depth in the following section. Linking back to the Double Bind research – the notions of proving one’s competence and taking “dead end” roles resonates all too strongly with the stratified patterns of employment of women of color in STEM (e.g. Malcom & Malcom, 2011). Additionally, the Double Jeopardy throws into harsh relief an unintended consequence of mentoring – while it may be a lifeline for female students of color in the sciences, it may negatively impact faculty of color in the sciences who take on this role unofficially and with minimal or no structural support, much less recognition for the value of this service.

Williams and her colleagues also identified racial and ethnic differences within these patterns among the 20 Latinos, 20 Asian Americans and 20 Black women that they interviewed. The key distinctions are that the prove-it-again bias occurs more often among the black women than the other groups; 76.9% of black women interviewed were more likely than other women to feel the need to prove their competence. Also related to the prescriptive stereotyping, Latinos who act too assertive were seen as angry whereas black women felt that they have more leeway in this area as long as they aren’t too angry or seen as too angry. It’s of note too, that black women often attributed their prove-it-again bias experiences to their race rather than their gender. This report thus corroborates the findings from the Double Bind report. In 2015, the “double bind” persists as the “double bind daughters” continue to strive to achieve the success they desire (Malcom & Malcom, 2011).

### *The Double Bind and Identity*

The Double Bind, including the “Double Jeopardy,” highlights the need for further inquiry into the role of identity in persistence. As early as 1976, women of color in science themselves expressed the concern that while individual examples of success exist and need to be recognized, there is a parallel need for collective initiatives wherein women of color in STEM support each other and are empowered to change the status quo of the system from its exclusionary “chilly” state to one that nurtures *all* who aspire to become scientists or engineers.

The Double Bind constitutes an identity struggle wherein one's social position circumscribes the possibilities for the realization of one's chosen career. It is the social reality reflected in the Double Bind that forms the foundation for this study. How do women of color in STEM—the “double bind daughters”—reconcile who they are with the dominant notions of what it means to be a scientist/engineer and to do science/engineering? It is important too to learn more about the challenges involved in translating individual success into collective empowerment. Embedded in *la facultad* is a call for a more just system for *all* students of color in STEM. What are the challenges those at the forefront perceive to such collective transformation? What is their role? How have they succeeded and what insights do they have into what is needed to foster the success of increasing numbers of women in STEM? These questions form the core of this study's inquiry into the possibilities for fostering transformation in which individual and collective success are interconnected – where the agency of one is understood to be part of the empowerment for all.

One can see the same language here as in Johnson et al.'s 2011 work around *la facultad* in relation to having a strong science identity and senior research scientist, Dr. Maria Ong's (2005) work around persistence of women of color in STEM using intersectionality as a theoretical lens. Both *la facultad*, the strength that can be developed in relation to navigating oppression throughout one's life, and intersectional scholarship on persistence reveal the interconnection between individuals' struggle with structural obstacles designed to oppress or exclude (i.e. systematically "track" out...) and the collective will that is needed to overcome such obstacles not simply for the sake of an individual minority woman in science but all.

### *Science Identity*

The following section offers an exploration of identity crises and victories as they have been found to occur among women, underrepresented minority, and first generation students in STEM. Crises entail conflicts between one's social identity and one's STEM identity. Victories involve strategies and structural qualities that conduce to identity convergence/ reconciliation/transformation. Both are founded on a complex understanding of STEM/science identity and how it intersects with other aspects of students' social identities (e.g. Carlone & Johnson, 2007; Tran et al., 2011). While the crises are alarming – feelings of incongruence between one's social and STEM identities at best (Figueroa & Hurtado, 2014) and experiences of direct discrimination and prejudice at worst (Tran et al., 2011) – the victories illuminate STEM identity performances and constructions that actively transform what it means to be a scientist and even what constitutes legitimate STEM practice (Johnson et al., 2011; Herrera & Hurtado, 2011). While this study is focused on the mechanisms behind such

transformation—*how* a particular group of women of color construct and perform such identities—it is key to first explore the landscape of science identity research as it pertains to the trajectories of women of color in STEM. A burgeoning area of research, models of STEM/science identity have grown increasingly complex over the past decade and their development warrants investigation.

The reality of the “double bind” for many women of color in science itself constitutes justification for exploring persistence in terms of identity. The problem of the “double bind” is *fundamentally* a problem of identity. Using identity as a lens to understand how women of color in the sciences transform pre-conceived/dominant forms of science identity and even science itself to engage in identification processes that not only valorize who they are as scientists but (leave open possibilities) for who can succeed in science and what science can be allows us to see these glimmers of hope, of possibility for a science more just, equitable, and socially transformative. Analyzing persistence in terms of identity helps us rethink dominant ideas of who a scientist or engineer can be and what counts as science (i.e. objective, culture-less...cultured definition of objectivism which is very Eurocentric whereas objectivity in, for example, Native American cultures looks different). Thus, the presence of women of color, with their worldviews and cultural backgrounds that differ from the dominant paradigm in STEM, actually expands prevalent notions of what it means to be a scientist or engineer and what constitutes STEM itself.

The following section offers an overview of identity research as it relates to the persistence of girls and women of color in STEM. First, science education researchers Heidi Carlone and Angela Johnson’s science identity (SI) model is outlined as it serves as



the foundation for subsequent research focused on girls and women of color in STEM. Next, expansion of Carlone and Johnson's model done by higher education researchers at the Higher Education Research Institute (HERI) at UCLA is explored. The model having been outlined, focus then turns to the forms of capital (i.e. framed as assets in several studies), that such research has revealed, including altruism, invisible strategies, cultural knowledge, and *la facultad*.

### *Background Research on Science Identity*

The impetus behind much of the research on science identity has been in response to the fact that the underrepresentation of women of color in science remains a systemic, pervasive issue. Millions of dollars have been poured into programming designed to address the issue of underrepresentation and into research to better understand the complexity of the problem. In recent decades, substantial national policies have been devised to support the formulation and application of comprehensive, evidence-based methods that increase the participation of girls and women of color throughout the STEM pipeline. Despite the combination of programmatic, research, and policy attention paid to increasing the participation of girls and women of color in the sciences, graduation rates and workforce demographic data reveal that girls and women, particularly of African American, Latina, Native American, and Asian Pacific Islander descent, continue to participate and succeed in the sciences at a disproportionately lower rate than their white and/or male peers (Rodriguez et al., 2012). The question thus remains: why?

Exploration of identity as an explanatory variable in the trajectories of underrepresented students in STEM dates back to science education scholar, Nancy

Brickhouse's study of the role of cultural beliefs in underrepresented minorities' (including girls') experience in science education (Brickhouse, 1994). The seminal qualitative study that shifted the task of conceptualizing the role of identity among female students in STEM toward a direct focus on girls of color at the higher education level was Hooks Distinguished Professor of STEM Education Heidi Carlone and Professor of Educational Studies Angela Johnson's work, "Understanding the Science Experiences of Successful Women of Color: Science Identity as an Analytic Lens" (2007). Carlone and Johnson's science identity model has been used as foundational research by well-established higher education researchers (e.g. the Higher Education Research Institute (HERI)) as well as for their own future research exploring identity in greater depth among those women of color who persisted through to successful careers in the sciences (Johnson et al., 2011). Their contemporaries in science education looked at science identity in relation to teaching and learning in science, striving to address the following issues: situated cognition and creating a science learning environment with many possibilities for who can be a scientist (Brickhouse & Potter, 2001) and the relationship between students' science identities and their broader senses of who they are and who they strive to be (Cobb, 2004; Nasir & Saxe, 2003), the process of socializing students into the norms of the discipline or community of practice (e.g. Lave & Wenger, 1991), and the ways in which dominant models of science identities that may not appeal to diverse students (Barton, 1997).

Carlone and Johnson's model is defined by three components of one's identity that make one a "scientist": performance (how one acts and speaks – i.e. performs – as a scientist), recognition (recognizing oneself and being recognized by significant others as

a scientist), and competence (one's knowledge and understanding of scientific concepts) (Carlone & Johnson, 2007, p.1191). They also situated the identity model in relation to the racial, ethnic and gender identities of their research participants as these additional aspects of their social identities acted as both a lens through which they viewed their experience in the sciences and as a veil which often hung between others' perceptions of their performance, recognition, and competence. While prior research had acknowledged the role that gender, race, and ethnicity likely played in students' experience and success in science (Sax, 1994) and engineering (Tonso, 2006), it did not directly explore the links between SI and students' social identities. Carlone and Johnson conceptualize science identity as a "cultural production," wherein women of color construct identities in the context of sociohistorical legacies dominated by white men in science, in fact creating "novel" or "*local*" meanings of what it means to be a scientist (Carlone, 2003; Carlone, 2004; Eisenhart, 2000). Such a conceptual framework allows for an acknowledgement of the sociohistorical context as well as the "double bind" phenomenon itself. In asking how successful women of color in science make meaning of their experiences in science and how they develop and sustain their science identities throughout their undergraduate and early science careers, Carlone and Johnson found among the women they interviewed that three patterns of identity formation surfaced: research scientists, altruistic scientists, and disrupted scientists (Carlone and Johnson, 2007). Vital in Carlone and Johnson's model is their use of a dynamic conceptualization of identity wherein identity is not what one *is* but is what one *does* – the very interaction between structure and agency. Acknowledging the growing research on science identity at the time of their article (Brickhouse, Lowery, & Shultz, 2000; Brickhouse & Potter, 2001; Eisenhart & Finkel,

1998; Tan & Barton, 2008), Carlone and Johnson explain their intention to further operationalize science identity so that it could grow in its explanatory power (Carlone & Johnson, 2007, p. 1189). Hence they developed the aforementioned model.

### *Intersections with Social Identity and Structures*

Carlone and Johnson are among a handful of scholars who have focused primarily on girls and women who have a high interest as well as competence in the sciences and who have been “successful” in persisting in the sciences at both secondary postsecondary levels as well as throughout their trajectories (e.g. Brandt, 2008; Fries-Britt et al., 2010; Griffin et al., 2010; Johnson et al., 2011; Tan & Barton, 2008). Two main paths of research have been taken: the first is the interaction between students’ social identities and their science identity (e.g. Chinn, 1999; Hurtado et al., 2012). Many scholars have used intersectionality theory (Crenshaw, 1989) to look at successful women in science and have highlighted the specificities of students’ of color experience in the sciences as distinct from other groups of students and as likely differing from the dominant white, male, Western norms of science and science classrooms (e.g. Brickhouse, 1994; Tran, 2011). A second path has revealed that students form science identities in response to the structural constraints they very often experience over the course of their careers in science – as students and then as professionals (Herrera et al., 2012). This research has shown us that girls and women of color have been able to successfully create science identities for themselves—a dynamic phenomenon wherein identities are continually created, enacted and re-created once again—that look different than the dominant definitions of who does science and how science ought to be done.

Building on Carlone and Johnson's SI model, higher education researchers at the Higher Education Research Institute (HERI) at UCLA have both expanded upon and problematized aspects of the model (Eagan et al., 2010; Figueroa & Hurtado, 2014). In a wealth of conference papers and presentations, scholars at HERI have explored many facets of the persistence of underrepresented minorities in STEM. In their research on the issue of underrepresentation (i.e. underrepresented minorities – URM) in STEM over the past decade, HERI scholars have analyzed ample quantitative data that explores students' experiences in their first, second and final years of their undergraduate career as well as their initial post baccalaureate years. The angles from which HERI scholars have analyzed persistence in relation to identity can be grouped into institutional (i.e. college context-related) variables (e.g. Hurtado et al., 2011) such as competition, particularly in gatekeeper, or introductory, courses (e.g. Eagan, Garibay, Soh, Hurtado, & Chang, 2012; Hughes et al., 2013), institutional status (e.g. Chang, Cerna, Han, & Saenz, 2008), and the co-curricular factors that shape the interest and preparation of underrepresented students in the sciences, or "opportunity structure" (e.g. Figueroa, Wilkins, & Hurtado, 2015) and personal characteristics and experiences including, but not limited to stereotype threat (Chang, Eagan, Lin & Hurtado, 2011), undergraduate research opportunities (which also fall into the category of "opportunity structure") (Hurtado, Eagan, Figueroa & Hughes, 2014), interest (Herrera & Hurtado, 2011), and background characteristics including pre-college academic preparation, race/ethnicity, and gender (Oseguera et al., 2006).

Researchers at HERI have taken up Carlone and Johnson's model to expand the theory of STEM/science identity as it relates to underrepresented students (Eagan et al., 2010; Herrera et al., 2012). Over the past decade, they have further examined the

intersection between students' STEM/science identity and racial/ethnic identity (Chang et al., 2011; Herrera et al., 2012; Hurtado et al., 2010; Tran et al., 2011) and have explored the articulation of identity in the case of the persistence of URMs in STEM graduate programs (Figueroa et al., 2015; Tran et al., 2011). Carlone and Johnson's SI model has now been applied to much larger samples of women of color in STEM through HERI's substantial quantitative database of longitudinal survey data collected over the course of students' college careers and into their initial post-baccalaureate years. Key findings have strengthened the theory and practice of identity in a contextual manner that reveals articulations of *la facultad*.

#### *Expansion of the Science Identity Model*

The earliest usage of Carlone & Johnson's model appears in HERI researchers' integration of the model into their research on the persistence of URMs in STEM in 2010. In asking how pre-college and first-year experiences shape students' science identity development over four years of undergraduate education, Kevin Eagan and his colleagues at HERI used Carlone and Johnson's model to create a science identity construct that they measured over the course of four years. In a sample of 1,133 STEM students in 137 institutions, Eagan et al. tracked students' persistence over four years and disaggregated the data between white and URM students. The construct had four primary factors: the personal importance to each student to "become an authority in my field," to "obtain recognition from my colleagues for contributions to my special field," to "make a theoretical contribution to science," and to "work to find a cure to a health problem" (Eagan et al., 2010). While Eagan and his colleagues do not disaggregate their data by race, that they account for race and gender makes their findings relevant to a study of

women of color in STEM. As prior research identified in relation to persistence generally, Eagan and his colleagues likewise found that certain background and college characteristics promoted stronger science identities: high school biology experience, undergraduate research experience, and having a strong science identity at the end of the first year – indicating the importance of founding such an identity early on in one’s undergraduate career (ibid).

Eagan et al.’s (2012) exploration of “accentuated advantage” in relation to STEM students’ persistence over time seeks to explain on how “cumulative advantage” (Allison, Long, & Krauze, 1982) which illuminates patterns of inequality in students’ science identity development over time, “accentuation” (Nelson Laird, Engberg, & Hurtado, 2005) sheds light on how students’ predispositions are enhanced over time (Eagan et al., 2011, p.3). These combine to explain students’ persistence in STEM throughout their undergraduate careers. Eagan et al.’s findings that having strong science identity at the start of college and at the end of the first year of college is a strong indicator of students’ persistence throughout undergraduate STEM education begs the question: how do women of color who have successfully obtained bachelor’s degrees in their chosen field enact these identities in the face of obstacles, in pursuit of their career goals? Factors identified in the “Accentuated Advantage” study included positive interactions with faculty and access to research opportunities – these both connect with the recognition and competence components of science identity. While Eagan and his colleagues didn’t directly highlight the role of race and gender in the dynamics of accentuated advantage, the implications were clear: the cumulative advantage of a having a strong science identity at the start of college shapes students’ trajectories such that those with stronger

science identities are more likely to persist than those without. If women of color in STEM are less likely than their white peers to have strong science identities at the start of college or in the first year (due to, for example, less access to research opportunities or negative interactions with faculty), it is necessary to better understand the personal characteristics and structural mechanisms that those with strong science identities possess and/or have access to.

### *Application of the Science Identity Model*

Herrera et al. (2012) further operationalized the concept of science identity through exploring the use of identity theory in science education (Barton, 1998; Brickhouse et al. 2000; Brown, 2004; Kozoll & Osborne, 2004). Acknowledging the ambiguous, dynamic nature of identity (Brubaker & Cooper, 2000; Gee, 2000), Herrera and her colleagues note that it is a useful concept in science education research as it explains the interactions between social (i.e. personal) and structural aspects of identity formation (Herrera et al., 2012, p. 5). It is thus, they argue, the most complete lens through which to analyze and understand persistence among underrepresented minority (URM) students throughout their education in STEM (Herrera et al., 2012). In alignment with Carlone and Johnson's usage of a structure-agency framework, Herrera et al. emphasize an interactionist model of science identity wherein the interplay of societal, disciplinary, and social structural forces and their impact on science identity development remain central (Herrera et al., 2012, p.6). The interactionist approach is key to understanding how women of color in science perceive themselves to be scientists and the obstacles they feel they face in their pursuit to becoming scientists. Per Herrera et al.'s findings, attention must be paid to both intersectionality (Crenshaw, 1989) and



context (Shanahan, 2009) to fully understand how science identity forms in relation to other aspects of one's identity and in the context of social structures (Herrera et al., 2012; Shanahan, 2009).

Other HERI researchers have likewise shed a spotlight on the need to examine the intersection between students' social and STEM identities to better understand their trajectories through STEM (Chang et al., 2011; Hurtado et al., 2010; Tran et al., 2011). Each has explored Carlone & Johnson's model to some extent, with the greatest attention paid to the role of race and gender in students' pursuit of becoming STEM professionals. Highlighting the prevalence of white, male norms in STEM classrooms – and in STEM more broadly (Bonous-Hammarth, 2000) – the HERI data analysis reveals the culturally constructed nature of STEM with qualities (e.g. competitive, individualistic, highly-abstract) that do not match the predominant cultural norms of many women of color (e.g. altruism, community-oriented, social) (Sax, 1994; Seymour & Hewitt, 1997). While much research has focused on “fixing” these students who do not “fit” the dominant paradigm, HERI research adds substantially to the growing research that highlights the possibility for, instead, fixing the *system*, echoing the call from “The Double Bind” report from decades before (Malcom et al., 1976).

### *Science Identity and Capital*

In addition to looking at intersections between science identity and social identity as well as structures, it is key to look at the role of capital as a tool women of color in STEM use to navigate the terrain that exists between various aspects of their identity as they strive to pursue their careers. Johnson and her colleagues as well as researchers at

HERI have found that many successful girls and women of color have been able to transform their structural constraints into opportunities for development; that is, they are able to take oppressive forces around them and translate them into sources of liberation (Johnson et al., 2011; Tran, 2011). For these students, the meaning and purpose of their education was not derived from their immediate, at times, hostile surroundings. Instead, the successful students studied explained that they derived their sense of meaning in and connection to science from a set of meaningful others outside their schooling context – often their families and local communities. It was this sense of connection that was driving them to succeed (Johnson et al., 2011). The forms of capital that relate to this sense of connection include: “invisible strategies” that students may develop or access and then apply in the actions they take to succeed, cultural knowledge developed from personal experience, and a strong sense of altruism and social justice. It is productive to understand such assets in terms of capital as identity itself is an active process and occurs through an individual’s interaction with the structures around him/her.

First, women of color in STEM may employ “invisible strategies” as a result of their social position. Felisha Herrera and her colleagues’ analysis expands on Carlone and Johnson’s SI model and offers a more detailed framework of STEM identity that highlights the significance of intersectionality (i.e. Crenshaw, 1989). Their qualitative data corroborated Carlone & Johnson’s 2007 finding that women of color in science, seeking to establish themselves and succeed in a hostile system, often create new forms of identification as scientists and even new forms of science. In fact, most powerfully, the HERI researchers’ findings have illuminated a “resilience or resourcefulness” that many students of color in STEM develop in response to their circumstances, directly related to

having a strong science identity (Herrera et al., 2012). Titled “aspirational capital” by Yosso (2005), successful students utilize “invisible strategies” (Tierney & Auerbach, 2005) to overcome seemingly insurmountable barriers (e.g. inadequate academic preparation or confidence in one’s abilities) based on interest and strong structural supports. Invisible strategies refer to students’ ability to prioritize or value their interest in STEM even if they don’t do well in a given class/on a test, drawing support perhaps from family or other sources (Tierney & Auerbach, 2005).

“Aspirational capital” and “invisible strategies” in the context of STEM education reflect forms of science capital as outlined in Archer et al.’s framework (2015) and resonate strongly with Johnson et al.’s identification of *la facultad* in which successful women of color in STEM were able to see beneath the surface of their interactions with significant others to see how others *recognized* – or didn’t recognize – them as legitimate STEM practitioners (Johnson et al., 2011). The link between *la facultad* and recognition is striking: each incident of *not* being recognized as real scientists actually provided an *opportunity* – instead of a seemingly insurmountable obstacle – for further STEM identity development. The extent to which successful women of color in STEM were able to apply *la facultad* empowered them to develop even more fully as who they recognized themselves to be: legitimate scientists engaging in work important to the them and for the benefit of others (Johnson et al., 2011).

Herrera and her colleagues engage in a comprehensive analysis of the importance of cultural knowledge in the science identity development of URM students in STEM as it acts as a “currency” (Yosso, 2005) or lens through which they connect their social identities with their identities as scientists (Herrera et al., 2012, p.18). Such cultural

knowledge is defined both in terms of legitimating the contributions of communities of color to the world of science – which often is portrayed as monolithic, objective, and culture-less when in fact it is culturally constructed (Cobb, 2004) – and in terms of acknowledging how STEM is taken up and enacted within communities of color. Such recognition is crucial to positive STEM identity development as students seek to be seen as legitimate scientists who add value to their respective subfields (Carlone & Johnson, 2007). Herrera and her colleagues make a crucial point: such a search for recognition does not occur with the intention of conforming to the status quo of science or what it means to be a scientist; rather, the desire to succeed is framed in terms of creating new definitions of who a scientist can be and what doing STEM looks like (Herrera et al., 2012; Tan & Barton, 2008).

Rooted in this sense of meaning and connection is an altruistic desire that many girls and women of color express as a motivating force behind not only their interest in science but their persistence in a field that often feels unwelcoming (e.g. Tran, 2011). Research has shown altruism to be manifest in two primary modes: First, in the general sense of helping others, particularly among female science students generally (e.g. going into medicine to heal others) (e.g. Brickhouse & Potter, 2001) and, second, in the sense of giving back to one's community, particularly among female students of color (Johnson et al., 2011; Tran, 2011). In the first mode, science is understood as a tool for helping others through healing. In the second, science is understood as a means for social transformation and social justice. Thus, individuals who have managed to succeed in a system that has been, in many ways, grossly unjust, have created new cultural productions of science that not only meet their needs for recognition and support but address the immediate physical

needs of others as well as the broader social needs for transformation and justice in their communities (Johnson et al., 2011). This small group of scholars has revealed that many successful girls and women in science in fact have been successful at a level that exceeds their individual paths: they have transformed science, as a system that has in many ways oppressed them, into a tool for their own liberation and the transformation of others. They have re-claimed science through altruism.

### Conceptual Framework

The work of Yosso (2005) and Archer et al. (2015) reflects the growing emphasis on assets-based explorations of why girls and women of color do, or don't, persist in various STEM fields. Generally, framing many of these assets (altruism, connection to community etc.) in terms of capital has proven useful in describing how they enable women of color to succeed in hostile climates (e.g. Yosso, 2005; Samuelson & Litzler, 2016). Thus, the Bourdieusian concept of capital provides a useful conceptual framework in which to analyze Latinas' trajectories through engineering, including particular challenges and successes they face (Bourdieu, 1986).

#### *Capital*

Increasingly, researchers seeking to better understand the factors associated with the persistence of women of color in STEM have looked to Bourdieusian notions of capital – social and cultural (Bourdieu, 1986). Utilizing primarily qualitative methods, researchers have found that peer and academic support networks – often student-initiated to fill the institutional void (Sólorzano et al., 2005) – and positive interactions with faculty constitute forms of social capital that enable women of color to pursue their

STEM career goals even in the face of hostile racial climates (Ceglie & Settlage, 2016; Reyes, 2011). Exploring the relevance of cultural capital in fostering the ability of women of color to overcome obstacles, researchers have also identified sources of community “cultural wealth” in which family support, religion, and altruistic orientations act as cultural capital that can promote their persistence (Ceglie & Settlage, 2016; Valenzuela, 1999; Yosso, 2005; Espinosa, 2011).

Of note is recent research that explores the role that “science capital” may play in persistence. Of the few studies that have explored the idea that there are forms of social and cultural capital that foster persistence have talked about the ways in which social support networks and academic supports can foster academic achievement in STEM (Ceglie & Settlage, 2016; Reyes, 2011; Yosso, 2005), one group of researchers has suggested that a theory of “science capital” may be useful in understanding forms of capital that are specific to success in STEM (Archer et al., 2015). Science education scholars Louise Archer, Emily Dawson, Jennifer DeWitt, Amy Seakins, and Billy Wong have recently put forth a theory of science capital as a context-specific set of social and cultural capital formations that, their research has found, are positively associated with science identity and aspirations among school-age children (Archer et al., 2015). While critique has been raised regarding the viability of the concept as it largely overlaps with other forms of social and cultural capital that Bourdieu has already theorized and other education scholars have already explored, the concept is useful in that it allows current researchers to become aware of ways in which students in STEM may take up and apply forms of capital that are science-specific (i.e. the specific attitudes of scientists or exposure to scientific concepts through museum visits etc.) (Jensen & Wright, 2015).

For the purpose of this study, being mindful of the particular sources of capital found to be strong among Hispanic/Latinx students in college generally: altruistic motivations for studying science (Ceglie & Settlage, 2016; Carlone & Johnson, 2007), religiosity that fosters student engagement (Liou, Antrop-Gonzalez & Cooper, 2009), and other forms of community cultural wealth including strong family ties (which can also dissuade persistence) and motivation to succeed for the sake of one's community/family (Yosso, 2005; Cole & Espinoza, 2008) allows me to identify and problematize forms of capital that may be, if not culturally-specific, culturally-relevant to Hispanic/Latina women in engineering.

### *La Facultad*

Thinking of *la facultad* in the original context in which feminist Chicana writer, Gloria Anzaldúa, developed it helps in situating it within a capital framework. In her text, *La Frontera/Borderlands: the New Mestiza*, Anzaldúa introduces the concept of *la facultad* as being the product of living at the border (Anzaldúa, 1987). While she is referring specifically to the Mexican American border, the concept is versatile enough to apply to the “double bind”/“double jeopardy” phenomenon (Malcom & Malcom, 2011; Williams, 2014) experience that many women of color in STEM have been found to have. As a means of surviving on both sides of the border seeing the deeper realities of the world one inhabits—a world in which one is neither native nor necessarily welcoming—thus acts as a survival/empowerment strategy; that is, it acts as capital that one can take up and apply with the aim of successfully achieving one's goals.

Johnson and her associates, using a multiracial feminist framework, found that the women of color they studied had developed *la facultad*, whether intentionally or not, in their interactions with others throughout their days as scientists. The women they studied realized that in order to succeed as scientists that they had to navigate many social situations that were inherently unjust and in which they felt their social roles as women of color, that intersectional framing of their identity, were overrode their identities as scientists or were seen by others as contrary to their science identities (Johnson et al., 2011). In other words, they felt they were perceived as women and as of color before – and perhaps instead of – as legitimate scientists. Thus, in order to carve out for themselves legitimate spaces of science identification and science practice, they had to always navigate around their gender, racial, and other forms of cultural identity.

*La facultad* is a phenomenon that can be seen in two lights. First, it is an incredibly useful skill or quality that women of color can be encouraged to develop in order to be empowered to navigate the system, the education system, the professional system of being a scientist so that their needs are met. Being equipped with the mental/conceptual tools to perceive injustice and know how to transcend it and transform it to do what is needed to achieve your career goals is an asset and can be positively associated with persistence (Chang et al., 2011; Ong et al., 2011); however, even as it can be empowering it is also troubling. At the level of the individual and from the perspective of agency, it is logically associated with persistence; at the level of the system and with respect to structure, it can allow for or even facilitate, unintentionally, the systemic, collective, and individual perpetuation of injustice and discrimination in the form of discrimination against students based on their race and their gender.



Exploring this concept requires accounting for both personal circumstances and students' perceptions of their environment. The capability of *la facultad* is thus the confluence of having a strong science identity (i.e. recognition of oneself as a scientist, recognition by significant others as a scientist, and demonstrated ability in the sciences), accessing one's assets and applying them to one's actual circumstances. In fact, the hostile environment is actually a critical component of the development of *la facultad*. If one is in an environment in which one feels completely supported, recognized, and acknowledged, then one need not look beneath the surface to identify how one is being perceived and possibly being discriminated against. This is not to wish a hostile environment upon anyone; rather, it is to acknowledge its role in the development of a faculty that can empower women of color in STEM to change potential stumbling blocks into steppingstones.

### Summary

The growing research focus on the experience of women of color in STEM is producing new knowledge around what it means to persist in STEM. What often gets framed in terms of deficit (i.e. achievement gap) and a problem that needs to be fixed (techniques that foster the assimilation of women of color in STEM into the dominant white, male scientific culture) is, from an assets-based view, in fact reflective of ways women of color are redefining who can do STEM and what STEM is – thereby removing barriers to diversity in science and fostering the success of all who desire to pursue STEM careers (e.g. Griffin et al., 2010; Harper & Newman, 2010).

Building on prior research, my study explores the forms of capital Hispanic/Latina women with Bachelor's degrees in engineering have used to transform crises into victories along their career paths. While research has revealed assets that successful women of color in STEM possess (e.g. altruism, cultural wealth), less is understood about how Latinas in engineering in particular develop or use capital (e.g. science capital, *la facultad* etc.) and apply it in an effort to overcome obstacles or about the dynamics between individual and collective success. Gleaning from the insights higher education and science education scholars have provided regarding the ways in which women of color transform what constitutes legitimate STEM identity formations, I hope to shed additional light on the agency study participants enact as they progress along their trajectories.

My study addresses two key gaps that recent reviews of the research on women of color in STEM has identified: a qualitative study of women of color STEM professionals and a theoretical/conceptual framework that addresses women of color in STEM as a stand-alone population, with a particular focus on Hispanic/Latina women in STEM (Ong et al., 2011). My study directly addresses the need for theoretical and conceptual frameworks that address women of color in STEM as a stand-alone population. *La facultad* is rooted in a multiracial feminist framework and thus is both informed by and informs the identification processes of women of color. Additionally, in carrying out ethnographic research on Hispanic/Latina professional engineers, my study adds to scholars' growing understanding of the critical challenges facing this population (Camacho & Lord, 2013a).

The need for transforming current STEM environments to enable greater numbers of women of color in STEM to succeed is too great to ignore any longer in research on persistence among girls and women of color in the sciences. As a scholarly community, we have started to move beyond the deficit-based, “fixing” stance toward fostering students’ of color success and must fully embrace an assets-based approach founded on a more nuanced understanding of individual-structural interactions that shape identity and thus persistence. Recall the unique social position girls and women of color in STEM occupy – their “double bind;” the potential for collective transformation in tandem with the requisite structural change latent in *la facultad* addresses the exigency of their gross underrepresentation. The assets that women of color in STEM describe as central to their science identities – a strong sense of altruism, social justice, and cultural knowledge – combine in the force of *la facultad*, with its related aspirational capital and invisible strategies, to create an awareness-in-action that can fundamentally change science and possibilities for science identification processes. These glimmers of possibility reveal gems too precious not to cultivate. With “chilly” contexts so prevalent and with the rates of participation and matriculation among women of color abysmally low, it is vital to do additional research into *how* capital use operates as part of identification processes and how successful women of color in STEM envision the requisite structural transformations required to enable the hundreds of thousands of their peers who have been systemically excluded from STEM to achieve the success they pursue.

## CHAPTER 3

### METHODS

This ethnographic study employs qualitative methods to provide a comprehensive understanding of how/why Hispanic/Latina women persist in engineering, a particular science, technology, engineering, and mathematics (STEM) field in which women have historically been and continue to be grossly underrepresented. The study draws upon elements of critical theory, including an ontology rooted in a “historical realism” that itself has been shaped by sociocultural political-economic and historical (SCPEH) factors and values that shape social dynamics; epistemology rooted in subjective relationships between individuals that produce certain sets of values and are shaped by those values (which are in turn shaped by the sociocultural politico-historical context); and a methodology that is thus necessarily carried out through dialogic interactions between the researcher and research participants and a dialectical relationship between knowledge production and application is assumed (Guba & Lincoln, 1994).

Ethnography informed by critical theory offers a useful framework in which to analyze the tensions that exist between the agency of the women I interviewed and the structures they navigate. Critical qualitative researcher Phil Carspecken explains the link between critical theory and ethnography as follows:

Critical theory therefore advocates conducting social research in ways that differ enormously from mainstream research. Researchers must not totally disengage themselves from the people of their studies. They should to the extent possible regard themselves as fellow citizens and work with people rather than study them. Research findings should not be cast as something fixed but rather as a fallible contribution to public discussion and debate, a contribution to social life, a carefully thought-through point of view that anticipates as yet unknown responses from other citizens. (Carspecken, p. x, 1996)

In this view, ethnographic research carried out in the context of critical theory situates all aspects of the research process in relation to the topic under investigation as well as the broader SCPEH context. Thus the researcher and the questions she asks do not exist distinct from her research site and the participants in the research process. The role of reflection is key: it is necessary to continually self-reflect and to do so in connection with reflection on the dialectic between structure and agency as seen in the social spaces about which she inquires (Anderson, 1989). Being reflexive is a crucial aspect of ethnography and informs the research process from the outset, not merely during the final stages of data analysis.

Carspecken's overview also highlights the unique, if "fallible," role that findings from critical ethnographic studies play in contributing to the discourses of society: "a carefully thought-through point of view that anticipates as yet unknown responses from other citizens" (Carspecken, 1996). As nothing more or less than a point of view, ethnographic findings are innately inquisitive and inviting of responses from others – they are inherently discursive. Ethnography is a holistic methodological approach as it is grounded in inductive approaches to generating data: interviews, observations, extensive contact with participants and collecting narratives from participants all with an awareness of the SCPEH context of the site and participants (Hammond & Brandt, 2004). Additionally, there is a sustained awareness of the situatedness of not only the data but of the researcher and the ways in which social identity shapes the participants' experience (Hammond & Brandt, 2004).

In science education in particular, researchers have used ethnography to shed light on the role that identity and agency play in students' attempts to learn and "do" science (Brandt & Carlone, 2012). In their overview of ethnographies of science education, science education researchers Carol Brandt and Heidi Carlone explain that ethnographers of science education examine the culture of science in schools, challenge the "prevalent myth of objectivism in science" and tend to be strongly committed to transforming science education into "an agentic tool" that improves the lives of science students (Brandt & Carlone, 2012, p.144). Ethnography is an invaluable approach to better understand the ways in which Hispanic/Latina women in engineering use capital along their career trajectories for it has the potential to illuminate the structure-agency tensions that characterize striving to succeed in a field characterized by historic, systemic underrepresentation of women and people of color.

Given that the generation of knowledge around *la facultad* is rooted in a multiracial, feminist theoretical framework (Johnson et al., 2011) and related research borrows indirectly from critical theory (e.g. Tran et al., 2011), choosing a critical approach is apt. While I remain cognizant of how feminist theory relates strongly to the construction of science identity (Haraway, 1988), wherein women who are scientists are positioned as "other" simply by virtue of being not men, I am confident that the broad perspective of critical theory enables me to perceive the ways that the research participants' myriad social identities influence their efforts to succeed as well as their notions of success. Additionally, a critical theoretical framework gives visibility to those aspects of my participants' social identities that I could not see or did not account for

directly in my interview protocol and therefore allows my data to reflect my participants' perspectives even as they are refracted through my own understanding.

### Site and Sample Selection

My site is the Hispanic Engineers' Society (HES – a pseudonym for the purpose of maintaining anonymity) a Hispanic/Latinx-serving organization that strives to foster the advancement of its members throughout the professional pipeline of engineering: pre-college through advanced professionals in all engineering fields. HES was founded approximately 40 years ago among a small group of professional engineers in California and have grown to serve over 50,000 members nationwide who have been members for one year or more (as of 2016, according to then-president of the HES NYC-area professional chapter, John (pseudonym)). As a grassroots, member-driven organization, the Society operates through establishing regional/state-based chapters both among professional engineers and on college campuses. Their collegiate cohort is the largest and most dynamic segment of their membership while a growing number of professionals are becoming involved in networking events as well as outreach at the high school level to increase interest and awareness among students of color in engineering and STEM generally. While somewhat new to national initiatives to increase the numbers of STEM graduates of color, HES has succeeded in supporting increasing numbers of Hispanic/Latino students in engineering and has recently partnered with several other national minority-serving engineering organizations in a collaborative effort to boost graduation rates among underrepresented groups from 30,000/year to 50,000/year by 2025 (50k coalition, 2017).

With an explicit focus on supporting the long-term professional development of its members, HES creates a variety of spaces (e.g. panels, high school workshops, college-based events etc.) in which professional engineers can interact with aspiring engineers to discuss tips for career advancement and share experience from the field (i.e. day-to-day work experience). The NYC-area professional chapter alone can have up to an average of 100 events scheduled over a three-month period. The potential for social and cultural capital sharing is thus rich.

While the organization is currently carrying out an internal evaluation of its impact, there is not a current focus on the experience of its female members. My findings related to members' perceptions of the organization (preserving anonymity and confidentiality) can thus add to HES's information and offer insight into the specific needs of professional women in the organization. I cannot provide conclusive data yet can offer to share thoughts regarding attributes of HES that have been impactful in the career trajectories of the women I interviewed.

The NYC-area professional chapter of HES has approximately 1,000 members, a significant portion of whom are female. As prior research has found membership in student-serving STEM organizations to be a source of social capital (e.g. Ceglie & Settlege, 2016), HES provides a site wherein members have opportunities to take up and apply capital that can empower them to strive towards and achieve their career goals. Speaking with and observing female HES members allowed me to learn about obstacles they face, how they approach those obstacles and insights they have into the relationships between their individual success and the success of their peers. Learning about women's experience within HES and in their work environments has generated knowledge around



the role that different spaces play in shaping their career trajectories – whether in the form of empowering them to advance or creating obstacles to their success.

The focus on Latina professionals in engineering, as a specific segment of underrepresented women of color in a particular STEM field enriches the current scholarly understanding of the experience of being a female STEM professional of color. The wide variety of career paths associated with engineering degrees act as diverse spaces in which to understand the career-related experiences of female engineers as well as common challenges women of color may face regardless of which engineering space they occupy. That HES comprises Hispanics from a wide variety of engineering subfields made it an ideal space in which to learn more about my unit of analysis: Latinas in engineering.

During my initial observations in the fall 2016, I sought to identify potential participants for my interviews who met my criteria for inclusion in the study: being a current, active member in HES; identifying as a Latina/Hispanic woman; having attained a B.S. degree in an engineering subfield in 2011 or earlier; and having been employed in an engineering-related job or having pursued an engineering-related post-baccalaureate degree since graduation. Because my goal was to learn about capital use among Latina engineers who had persisted in their engineering careers, I used HES membership and sustained career involvement (i.e. 5+ years) as indicators of persistence. I had met several HES members, including the president, prior to the project start and so asked them for assistance in recruiting participants either to participate in an interview if they were eligible or to connect me to other members who were eligible. In this way, I initially employed a criterion sampling technique (Patton, 2001) that started with a few contacts I

had met on my own or through the HES president who met the criteria for the study. These contacts as well as one of my key informants, mentioned below, then referred me to other eligible women so the remainder of my sample grew based on their connections, modeling a snowball sample technique (Creswell, 2013).

To summarize, my sample was composed of 10 women – nine of whom worked as professional engineers and one of whom was an engineering education graduate student. The graduate student had earned her “Engineer in Training” (EIT) licensure (professional engineering licensure widely recognized by employers); another participant had earned her PE (Professional Engineer’s license granted to those with a B.S. in engineering, who have worked at least four years’ under a PE, and who have passed state licensing exams) and PMP (Project Management Professional credential earned through testing). Nearly half of participants held a management position at some point in their career. The sample (outlined in Table 1: *Interviewee Demographics*) represented a variety of engineering and technology subfields and participants had a wide age range: late 20s to late 40s. Two women held patents. Three of the participants were married and two of these had children. More than half of participants were born outside the U.S. and, of these, each was from a different country of origin. Given the professional and ethnic diversity of my sample, the women I interviewed appeared to be representative of HES membership overall as well illustrative of the diversity of women in engineering in general (see Appendix D for complete participant demographics table).

To contextualize participants’ experiences and provide data to triangulate their responses, I interviewed three additional HES members who did not meet criteria for participation yet occupied key roles in HES and in my study as key informants. Two of

Table 1

*Participant Demographics*

Name	Job	Engineering Back-ground	~Age	[Parents'] Country of Origin	Family Status	Relative Educational Attainment
Mary	Management-level position in procurement (Bacardi Martini)	Chemical Engineering	Late 30's	Colombia (immigrated with mom at age 3)	Married	First Generation College Student (FGCS)
Camila	PhD student, Virginia Polytechnic Institute and State University (Virginia Tech.)	Civil Engineering; Environmental Engineering; Engineering Education	Late 20's	Dominican Republic (she moved here for university)	Single	Family of Engineers
Victoria	Independent IT consultant	Computer Engineering	40's	Mexico (immigrated here following Master's degree)	Single	FGCS
Ana	Project Manager – Tishman Construction	Electrical Engineering	30's	Ecuador (came to U.S. for college)	Single	Both parents doctors
Isabel	Deputy-Director (NYC Mayor's Office of Housing Recovery)	Chemical Engineering	30's	Born in U.S., parents origin unconfirmed	Single	Unknown
Pilar	WW Manager (Lexmark International, INC.)	Industrial Engineering/ Chemical Engineering	40's	Venezuela (came to U.S. for grad. school)	Married, school age daughter	Both parents STEM backgrounds, college or higher

Name	Job	Engineering Back-ground	~Age	[Parents'] Country of Origin	Family Status	Relative Educational Attainment
Rosa	IT Project Manager (Credit Suisse)	Computer Information Systems/Mechanical Engineering	40's	Born in U.S., parents from Dominican Republic	Single	Unknown
Alexandra	Gov't contracted IT specialist	Computer Science	30's	Dominican Republic, came to U.S. for college in 1999	Married	Father and siblings in engineering
Mónica	IT Training & Strategic Project Specialist (Mercedes-Benz USA)	Computer Science	40's	Dominican Republic, came to U.S. at age 16	Married, has 3 children	FGCS
Nicolyn	Project Engineer (Northrop Grumman Corporation); currently starting own company	Industrial Engineering	30's	Born in U.S., Mexican background	Single	FGCS
Mari-elena	Industrial Engineer (UPS)	Chemical Engineering	20's	Born in U.S., parents from Ecuador	Single	FGCS
Esther	Project Manager (Samsung)	Mechanical Engineering	Late 20's	Mexico, came to U.S. at age 7	Single	FGCS
John	Product Manager (NY DoE)	Computer Science	30's	Unconfirmed	Single	FGCS

these participants were also Latina STEM professionals who were HES members and had graduated between 2012 and 2015; one had earned a B.S. in engineering yet worked in the technology industry and so considered herself a career switcher. The other worked in an engineering-related position. The former had been a key informant prior to the start of my study, was involved in organizing many HES activities, and considered herself committed to the success of Latinas in STEM. The latter was the most consistent HES volunteer that I met in the field. The third HES member I interviewed was the HES-NYC chapter president who I selected to interview to provide an administrative perspective on Latinas' involvement in HES as well as a male perspective on the status of Latinas in engineering broadly.

### Data Sources and Data Collection

To answer my research questions:

1. What forms of capital do women of color utilize as they strive to succeed?
  - a. What currently existing structures facilitate/inhibit capital production and use?
  - b. What other forces play a role?
2. What role does the organization play in women's access to various forms of capital and how they use capital?
  - a. What other forces play a role?

I employed multiple qualitative data collection methods: observations, semi-structured interviews, and document analysis. Each method yielded data that addressed different aspects of my question, as Table 2: *Overview of Data Collection: Observations*, Table 3: *Overview of Data Collection: Interviews* and Table 4: *Overview of Data Collection: Documents* indicate.

As seen in Table 2, observation data primarily addressed the second research question and shed light on the culture and atmosphere of HES as a context in which study participants used various forms of capital and which mediated their capital use. As Table 3 shows, interview data constituted the majority of findings that directly related to both research questions. Documents—nearly all online media, as seen in Table 4—also provided contextual data that helped to situate study participants within HES’s broader community as well as to situate HES within a broader socio-cultural context. What follows is an overview of my data collection process.

### *Observations*

Following my IRB approval in October, 2016, I began the first wave of data collection: participant-observation at HES-NYC events. While interviews are critical data sources because they generate an insider’s perspective, observations allow the researcher to strive to see their participants’ worlds through their own eyes and not solely through the eyes of the participants. As the dynamic between what one says about one’s experience and what one actually does often involves discrepancies, observations are a tool for the researcher to experience the field she is studying to develop some sense of an insider’s perspective for herself; thus, participant-observation is critical to an ethnographic research design. Also, rooted in anthropological methodology, field observations have traditionally been used by anthropologists of education to generate thick descriptions of the research site to provide detailed contextual information pertaining to the research question (e.g. Geertz, 1973; Spindler & Spindler, 1990). My intention in observing a variety of HES events was to become more familiar with the

Table 2

*Overview of Data Collection: Observations*

Source	Content	Location	Date(s)	Length	RQ/Project Connection
1	Mock career fair	CCNY	10/22/16	7h25m	HES capital; women in HES
2	Professional networking event for Latinos in Construction	Hotel in Midtown Manhattan	10/26/16	3h15m	HES capital; interviewee context
3	NYSci STEM Night	New York Hall of Science – Queens, NY	10/28/16	1h25m	HES capital; women in HES
4	Minority student “College Access Fair”	Fordham University	11/19/16	3h10m	HES capital; women in HES; HES social context;
5	BuzzFeed Latina Tech event	BuzzFeed Headquarters, Manhattan, NY	11/29/16	1h43m	Women in HES; women in alternative engineering (tech.) spaces
6	NYSci STEM Night (Topic: Social Media)	New York Hall of Science – Queens, NY	12/9/16	2h37m	HES capital; women in HES
7	NYSci STEM Night	New York Hall of Science – Queens, NY	2/3/17	2h34m	HES capital; women in HES
8	Regional Leadership Development Conference	Hotel in Brooklyn, NY	3/2/17-3/4/17	17h	HES capital; women in HES; interviewee context/interaction/observation
9	Girls in Science and Engineering	Intrepid Museum of Air and Space	3/11/17	2h	HES capital; women in HES; interviewee interaction/observation
Total	99 pages field notes	--	--	41h9m observations	

Table 3

*Overview of Data Collection: Interviews*

Source	Content	Location	Dates	Length	RQ/Project Connection
<i>Interviews – primary</i>	Women 5+ years post-B.S. Engineering degree, having worked or schooled in engineering-related field since	In person at RLDC or in office; over the phone	3/3/16 – 8/2/16	10 interviews, ranging in length from 32 mins to 65 mins (avg. length = 48 mins)	All types of capital; etic view of science capital (social, cultural, other); emic view of specific types of capital mentioned within context of each interview and then across interviews as patterns arose —> RQ1 and RQ2; in one case: national, administrative perspective
<i>Interviews – secondary</i>	HES-NYC president; two Latina key informants (~1-3 year(s) too young to fit into primary pool)	Over the phone	3/5/17-7/29/17	3 interviews ranging from 60-86 minutes	Another dimension of RQ1, RQ2; administrative perspective

environment in which my participants sought support among like-minded peers and begin to get a sense of the typical HES member's experience. From a methodological standpoint, I also hoped to meet initial potential interviewees and other organizational representatives who would generate knowledge related to my research question.

I carried out approximately forty-one hours of participant observation over the course of six months (see Table 2). During my observations, I took notes on the atmosphere and the types of interactions taking place, with a particular focus on how women moved through the spaces. The specific spaces I observed were: a professional



Table 4

*Overview of Data Collection: Documents*

Source	Content	Location	RQ/Project Connection
<i>Documents/Media</i>	HES-NYC Website	Online	RQ2: HES capital; HES social context; HES: media; HES culture/atmosphere
	HES National Website		
	HES-NYC Twitter Feed		
	HES National Twitter Feed		
	HES-NYC Facebook Page		
	HES National Facebook Page		
	HES-NYC LinkedIn		
	RLDC Conference Program	Brochure from regional conference	

networking event, a mock career fair hosted by a New York City-based collegiate HES chapter (sponsored in part by HES-NYC), three high school science nights at the New York Hall of Science in Queens, a college fair for students of color, a “Girls in Science” event at the Intrepid Museum in Manhattan, a Latinas in tech. event at BuzzFeed and HES “Northeast Region”’s annual Regional Leadership Development Conference held in Brooklyn. All events were held within New York City. The urban environment play a role in my data collection and analysis insomuch as there was always the contextual “buzz” of the city present during observations and the visual reminder of the diverse setting surrounding HES and its members. An excerpt from my field notes describing my arrival at Fordham’s college access fair at which HES was a participating organization shows this and how it connects as well to my positionality:

I arrived at the McGinley Center at approximately 12:05PM after taking the train from Pelham to Fordham...I walked across the street and into the Third Avenue gated entrance. I was struck – not surprised – by the urban atmosphere – cars everywhere and folks from all different backgrounds. (Reminded me that this organization’s location and being able to do ethnography in NYC is so ideal for an Urban Ed student – a blessing to be able to do research I enjoy in a most urban space with such interesting dynamics). (Observation, field notes, 11/19/16)

Additionally, as HES-NYC has no regional or local headquarters, observing HES events was in itself informative regarding how HES maintains its organizational culture. By my third observation I noted that “I was struck by the variety of spaces HES occupies – universities, common/dining spaces in downtown NYC hotels, event spaces in restaurants, and public science museums among others” and wondered about the “trickiness” of this for both data collection and analysis purposes. Regarding data collection, could I generate adequately “thick” descriptions of spaces if I only visited each space once? I wondered in a memo following my fourth observation if I was “...not taking notes...as would be needed for a truly thick description of the space” because it took me time to get used to each space during each observation and I needed also to focus on the individuals within that space – the aspects of continuity during each visit to the field (Memo, field notes, 11/19/16). Regarding analysis, I also memoed following my fourth observation: “As HES is not really defined by space/physical location per se, I wonder how important space/place is for defining the organization?” Following my first few observations, I reflected on this question in relation to my research question:

HES occupies a variety of physical/social spaces (i.e. schools, hotel party spaces, city museums, colleges/universities) – how does this shape the forms of capital HES members may access and the extent to which certain members get to use certain forms and when/how? Yet [that] HES has no physical headquarters though is very impactful – sign of a truly globalized organization, not defined by space per se yet completely dependent on accessing and using space to promote its work. Also, membership tied to the notion of the organization and sense of belonging with other people – socially defined (culturally too? Both in terms of

Hispanic/Latinx culture and in terms of professional culture of engineers...).  
(Analytical memo, 11/17/16)

While the culture of HES is explored more fully in the following chapter (Chapter 4), it is notable here that the question of space/place related directly to the data I collected regarding the forms of capital HES members used, the culture of the organization and the way in which a lack of constant/static physical space increased the need for HES members to define their belonging to HES in other ways: organizational culture, fellow HES members etc. Seeing Latinas, and their peers, in a space defined by its social and cultural – and not physical – attributes, allowed me to focus on capital use in a context that highlighted relationships. I could see my participants “in action,” as it were; observations provided a “birds-eye” view of how they enacted their identities in relation to others (e.g. Lareau & Shultz, 1996).

### *Interviews*

I started reaching out to potential interviewees in December of 2016 with the aim of running interviews from January through March 2017. While my observations generated a sense of HES’s culture and varied capital use among HES members, as well as those with whom HES members interacted, they generated data that were primarily “etic” in nature; that is, I developed an understanding that was nuanced yet limited by my positionality as an “outsider” to HES, to engineering as a field and the worlds Latina engineers occupy. Interviews are thus critical in offering an “insider’s” view, or emic perspective. Balancing an emic perspective with an etic one can result in well-rounded data that accurately reflects the subjective views of both the research participants and the researcher herself (Lincoln & Guba, 1985).

In a critical theoretical framework, the voices of the research participants are essential to generating an emic understanding of the field (e.g. Creswell, 2013). Additionally, semi-structured interviews are potential spaces in which significant knowledge generation may occur (Seidman, 2013). Thus, I was eager to speak with Latina engineers themselves to begin to gain insight to an insiders', or "emic" perspective on forms of capital they believed they used and the role they felt HES played in their access to capital along their trajectories in engineering.

I recorded in my field notes in December, 2016 that I "...need[ed] to do interview invitations ASAP to try to get 1-2 set up before I travel. Just emailed [name of woman in HES who I emailed]" (Memo, field notes, 12/1/16). At a high school-oriented science event in December, I reconnected with the HES-NYC president and he offered to assist with interview invitations; we also agreed that the upcoming Regional Leadership Development conference in early March would provide a good opportunity to connect with my target group of women in HES who had graduated over five years prior. I described our conversation in my field notes:

About 500 people expected to attend [the conference]women of color in STEM~150 pre-college summit, 350 college students...100 professionals, 25 women – so definite potential interviewees. I told him what my cohort was (5 years post-B.S., professional engineers)...He said that as far as getting 15 interviews, he would post something on the listserve and I should be able to get 15 responses no problem (great!). I also mentioned that I planned to interview a few other folks like him, perhaps [name of male long-time (10+ years) HES member; name of female active HES volunteer] – other key administrative HES reps, even if not in my cohort. I said I would definitely send him something in January, after the holidays. (I thought that sounded good – even if I didn't get all 15 from listserve, even 7 then from the conference I should be able to get the additional 8, for example, whether through other contacts, or doing that onsite. It was great to get that boost of support from him.... (Conversation, field notes, 12/9/17)

Per our conversation, I sent him the invitation in January (1/23/17) with the aim of starting interviews in early February. I tried to set realistic expectations and anticipate minimal yield from the listserve, knowing that I would still need to put in legwork to connect with interviewees on my own. My concern about interviewee options and yield arose in part because I had observed primarily female college students and most of the women that I spoke with who appeared to be out of college were recent graduates. In an analytical memo I wrote in February 2016, following seven of my total of nine observations and prior to the regional conference in March 2016 where I would end up actually beginning the interview phase of my data collection, I expressed my concern both in relation to my project and as a reality possibly reflective of a larger issue: “My brief exposure to HES events is that most women who attend events are in the <5 year category. Are others too busy...not interested...not there? Thinking in terms of mid-career drop-out research [Fouad, Singh, Fitzpatrick, & Liu, 2012] absence/reduced numbers would not be surprising” (Analytical memo, 2/16/17). I was worried, not only because John, the HES-NYC president appeared to have not yet sent out my invitation but because I was not meeting very many potential interviewees myself. I tried to understand this reality through the lens of a larger social phenomenon that I had heard referred to at the BuzzFeed event I attended:

[Name of presenter] gave an overview of her professional background and the focus of the workshop she would be leading. She referred to her research on the high mid-career drop-out rate among women in tech and highlighted the fact that obstacles to “climbing the ladders” were not limited to parenthood but facing diversity issues that were barriers to advancement. She connected to my introduction, saying she was glad graduate work was being done on the mid-career phenomenon.... (Observation, field notes, 11/29/16)

I actually hadn't been aware of the "mid-career phenomenon" in setting the variables that defined my interviewee pool yet was glad my research was viewed as valuable by others in related fields. Also, it helped me to see the absence of potential interviewees as data itself: women 5+ years into their career were not as present at HES events as younger women. With whomever I *was* able to interview I then had the opportunity to inquire about this or could at least triangulate this observation with participants' descriptions of their involvement with HES.

While waiting for John to send out an interview invitation, I did a pilot interview in early February 2017 with "Esther" (pseudonym), a woman who had been a key informant early on in the project yet was a year shy of my interviewee criteria. I then proceeded to attend the regional conference with the hope that, per my December conversation with John, I would indeed meet some early or mid-career professional women that had been absent from the other spaces I observed. At the conference, I met my first three primary group participants and carried out semi-structured interviews onsite (see Chapter 5 for descriptions of initial introductions). I met another prospective interviewee at the conference and emailed her thereafter to schedule an interview. Following our interview in April, 2017, she forwarded my interview invitation to seven women with her own note describing the interview experience as "enjoyable":

Emily is doing her doctoral research on Hispanic women in STEM—the type of research that can provide insights to HES and help us further the mission of our organization. Emily attended RLDC, that's [where] we met, she was able to interview a few HES members there but needs more participants for her research. I participated in the interview via phone afterwards - it was an enjoyable experience that took less than one hour. Please consider participating and/or reaching out to others. Reply to Emily if you are willing to help.  
Thanks!  
(Pilar (pseudonym), email communication, 6/14/17)

I was grateful for her support and hoped that her invitation would generate more interviews as hers was my sixth interview and I had hoped for at least 15 with women in HES, together with an additional five interviews with other HES stakeholders. Five of the women responded positively and I was able to schedule interviews with two of those five women. The other three women began the scheduling process yet two of them stopped responding after follow-up emails and the other interview I missed due to a family emergency that arose on the day of the interview and forgetting to update my calendar. Unfortunately, we were unable to reschedule.

Realizing after the conference that, while three interviewees was a good start, I needed to try much harder to attain my goal of 15 interviewees, I reached out to Esther as well as my three interviewees with a request to forward my interview invitation to 4-5 women they thought may be willing and able to do an interview, based on the eligibility criteria of being a Latina/Hispanic woman who was an HES member, had a B.S. in engineering and 5+ years in industry, or graduate school. I hoped that in asking for a total of ~20 interview invitations to be sent out between them, it would generate at least five responses. In addition, I was still waiting on the email John had offered to send out to the HES-NYC listserve, which had dozens of subscribers and presumably at least 10 potential interviewees. I had hoped that between the snowball sample from my initial interviewees and John's contacts, it could provide up to 15 additional interviewees.

Esther, the key informant I had emailed, sent out my interview invitation via email to seven women on the same day I had emailed her and via Facebook shortly thereafter. Her note was similarly warm to Pilar's and five of the eight women she emailed/Facebook Messaged responded. I ended up interviewing four of them. The tenth

woman I interviewed was a HES member I had actually met at an HES event prior to the start of my project and then met again during one of my observations.

I thus began my interview data collection using a criterion-based sample (Patton, 2001) of three women I met at the conference and then employed a snowball sampling technique wherein I asked my interviewees and key informants for references to other eligible participants and they referred me to the remainder (Creswell, 2013). Interviews were held in person or over the phone, according to the interviewees' preference or due to logistical necessity (i.e. those participants who lived outside the NYC-metro area).

Prior to each interview, women were asked to fill out a participant voluntary consent form (see Appendix G). While the semi-structured interview protocols are attached (Appendix E – Primary participants; Appendix F – Secondary participants), it is important to outline briefly here the flow of the participants' protocol. Broadly speaking, questions were based on Carlone & Johnson's 2007 science identity model and their semi-structured interview protocol that asked participants to reflect on their experiences in science and specific successes and challenges they faced (Carlone & Johnson, 2007). I began with background questions regarding participants' trajectories through engineering. Asking open-ended questions allowed the participants to define their own narrative and provide background information about which I could inquire further as needed. These questions helped to establish rapport and trust at the start of the interview and created a safe space in which the interviewee felt comfortable sharing her experience (Seidman, 2013). Starting with the question "Can you describe to me your trajectory throughout the sciences broadly?" generated responses that ranged from 30 second summaries of their schooling and current work in engineering to 60 second or longer



descriptions of how they first became interested in science as a child, the role of their family, their culture, and how these led up to their current job position. Responses were generally narrative in nature and women generously shared aspects of their life stories with me. I then proceeded to inquire about obstacles the interviewee has faced and how she dealt with those obstacles. The interview closed with questions that asked for participants' insights into the causes of underrepresentation, many of which had arisen earlier in the interview. With the exception of the last question which was wordy and confusing, most questions read smoothly and participants readily responded to each question.

In addition to interviewing HES members who met selection criteria, I selected several additional individuals from the organization who were key stakeholders in the success of the organization and its members. I had intended for these interviewees' responses to supplement those of my core group; however, as the reader may see in the following chapters, their insights ended up being critical to understanding women's use of capital and the organization's role in capital use. Because they either occupied an influential administrative position (i.e. John as the HES-NYC president) or a social position highly comparable to my primary interviewee pool (3-4 years into their careers and also active HES volunteers), their experiences and thoughts shed much light on capital use and helped to triangulate core participants' responses and my observations. As a result, I drew upon these data heavily as they too illuminated the possibilities for fostering success among greater numbers of women of color in engineering and other STEM fields as well as actual and potential barriers to transforming the system. The triangulation between primary and secondary participants' interview responses and my

observation data allowed me to understand aspects of the primary participants' experiences and elements of HES from other perspectives and strengthened the credibility of my findings ((Guba & Lincoln, 1994).

### *Documents*

To supplement interviews and observations, I reviewed HES-related documents. Analysis of HES's written culture (nearly all online in digital format) provided insight into the sociocultural, politico-historical context in which research participants constructed their science identities and developed and/or accessed means of achieving their goals (Bowen, 2009). HES documents provided information regarding its mission and how it relates to fostering the success of the women who are members as well as its membership overall. Through reviewing HES-NYC and HES National's Tweets and Facebook announcements and photographs, I was able to learn about the discourse around success and striving towards achieving one's career goals within the context of HES. Such data corroborated prior research that showed that institutions can be sources of social and cultural capital (e.g. Reyes, 2011). Overall, a close reading of HES-NYC's and HES National's websites, Twitter feeds and Facebook posts helped provided both contextual and evidential data regarding the ways in which the Latina HES members (HEStinas) persisted along their trajectories through engineering.

Together, observation, interview, and document data provided both an emic and etic understanding (e.g. Lareau & Shultz, 1996) of which forms of capital Latinas use as they strive to succeed in STEM, how they applied various forms of capital to the obstacles they faced over the course of their careers as engineers and other critical aspects

of their experience that they identified. Observing Latinas and their Latino peers in engineering in the context of HES events, hearing their stories during interviews, and analyzing HES's documents provided data on the tensions between the agency of my participants and the varied structures they navigated along their trajectories. Additionally, learning about such structure-agency tensions also provided insight into the challenges involved in translating the individual success that my participants experienced into the structural change and collective transformation they wished to see.

### Data Analysis

Data analysis occurred during four general waves:

1. Transcription of field notes (99 pages), including memoing, that revealed emerging themes regarding women's experience in HES and HES's organizational culture.
2. Transcription of interviews, including memoing, that also revealed emerging themes.
3. Open (i.e. first level) coding of observation and interview data using the qualitative data analysis software, ATLAS.ti, to identify demographic/descriptive codes as well as (dis)confirming emerging themes that arose during transcription, identifying new patterns, and memoing.
4. Axial (i.e. second/third level) coding using ATLAS.ti to first (dis)confirm the presence of codes found during open coding and then to code observation and interview data accordingly.

### *Wave 1: Notes from the Field*

During each observation I either took notes during the observation, while I was in the field, or immediately after – either in writing or a verbal dictation. In most instances, I transcribed field notes 24-48 hours after my observations to preserve as much detail from the site as possible. I marked each set of notes with the time, date, and location to contextualize the observation and enable me to keep track of the document, particularly for the purpose of uploading notes into ATLAS.ti in a systematic manner. I put initial thoughts and questions (i.e. observer comments) in *italics* throughout the text as I transcribed my notes. These generally consisted of analytical inquiries regarding something I'd observed or methodological notes about data I hoped to collect in the future to address a gap I saw in my notes. I also did brief memos at the end of approximately half of my observations. Moreover, I did analytical memos at three points during the project at junctures when it seemed timely: First, following my October 2016 observations because I could sense some themes emerging from my first few observations and wanted to take time to reflect on them (11/17/16, 5 pages); second, following my November/December/February observations so I could “get an overview of what I've observed during my past four visits to the field, to identify any themes/patterns and key questions that appear in my findings, and to respond to queries from my first analytical memo” (Memo, 2/16/17, 7 pages); and lastly, following my final observation in March once I realized that I had found emerging themes, had saturated data points around capital-related themes and had done over 40 hours in the field (3/22/17, 10 pages). These memos represented a key part of my analytical process as they were spaces in which I could identify patterns in the data and note emerging themes and ideas as well as

potential areas of focus for subsequent observations (Bogdan & Biklen, 2003).

Additionally, maintaining a high level of detail in my note-taking and typing up my notes soon after observations enabled me to stay as close to what I had observed in the field as possible so as not to lean on recollection to generate knowledge about my site (Lareau & Shultz, 1996).

I took notes with the understanding that field notes involve not only fleshing out one's written notes from the field but identifying emerging findings from the field that can further inform subsequent observations, such that one moves from a "vacuum" data collection orientation to a "spotlight" orientation where one's focus is keener and honed in on data that directly address one's research question (Horvat, 2013). My goal over time, through in-text memos as well as periodic analytic memos during the observation phase, was to move from the "vacuum" stage in which all aspects of HES – its culture and its members – seemed pertinent and interesting toward a "spotlight" focus on capital use among its members. Regularly posting my research questions at the start my field notes and in memos assisted with gaining this focus. As far as timeline, I transcribed field notes as I carried out my observations and so this data analysis "wave" overlapped with my data collection phase: October 2016-March 2017.

### *Wave 2: Hearing Participants' Voices*

The second wave of data analysis occurred during and following the interview phase of research. I did limited notetaking during interviews and did a brief memo following the interview, prior to transcribing. Notes highlight points that stood out to me while memos noted the feel of the interview overall and aspects of the interview that I recalled that resonated with my project or that simply struck me. Interviews ran from

March, 2017 through August, 2017. After purchasing a foot pedal and Express Scribe Transcription software, I began the interview transcription process in September, 2017?. I transcribed the interviews verbatim, excluding repeated “um’s” and “ah’s.” As I transcribed, I aimed to remove all identifying information that may have been present on the recording. My main task was to transcribe what participants were saying, doing my best to decode words/phrases that I had difficulty understanding. I marked each unintelligible word/phrase with a time stamp so I could return to it to clarify meaning as needed.

The process of transcribing myself gave me the opportunity to include “transcription notes” in *italics*, similar to observer comments, in response to interviewees’ remarks that shed light on emerging themes or other points of interest related to my research question. These comments, together with interview memos before the interview and following transcription, allowed me to merge data analysis performed at different time points so that all of my thinking about a given interview was kept in a single “interview memo” for each of my participants – memos that became part of my data pool in ATLAS.ti. I also did a brief analytical memo in July of 2017 focused on themes and questions that had bubbled up following interviews, as accounted for in the brief memos I had done. All of these memos were critical aspects of my analytic process as they provided space to reflect freely upon not only emerging themes or new questions but my role in the project and the progress of the research overall; my memos thus made theoretical contributions to the project as they highlighted tacit themes and undercurrents in the data that could only be revealed through reflection (Bogdan & Biklen, 2003).

### *Wave 3: Open Coding & Codebook*

Using ATLAS.ti, I first analyzed observation data (while I was still in the process of transcribing interviews) and then, upon completion of interview transcriptions, interview data for themes that naturally emerged as well as specifically in relation to my research question. While I kept my research question as a guide for my analysis, I coded the participants' responses according to their own words and tried to stay open to possible ambiguities (Horvat, 2013). As themes arose and became saturated data points – found consistently throughout the interviews and/or observations, these themes, or codes, became part of the codebook. The codebook is thus the compilation of all the codes that arose from reading through the data and a was space where, using ATLAS.ti, I was able to look at connections (i.e. cooccurrences) between codes and so develop an increasingly nuanced theory around participants' experiences in engineering. I first developed a set of codes that applied directly to observation data (see Table 5: *Data Analysis: Open Coding Code List*).

As one can see , these codes were primarily demographic and descriptive – and not conceptual – in nature. Given that observations were intended to learn about HES as a social space my participants occupied, descriptive codes regarding HES's structure and culture and the role of women at HES events sufficed. While several of the “HES demographics” codes do not pertain directly to my research question, which focused on Latinas, they arose organically from being in the field and observing the significance of additional factors such as professional background (i.e. Hispanics connected with HES even though they were not engineers) or the racial/ethnic diversity of HES members,

Table 5

*Data Analysis: Open Coding Code List*

<b>Demographic/Descriptive</b>	<b>Conceptual</b>
Engineering Companies	STEM and Gender
Engineering: Culture	Women: Positive Social Identity Reference
Engineering and Business	Women: Presentation of Self
Latinx: Racial Diversity	
HES Demographics: Career Opportunities	
HES Demographics: Female Leadership	
HES Demographics: Membership Diversity	
HES Demographics: Professional Diversity	
HES Demographics: Women in HES	
HES: Media	
HES: Social Context	
HES Demographics: Female Engin. Major	
HES Demographics: Member backgrounds	
HES Demographics: Middle school	
HES Demographics: Racial/Ethnic Diversity	
HES: Culture/Atmosphere (also conceptual)	
HES: Organization	
Women: Alternative Engin Spaces	
Women: Dress	
Women: Language Use	



including those who did not identify as Hispanic (see Chapter 4 for further explanation of racial/ethnic diversity of HES). These codes helped to display the dynamics of HES culture and so were useful in providing contextual information to better understand my research question. Also, the HES: Culture/Atmosphere and Engineering: Culture code was certainly “hybrid” to the extent that it was simultaneously descriptive and of culture, in HES and in engineering, in my analysis kept me aware of the situatedness of HES within a broader sociocultural politico-historical context (Lincoln & Guba, 1994).

Having completed transcription, I then did an open coding of interview data and generated the following “rough” code list (see Table 6: *Data Analysis: Open Coding for Themes*). I also applied HES-related codes as participants mentioned HES-related events or observations. Here the codes were composed of a mix of descriptive and conceptual themes.

Reading through the interviews following the coding of my observations allowed me to see how participants’ experiences were associated with what I’d observed. Having done several analytical memos on observations and interviews, I could ask: does what I observed relate to interviewees’ experiences? Are my interviewees exceptional HES members? Do their experiences relate to those of their peers? HES presents itself in a certain way – does how my participants perceive the organization map on to this presentation? It was in response to questions such as these, that I did a post-rough coding analytical memo on my data. As qualitative research is necessarily iterative (Hesse-Biber & Leavy, 2006), taking time to do a memo at this point helped me to look at my codebook to note frequencies of codes (see Appendix C for complete codebook).

Analyzing of data in ATLAS.ti allowed me to see congruencies and discrepancies in my data. Congruencies disclosed saturated data points where a theme emerged (e.g. capital, social identity, barriers) that applied to many participants or was consistent across

Table 6

*Data Analysis: Open Coding for Themes*

<b>Demographic/descriptive</b>	<b>Conceptual</b>
Interviewee dems [demographics]	Interviewee: Agency
Interviewee: College	Interviewee: Barriers
Interviewee: Elementary school	Interviewee: Capital
Interviewee: High school	Interviewee: Engin. interest
Interviewee: Job	Interviewee: Family
Interviewee: Middle school	Interviewee: Framing the issue
Interviewee: Post-college	Interviewee: Framing the solution
Interviewee: HES in college	Interviewee: Language
	Interviewee: Motivation
	Interviewee: Social context
	Interviewee: Social identity

multiple areas of a participant's experience (i.e. their recollected trajectory, their present experience, and their membership in the Society and workplaces, where requisite data have been collected). I could also balance my own hunches about what I thought were interesting or critical themes with the frequencies of the codes to remain focused on what participants actually said. In this way, I could foster the validity of my findings -

acknowledging my role as the researcher throughout the data analysis process through observer comments and memos – to produce “transparent” research that reveals the mediated nature of knowledge production (Guba & Lincoln, 1994, p.110).

#### *Wave 4: Axial Coding and Capital Codes*

Having memoed I could thus proceed with axial coding. Starting with data coded “Capital,” I identified forms of capital that women referred to in relation to persisting in their engineering careers. The forms of capital that women referred to clearly reflected findings from prior research on persistence among women of color in STEM broadly and Latinas in engineering specifically; examples included strong family ties that either supported them or acted as a structural barrier to their career pursuits (e.g. views that women are not suited as engineers, lack of understanding of why engineering was a worthwhile career to pursue), the role that encouraging mentors played in helping them to maintain a positive outlook during challenging times, and the role that HES played as a student and professional support network. As a result, using etic, pre-defined conceptions of capital (i.e. cultural, social, and science) was conceptually useful to describe the majority of support and motivation participants described. Chapter 6 contains illustrations of these codes. References to supports that didn’t fit into these categories and for which adequate data analysis has yet to be done are contained in the codes “My Observations” and “Other.” The “Capital Codes” list thus consisted of the following forms of capital: **Cultural, direct counsel** (forms of capital that participants mentioned in the form of advice), **HES** (capital resulting from HES membership), ***la facultad***, **my observations** of forms of capital displayed at HES events, **other** forms that couldn’t be easily categorized, science, social, and instances when participants or other HES members spoke about or

were observed to be a **source** of capital to others. *Please* see Appendix F for complete codebook.

Moving toward a “spotlight” focus, I went back through the data I had coded as either HES: Capital or “Interviewee: Capital” and recoded it according to the language participants used to describe the role that various types of capital played in shaping their careers. It was these data that informed an emic view of participants’ conception of the primary motivating factors in their persistence as outlined in Chapter 7.

### Rigor in Research Design

Qualitative research scholars, Yvonne Lincoln and Egon Guba, identify specific criteria that all qualitative data collection and analysis need to meet to constitute a rigorous research design: credibility, transferability, dependability, and confirmability. While a table of data sources, research questions, and design criteria is shared in Appendix B, a brief description of how my methods achieved these design criteria is as follows:

#### *Credibility*

Lincoln and Guba describe credibility in terms of whether the research findings are credible in the eyes of the participants (Lincoln & Guba, 1985). I attempted to produce credible results through member-checking my observations periodically with participants during the observations themselves as well as during several interviews; I thus was able to glean key informants’ input as to the applicability of my observation-based findings to their experience to some extent.

### *Transferability*

Through observations, document analysis and engaging in regular reflection through regular analytical and methodological memos, I aimed to describe my research setting with sufficient detail such that another researcher could replicate my study and account for any differences in their setting and research paradigm.

### *Dependability*

Corresponding to the notion of “reliability” in quantitative research, dependability in qualitative research requires that the researcher fully acknowledge the dynamic context in which she collects and analyzes data, and the methodological assumptions under which she works (Lincoln & Guba, 1985). I fostered dependability through the collection and analysis of contextual data and used memos to remain aware of changes within the research context.

### *Confirmability*

Observer comments and analytical memos helped me to identify peculiarities and potential instances of bias so that I could aim to produce findings that, ultimately, can be confirmed by others who may wish to replicate such a project (Lincoln & Guba, 1985).

### *Limitations*

While I strove for rigor in my research process, I must acknowledge gaps in my data sources, methodology and resulting findings. My findings reveal aspects of Latinas’ experiences in engineering; yet findings are at best preliminary given the scope of this dissertation and the execution of the research methods.

Regarding data sources, I had hoped for 40-50 observation hours and 15-20 interviewees. Achieving my minimum desired goal of approximately 41 hours, I paused this aspect of data collection to focus on interview invitations and appointments with the hope that I would return to the field following my intended interview phase of February – March 2017. As there was a delay with distributing an interview invitation to the HES listserve (the HES-NYC professional chapter president did not distribute it, likely becoming too busy to do so himself), and I had not met many potential interviewees in the field, the interview phase started instead in March. By April, I had only seven interviews (six primary and one secondary) and so wanted to continue focusing on gathering additional interview data. With only 6 interviews, my primary goal was to get up to at least fifteen interviews with core group participants (Latinas 5+ years into their career) and at least five with the secondary group of HES stakeholders. I reached out again to the HES-NYC president as well as to several key informants (also prior interviewees) to take them all up on their offer to share my interview invitation with women they felt met my criteria. Luckily several women responded and, through a series of emails and/or Facebook messages, I finally scheduled interviews with an additional four women (as explained earlier). That they were (understandably) busy added to the delay. As it was late in the summer at this point and I needed to begin data analysis by September at the latest, I decided to pause data collection to focus on transcription and additional data analysis. Fortunately, data analysis revealed that 41 hours in the field resulted in data that told a story and the ten interviewees' responses contained enough data and sufficiently visible patterns in participants' responses for me to be able to reach

saturation regarding various types of capital women identified and thus address my research questions (Creswell, 2013).

In qualitative research, the researcher must acknowledge that she can neither learn “everything” about her object of study, nor can she perfectly represent participants’ stories. Despite limitations in my data sources and analysis, I was able to gain insight from a variety of sources into the experiences of Hispanic/Latina women as they strive to succeed in STEM and my findings add to the discourse on possibilities for fostering success among a greater number of women of color in STEM. (See Appendix A for Research Timeline).

#### Positionality

I am woman of color striving to earn a PhD in Urban Education and hoping to teach and do research at a postsecondary institution upon completion of my PhD. I am also a mother of four young children. My two daughters love math and science and I pray they maintain that love as they continue along their educational journeys. I thus view my schooling through the lens of my own development as a scholar who can potentially contribute to the discourse on engaging in science education in an evermore equitable, empowering manner as well as through the lens of a mother who strongly desires that her daughter who wishes to become a math teacher may achieve her goal in a holistic, nourishing manner that honors her identity. Thus, I am positioned as much as a fellow woman of color pursuing a career in the (social) sciences as I am a mother wishing that her daughters, and sons, strive to achieve success in a manner that upholds excellence and meaningfulness for themselves and their communities.

Furthermore, having spent the first three years of my graduate studies working as a graduate research assistant on a National Science Foundation (NSF) grant that employed a multimethod approach to an exploration of factors related to persistence among undergraduate science majors, I had the opportunity to engage in a reflection of why students may opt in, or out, of a STEM degree. Seeing that cursory data analysis revealed associations between race and retention – that is, underrepresented students of color did appear to drop out at higher rates than their white peers despite having expressed an interest in their coursework and an intention to pursue a STEM degree in their interviews – I was interested in learning more about the relationship between social identity and persistence. The opportunity to study the experiences of Latinas in engineering thus felt like a natural next step in my own trajectory as a researcher. Examining the intersections between science identity (including interest in STEM and intent to pursue a STEM degree/career) and race/ethnicity as well as gender expands upon my prior research interests.

Also my identity as a “non-engineer” made me stand out at times. As far as my non-engineer identity, this may have been articulated through my appearance:

Talking with one of them (green shirt...not taller one), she thought I'd appeared like a researcher/academic, not as an engineer (I agreed yet wonder, what does it mean to "look" like an engineer? I definitely feel a bit out of place though being with other folks of color definitely eases some of that) other Muslim (non-Hispanic) F who had joined the conversation downstairs before the group moved upstairs to "close out" (their tabs) and ended up getting another drink...she agreed. (I wonder how I appear? It actually felt a bit comforting to know I appeared as anything - gave a sense of visibility though I can only hope it was a positive reference). I laughed and acted surprised. (Conversation, field notes, 10/26/16)

I wasn't really surprised though. While I did my best to dress in business casual for HES events, I also was sure that I wasn't fooling anyone. Between my simple slacks and tops



(and possibly my pregnant belly gave me away too?), often tousled hair and no make-up, I definitely did not appear like the HES tinas I had observed. While I always felt welcomed at HES events, I felt I definitely maintained my guest status throughout the project.

When I interacted with study participants and observed at my site, I did so with a sense of optimism that despite the sociocultural politico-historical context that has shaped current underrepresentation of women of color in STEM, we can foster the success of greater numbers of women of color in STEM so long as we better understand the obstacles they face and the means they have drawn upon to overcome those obstacles. Such understanding can contribute to the movement from individual success stories toward the achievement of success among greater numbers of those who desire to pursue careers in STEM.

### Summary

Through the collection of rich data and the implementation of rigorous analysis I made an effort to honor my research participants' experiences (Lincoln & Guba, 1985). Ethnography is messy at times; however, the insights into the situated nature of inequities and the possibilities for social transformation that ethnography can produce are too potent to dismiss in the name of an easier or more "straightforward" method. The flames of hope that study participants reflect are likewise too visible to blind oneself to in the name of being too localized or too obscured by assumptions of inequities that may not be "real" or researcher bias too strong to overcome. As scholarship on the experience of women of color in STEM is expanding, any research that illuminates the dynamics between structure and agency and highlights forms of capital that may be useful in fostering

success among some is value-added to the overall discourse. As a scholar in the very early stages of an academic career, contributing to the discourse on how women of color succeed in STEM and the complexities involved would constitute success along my personal trajectory and would be an honor.

What follows is the presentation of background data and findings directly related to my research focus on forms of capital that Latina engineers use during their career trajectories. The name of the organization as well as the names of participants are pseudonyms to preserve anonymity. Chapters 4 and 5 are background chapters: Chapter 4 provides a brief overview of the mission, history, and “family” culture of the organization that constitutes the setting for the study: HES. Chapter 5 builds on this background to offer a glimpse into HES membership and brief descriptions of the research participants whose experiences form the core of this study. Chapters 6, 7, and 8 present findings related to forms of capital participants used: Chapter 6 outlines an etic view of forms of capital I came into the study bearing in mind (e.g. science capital and *la facultad*); Chapter 7 outlines forms of capital related to those in Chapter 6 yet in iterations based in participants’ emic view of the “struggle” of being in engineering and the means they’ve tapped into to navigate through the struggle; finally, Chapter 8 outlines social forces participants identified as impactful to their experience as Latina engineers and the role that HES played in relation to those forces.

Even with limitations in research methodology, the study generated findings that may prove useful to other scholars of science education seeking to better understand the challenges involved in women of color’s STEM achievement and the potential for fostering success among greater numbers. Engaging in ethnography created a space for

reflection on the structure-agency relationship among those Latinas who persisted and who continue to persist, those who play a vital role in demonstrating not just through word, but through deed, that indeed STEM is for all. Such reflection bears implications not only for the research participants in this project but for women of color in STEM at various points in their trajectories: to learn about the tensions involved in a woman striving to exercise her agency within structures that have historically been designed to exclude her teaches us not only about the nature of oppression but the possibilities for transformation.

## CHAPTER 4

### THE SETTING

The main space that informed my findings was the Hispanic Engineers' Society (HES). Attending various HES events gave me a sense of the network to which my participants belonged. To better understand this network, I observed a career fair, a college fair, professional networking events, high school science, technology, engineering, and mathematics (STEM) nights, and a regional conference. As each of the participants that I interviewed had different educational backgrounds and professional occupations, membership in HES provided a thread of commonality that allowed me to analyze their responses in relation to at least one shared context that I had become familiar with. Their membership also acted as an indicator of science identity, as each participant had voluntarily joined an organization focused on professional development and overall support of Hispanics in engineering.

To reveal my positionality: my general sense as I observed HES events over the course of a year – first in the Spring of 2016 to get a sense of its fit for my research and then during my data collection phase from October 2016-April 2017 – and as I have more recently explored in HES's web presence is that HES is a source of *positivity* – positive outcomes for members, positive development for administrators, and positive relations with sponsors. It consists of a network of like-minded individuals who support each other in their career development. Bound by a common belief that through supporting each other and working hard they can achieve their individual professional goals and contribute to the betterment of their communities, HES members strive to “lift as they

rise” (HES, “Membership,” 2018). My second foray into the field displays a momentary glimpse of the atmosphere I grew to expect at HES events:

I hesitated in the lobby...recalled using a side entrance off the lobby the last time and so tried that, only to walk into a small bar area with approximately 6 people sitting on various couches/at the bar having cocktails and a server asking if anyone wanted to spin the trivia wheel...It was a subdued atmosphere and I didn't recognize anyone – nor did anyone appear Hispanic or like a HES member (no suits)...[It was a] sad trivia space...[I] stopped at the bar to ask if the HES networking event was being held and if so, where. [The server] said, “oh yes, downstairs” – as soon as he said that I listened and realized the loud hum of voices coming from down the stairs – the hustle/energy that I expect now at HES events. (Observation, field notes, 10/26/16)

What follows is an overview of the HES national organization and the HES-NYC chapter – its history, mission, and scope as articulated in documents online and from the perspective of some research participants, including the current (as of 2018) HES-NYC professional chapter president. Following this overview, I situate HES in the larger context of engineering and aspects of engineering culture.

### Hispanic Engineers' Society (HES)

The New York City chapter of the Hispanic Engineers' Society (HES-NYC) (pseudonym) was founded in the late 1980s and incorporated into the HES national organization a year later (HES-NYC, 2018). The HES national organization was founded in the 1970s in Los Angeles, California. It was started by a group of Hispanic engineers whose “objective was to form a national organization of professional engineers to serve as role models in the Hispanic community” (HES, “About,” 2018). The founders are referred to as the “Founding Fathers” – there were 6 in all, some of whom still speak at HES's annual national conference. HES began with two student chapters and now, over

40 years later (at the time of this writing), HES has numerous chapters at the high school, college, and professional levels. The national headquarters remains in California.

HES's mission reads: "HES changes lives by empowering the Hispanic community to realize its fullest potential and to impact the world through STEM awareness, access, support and development" (HES, "About," 2018). One can see from the mission that the nature of the organization is simultaneously cultural and professional.

HES's vision bears an empowering, hopeful tone: "HES's vision is a world where Hispanics are highly valued and influential as the leading innovators, scientists, mathematicians and engineers" (HES, "About," 2018). Both HES's mission and vision are rooted in two critical aspects of science identity – recognition and ability. The organization's motto: "Changing Lives...Empowering Communities...Impacting the World..." too conveys a sense of power, empowerment and confidence. HES presents itself as an active organization focused on developing its members in service to their communities. STEM in the context of HES acts as a common professional space shared by individuals with a common cultural background. Although HES is an organization designed specifically with engineers in mind, the broader category of "STEM" is embedded in its vision. The dominant discourse within the organization appears to be cultural, with *STEM being an area of common interest, a shared professional goal.*

### *Organization*

HES's administration is composed of a National Board of Directors, a Chief Executive Officer (CEO), a Chief Operating Officer (COO) and regional committees. Within each region, there are professional chapters each with their own president and vice president; collegiate chapters with their own executive boards; and high school

chapters. There are a total of seven regions and numerous professional, collegiate, and high chapters therein.

HES-NYC is part of HES's "Northeast Region," comprised of New England, New York, New Jersey, Pennsylvania, Delaware, Washington D.C., Virginia, Maryland, West Virginia and Puerto Rico. The New York City chapter "formed in [the late 1980s] and was incorporated [a year later] by a group of Hispanic engineers and scientists responding to a need to unite Hispanic culture and professionals in the New York City Metropolitan area" (HES-NYC, "About," 2018). HES-NYC's website explains that "The founders aspired to both provide positive role models to young professionals while creating a strong member network" (HES-NYC, "About," 2018). As of the time of the study (2016-17), the chapter has a president and finance vice president. The president is an IT professional and held positions on the National Board and the regional leadership council. The VP has a Bachelors and Masters in Electrical Engineering from CCNY and is a Wireless Test Engineer for the Northrop Grumman Corporation. He served on the executive board of the HES chapter at CCNY. The area that HES-NYC serves includes New York City, Long Island and areas of New Jersey and student chapters include: City College of New York, Columbia University, Manhattan College, New Jersey Institute of Technology, Polytechnic Institute of New York University, Rutgers University, State University of New York at Stony Brook, and Stevens Institute of Technology.

### *HES Culture: "HES familia"*

While each HES chapter likely has its own unique characteristics, my observation of both HES-NYC initiated events and sub-regional or regional events co-hosted by HES-NYC was that there's definitely a consistent atmosphere or "culture" that typifies the

activities that HES carries out. Early on in my fieldwork, I was struck by the consistently welcoming atmosphere generated at HES events. Even during my first observation, at a mock career fair hosted by HES-NYC and several HES college chapters, I recorded that I “noticed affectionate interactions/greetings (hugs and kisses between women and men, warm handshakes & back pats particularly among professionals but also between professionals and students and between students- cultural? Long shared history of being in college together?)” (Observation, field notes 10/22/16). Following my first observation, I observed that hugs and kisses were standard greetings among male and female HES members and even came to expect a hug and light kiss on the cheek myself as I became acquainted with HES-NYC members over time at HES events. These friendly greetings added a vibrancy to professional networking events and conveyed a sense of what it meant to be part of the HES *familia*, a term commonly used in social media references to the HES national organization (HES, 2018).

The significance of the HES *familia* became clear in a single statement from an interviewee:

...[Y]ou know, the only reason – I didn’t know you but the only reason was because and I’m not best friends with (name of one of my secondary interviewees who referred me to her) you know I see her once a year at a HES event...but the fact that you came recommended from someone in the Society you know I said “Absolutely” you know “let’s make time to meet you.” Rather than be like “I don’t know who you are. I’m sorry I don’t have time for you” you know? (Ana, Interview, 4/5/17)

Being connected to a HES member gave me credibility and in this case led me to a much-needed additional interviewee. The participant’s reference to “let’s make time to meet you” is an illustration of gaining access to research participants—a standard and necessary aspect of the research process—and is also an indicator of being part of HES’s extended family, or “*familia*”. Being part of HES doesn’t necessarily constitute close



friendship, as the participant above implied (“I’m not best friends with (-----)”); however, it does involve a trust-based connection that can give, or deny, access to information – a critical aspect of social capital, as explored more fully in Chapter 6. In the case of being connected to new interviewees and in my encounters with a variety of HES members, I felt consistently welcomed as a member HES’s extended family.

Another demonstration of HES’s welcoming atmosphere was in the racial/ethnic diversity I observed at HES events. This was due in part to the naturally-occurring racial/ethnic diversity within the Latinx/Hispanic community. As culturally/linguistically-defined social categories, “Latinx” and “Hispanic” are not tidy labels. At the professional networking events, I always observed several individuals who appeared African American or Asian yet because of the racial/ethnic heterogeneity of the Latinx community I always had to consider the possibility that they too could self-identify as Latinx or Hispanic. In addition to the inherent diversity of the Latinx community, there was an additional layer of racial/ethnic diversity observed at HES events. Whether seen among HES members who noted themselves that they were permitted to join even though they weren’t Hispanic, they just really enjoyed the feel of the organization or among students interested in HES and, upon hesitating about their eligibility because they weren’t Hispanic, observing a HES member’s response that this didn’t matter, they were still welcome, there was a consistent feeling of openness and inclusion at the events I observed (e.g. observation, field notes 11/19/16). I recalled from a professional networking event meeting a Muslim female who appeared to be Indian, a recent grad from NYU who explained that she was involved in HES throughout college because although not she's not Hispanic, “they're such a great organization” (Conversation, field

notes, 10/26/16). The inclusive atmosphere of HES overcame potential boundaries resulting from racial/ethnic or even cultural difference in the case of this HES member. At the regional conference I attended the racial/ethnic diversity was particularly noticeable during the career fair: groups of Indian and Asian students gathered to meet recruiters and seek resume feedback.

I followed up with HES-NYC's president about the inclusive atmosphere I had observed and asked him for his thoughts:

I asked about Asian students [I had noticed several in attendance at the mock career fair we were presently at, including one student serving on the executive board of a college chapter], he said that was a "touchy issue," several parts to it: they are willing to [work hard] to get ahead and there is not (at CCNY) an organization that serves them and so HES is their option. Also, from an organizational standpoint, anyone is welcome; however, they've gotten in trouble with sponsors who recruit for Latino students in particular (and have budgeted proposals to attend HES events as part of focused diversity initiatives) and end up getting a number of Asian students applying for their jobs. And, another touchy aspect, he mentioned, was that Asian students [may] not be welcome at NSBE [National Society of Black Engineers] events and Latino events are seen as more open/flex given the diversity of the Latino/Hispanic community. (Conversation, field notes 10/22/16)

There are several interesting aspects here: First, it's a "touchy" issue, this issue of inclusion in a group designed to address the issue of underrepresentation in STEM. There was the individual observation that groups such as "Asian students" were willing to work hard to get ahead, so attending such events as the one we were at made sense—it was a free mock career fair that would help to hone their interview skills (mock interviews were offered as well) and gave them the opportunity to receive feedback on their resumes. Also, structurally, their university didn't provide a support system geared toward Asian students in particular and so an alternative was needed – HES was that alternative. In this sense HES was staying true to its mission of changing lives and empowering

communities by welcoming any interested student, regardless of their racial/ethnic background. Second, the welcome that Asian students may receive at HES events was assumed to be distinctive of HES (and perhaps implied, other Latinx organizations) as their presence at the National Society of Black Engineers (NSBE) would likely not be welcome, according to the HES-NYC president and Andrew, the other long-time HES member whom I was speaking with at this time (Observation, field notes 10/22/16). I am not familiar enough with NSBE to speculate nor did I inquire further into this statement at the time, yet simply from an organizational perspective, I can see how the presence of members from a non-underrepresented group at events specifically designed for the promotion of historically marginalized groups in STEM could be viewed as problematic with respect to sharing scarce resources such as scholarships or other career opportunities. Asian students based on appearance alone would be more likely to stand out at a NSBE event which may be more racially homogeneous than a Latinx/Hispanic event. Again, the innate diversity of the Latinx community fosters a sense of inclusivity, a broad sense of belonging simply based on the fact that the community itself is heterogeneous—you cannot easily tell “just by looking” who is or isn’t Latinx. Third, and lastly, regarding the “getting in trouble” aspect, this is where the standard practice of inclusivity can get tricky, as I explored in an analytical memo, an excerpt of which is shared here:

HES as an open organization – all are welcome – are warmly welcomed; yet, as I saw in first observation, it can get tricky as far as honoring (privileging?) the organization’s mission to support Latinx/Hispanic engineers specifically as there are limited spaces to do that. While such access and support aren’t presented as a limited/scarce resource as far as attendance at events, when it comes to professional networking, jobs are limited and potential employers with prescribed diversity initiatives do care when HES candidates don’t match the intended demographic (i.e. Asian HES members applying for (and receiving?) jobs

intended to be offered specifically to underrepresented groups. Leaves me with Q – are Asians underrepresented in engineering? I know they’re not in other STEM fields...Wow, an interesting phenomenon to have to deal with – as folks of color, yes, come and join us – but when it comes to actual professional outcomes – please don’t take jobs away from us – as these are a limited/scarc commodity even if networking/socializing occur in abundance. (Analytical memo, 11/17/16)

In the case of career fairs (such as the one I observed at the regional leadership development conference where many non-Latinx students were in attendance), inclusivity becomes complicated by the fact that companies pay to send recruiters to recruit potential job candidates to fulfill diversity goals (be they quotas or broader goals). Thus, if Procter and Gamble, for example, sends their recruiter to RLDC with the aim of identifying a few Latinx students they could bring in for internship/job interviews (since, administratively, they are under obligation to employ a certain percentage of “diversity hires”) and the qualified candidates end up being Asian instead and these students apply for a given position and get hired – by others in the company likely not directly connected with the original recruiter – then the cause for this mis-hiring, as it were, is attributed in part to HES for not supplying Latinx job candidates. As one can see in my reflection, this is indeed “an interesting phenomenon,” or an unintended consequence of inclusivity, that poses a challenge to the delicate or “touchy” nature of balancing the needs of individuals minority-serving organizations intend to serve with the needs of individuals the organization happens to serve. In the case of HES, a welcoming culture prevails – note that while the current president spoke of this issue and a long-time member said it had been an issue when he served on a college executive board in the 1990’s, there have been no programmatic adjustments made to block access to HES events for any group – yet there are moments when this culture is fraught with the reality

that there is some conflict involved in trying to be an organization for everyone even while valorizing the needs of a particular group.

Creating the HES *familia* and a welcoming culture is critical as it is the HES culture that designates a given HES event. Without a regional or local headquarters, HES is a typical product of the age of globalization where organizations are increasingly defined more by shared culture, shared interests, and other intangible connections rather than by geographic or spatial proximity (Appadurai, 2001). As a result, the role of culture becomes salient to a greater extent perhaps than if HES-NYC was located in a particular brick-and-mortar place. I was struck by the place-less-ness of HES's organizational structure early on, as I recorded in an analytical memo early on in my field research:

HES occupies a variety of physical/social spaces (i.e. schools, hotel party spaces, city museums, colleges/universities) – how does this shape the forms of capital HES members may access and the extent to which certain members get to use certain forms and when/how? Yet HES has no physical headquarters though is very impactful – sign of a truly globalized organization, not defined by space per se yet completely dependent on accessing and using space to promote its work. Also, membership tied to the notion of the organization and sense of belonging with other people – socially defined (culturally too? Both in terms of Hispanic/Latinx culture and in terms of professional culture of engineers....(Analytical memo, 11/17/16)

Each of the events I attended was in a different physical space, yet each event “felt” like a HES event. This was due in part to the generally strong presence of the HES brand (to be discussed in the following section on *Media*) and in part to the atmosphere – the warm greetings, the sounds of animated discussion and laughter, the sprinkling in of Spanish phrases during announcements and in conversations, the empowerment-oriented program content of workshops, the integration of humor and playfulness into professional networking events (e.g. small group trivia activities, sharing of engineering horror stories

during an event scheduled near Halloween) – these all defined the organization and seemed to create a sense of belonging for the members in attendance.

### *Media*

As an organization not bound by physical space, the role of Internet and other media in creating and maintaining the organization and its culture is particularly significant. While Internet media are the dominant form of media, all events I observed were graced by the presence of a large HES-NYC banner (~ 4' x 7') that informed passers-by or on-lookers that this table, this room, was a HES-NYC space. Skilled at sharing their brand, HES members transported the HES banner in cars and via subway to events at museums, hotels, and schools alike as a standard set-up procedure. As a frequent visitor, I looked for the banner as my first landmark for finding where they were located in each new space I visited and felt a sense of having officially arrived each time I found it. The one time I saw a handmade tri-fold in lieu of the banner, I noted it, and felt the banner's absence: "I kept looking around for the HES banner that I had now come to expect at such events and didn't see it, yet then saw "Hispanic Engineers' Society" printed on a banner, a tri-fold and was like "oh, there they are!" Interesting though that I was looking for that banner, they always have that banner, so emblematic of who they are, so professional-looking. So this was a little bit different" (Observation, field notes 2/3/17). In this observation from the end of my fieldwork phase, I noted that I had become accustomed to seeing the banner – a sign of successfully consistent visual branding. Related to this, the HES logo is imprinted not only on the banner but on t-shirts HES volunteers wear and all of HES's internet and print media. HES's internet presence includes its website, Facebook page, Twitter account, and LinkedIn account. One of the

college chapters appears to have an Instagram account. As pictured below, most of HES's social media incorporates photographs from various HES events. The language tends to be upbeat – “We’re excited to host...!” – and often boasts HES’s goals or accomplishments (e.g. “800+ Latinos” expected to attend the upcoming Regional Leadership Development Conference (RLDC)) (See *Figure 1: HES-NYC Tweet February 2018*).



*Figure 1: HES-NYC Tweet February 2018.*  
Retrieved 2/15/18 from HES-NYC Twitter account.

HES-NYC's social media activity appears to be moderate with 2-3 Tweets/month on average and Facebook posts with each event they host, so 2-3 Facebook posts/month as well. The website often features an outdated calendar item (e.g. a golf outing from June 2017 is currently on the home page, listed as an “upcoming event”). The

organization's social media impact appears moderate as well, judging from the number of Facebook Likes/Follows (736/734) and Twitter followers (642). Facebook and Twitter appear to be the primary channels for communicating HES events. I regularly observed HES members taking photos of individuals speaking at events or of groups of HES members engaged in conversation at events (i.e. with students at a high school science event or with each other at conferences). At the mock career fair, they had set up a photo station with a HES banner where HES members could pose for photos that they could then tag and post online – there were in fact periodic announcements about this photo station and it seemed that the fair organizers wanted for people to make as much use of the station as possible. Likewise, at the Regional Leadership Development Conference (RLDC), attendees were encouraged to take photos (again, in front of a HES banner) to post and tag them with various HES-related “#’s.”

#### *Activities—National and Regional*

At the national level, HES hosts an annual conference which boasts an average attendance of over 6000 HES members from around the U.S. HES claims that it is currently the largest technical and career conference for Hispanics in the U.S. The conference provides a space for networking, workshops, guest speakers, award ceremonies, and competitions such as hackathons. HES's newly-appointed CEO, a lawyer by background, relates the role of the conference to the need to increase Hispanic representation in STEM:

According to the Census Bureau, Hispanics in the U.S. represent 15% of the workforce, but only 8% of the STEM workforce. HES's mission is to improve on those numbers and to empower Hispanics as leading innovators, scientists, mathematicians and engineers. The HES National Conference is our chance each year to renew that mission and engage with the membership we serve to ensure



progress is made. Students and professionals from around the country come together to create opportunities for their careers” ([CEO name], “Home,” 2018).

The reference to national statistics here demonstrates how HES’s leadership uses the social context as a reminder of the urgency of HES’s work. Starting at the national level, reading the social reality of the underrepresentation of Hispanics in STEM is itself a call to action: Hispanics are inadequately represented in the STEM workforce, therefore let us gather to address this issue. Interestingly the focus of the discourse is on Hispanics in STEM, not specifically engineering, as that is the level of the problem the organization seeks to ameliorate. Also of note is an implied agency among members – students and professionals alike who are invited to “come together to create opportunities for their careers.” They are not passive recipients but creators in the discourse; additionally, it is of note here that allusions to agency occur even at the national level of HES’s public discourse (i.e. a statement from its CEO posted on its website).

The other national conference that HES sponsors is the National Institute for Leadership Advancement (NILA) that provides leadership development for newly-elected student and professional chapter executive board members. The conference aims to relay skills necessary to serve successfully on an executive board as well as for attendees’ careers more broadly. NILA reflects HES’s emphasis on leadership development that can be seen at multiple levels of the organization: mock interviews at the college level that groom students preparing for internships and jobs, professional networking events at the regional level where HES members seeking jobs have space to mingle with other professionals and the national conference where HES members have opportunities to network with recruiters and company representatives.

The variety of activities expands at the regional and local level. While the activities I observed are explored in relation to how HES shapes capital use among its members, it is useful here to cite some of my observations to give a general sense of HES events. As mentioned before, HES is a national organization divided into seven regions. Each region hosts an annual regional leadership development conference (RLDC) which is designed “for the leadership of the HES student chapters to improve their organizational, managerial, and technical skills” (HES, “Events,” 2018). Specifically, the conferences aim to help “college students develop and improve their pre-college outreach programs and improve the infrastructure of HES student chapters. [And] Student leaders learn how to interact and network with HES’s corporate supporters” (HES, “Events,”). This written description is displayed on both HES’s national website and HES-NYC’s website advertising the next RLDC for the “Northeast Region”—RLDC 2018 (as of March 2018).

At the regional conference I attended in March of 2017, I observed a wide range of student and professional HES members. The conference program was divided according to “tracks” so that participants could focus their attendance accordingly if they wished: graduate student programs, a Latinas track, and a professionals’ track, among others, were offered, each with their own sets of workshops. According to John, HES-NYC’s president (at the time of the study), setting up tracks was a method the conference organizers had implemented so that conference-goers could attend the whole conference or just the piece that pertained to them (Conversation with John, Field notes 12/9/16). Attendance at the RLDC is growing annually: in 2017 ~500 participants were expected, yet the conference achieved its highest registration rate at 540 for the conference program

and this number went up to 600 students for Saturday's career fair (Conversation with John, Field notes 3/11/17); in 2018, ~800 are expected to attend (@HESNYC, #2018RLDC, 2/2/2018).

A typical flow of activity for the HES-NYC professional chapter is listed in Table 7: *HES Sample Annual Calendar*. Most activity is initiated and coordinated by the professional chapter in partnership with one or more college chapters. High school and middle school chapters are generally started in schools in regions of the city, primarily Manhattan. Activities range from those sponsored solely by HES-NYC to those sponsored by other organizations yet which HES-NYC attends: professional networking events, hackathons, public school events, charity and social events fall primarily into the former category while larger scale events such as career and college fairs and museum-based events are sponsored by the host institution (e.g. museum, university) and HES attends as a participating organization.

#### *Activities—Local*

Below is a snapshot of activities carried out at the local, chapter level (see Table 8: *HES Activity Overview*). Having attended both types of events it is notable that HES's presence is consistent in quantity (i.e. numbers of volunteers present, appropriate to the size of the event) and quality (i.e. the spirit with which they shared information and the content of what was shared) regardless of their role in the event. Whether one organization out of 100 such as in a college access fair for minority students (observation, field notes 11/19/16) or one of a handful of organizations at a poorly attended middle and high school science night at a museum (observation, field notes 10/28/16), volunteers were observed consistently standing up at their tables, smiling, and ready to engage

Table 7

*HES Sample Annual Calendar*

<b>Month</b>	<b>Activity</b>
January	3 Kings Day celebration and Toy Drive (2 days of events)
February	NYSci – MS/HS evening science event at the NY Hall of Science (several HES volunteers may attend these monthly NYSci events)
March	Intrepid Girls in Science event – all day Saturday; RLDC – Thu eve – Sat aft
April	High school event – Dia de ciencias – all day Saturday
May	HES-NYC “ <i>familia</i> night” (Baseball or other outing)
June	Professional networking event
July	Summer BBQ
August	Generally no scheduled activity (none listed on FB events page for past three years)
September	Professional networking event
October	College Access Fair; Professional networking event
November	Volunteering or professional networking event
December	Professional networking event; Holiday cena (annual holiday dinner with speakers)

students who directly approached them or who even appeared mildly interested as they looked from a distance. Andrew (pseudonym), a long-time HES member, explained that they had learned from experience that it was “most effective to offer to take the email addresses of [interested] students and send them just one email that had a brief

Table 8

*HES Activity Overview*

	<b>Professional Chapters</b>	<b>College Chapters</b>	<b>High/Middle School</b>
<i>Leadership/skill Development</i>	<ul style="list-style-type: none"> <li>• Profesional networking events (evenings, bar/casual locations, at times industry-specific, speakers and/or group activity)</li> <li>• Career fairs</li> <li>• Hackathons</li> </ul>	<ul style="list-style-type: none"> <li>• Executive board meetings</li> <li>• Study halls</li> <li>• Mock career fairs</li> </ul>	Chapter meetings
<i>Outreach</i>	<ul style="list-style-type: none"> <li>• College fairs</li> <li>• High school STEM nights at museums</li> <li>• Public school STEM events</li> </ul>		Events sponsored/organized by professional and college chapters
<i>Charity</i>	<ul style="list-style-type: none"> <li>• Dia de los reyes magos (3 Kings Day)</li> <li>• Holiday toy drives</li> </ul>	<ul style="list-style-type: none"> <li>• Holiday toy drives</li> </ul>	
<i>Social</i>	<ul style="list-style-type: none"> <li>• Holiday Cena</li> <li>• Summer BBQ</li> </ul>		

description of HES, a link to the regional/national websites (I think it was both) and a link where they could add their email address to HES's listserv for event announcements and further information about HES. This way they wouldn't be spamming anyone" (Conversation, field notes, 11/19/16). Andrew explained that HES members had also learned "that they needed to 'own the event...don't just have a table'" and, as I recorded in my field notes, I "could see this in each member's looking out for potentially interested

students...all of them standing in front of the table rather than just sitting behind it” (Observation, field notes 11/19/16). He also proudly stated at the end of a college fair at which many students had approached HES’s table, “so this is how we do events” (Andrew, Conversation, field notes, 11/19/16). The presence of HES’s members is consistent with the organization’s mission of striving to change lives: through active participation in events, members seek to connect with students who may be interested in STEM. events Overall, HES provides a family-like network to its members and maintains a vibrant, inclusive atmosphere through its regular programming. Defined by shared cultural and professional values, HES offers events that foster the development of engineers from middle school up through the mid-career professional stage. In such a context, the potential for capital flow is rich.

## CHAPTER 5

### HES MEMBERS AND PARTICIPANT OVERVIEW

Having briefly reviewed elements of HES's structure and activities, it is now fitting to offer an overview of what makes HES, *HES*: its members. First, I will explore who HES's members are broadly speaking and then will provide an overview of those HES members who were interviewed.

#### Membership

HES-NYC (and the broader HES organization) comprises middle school, high school, collegiate and professional members. The membership is predominantly Latinx/Hispanic, with some members identifying as Asian, Black or White. As members can elect to join the organization—there is no application process, just a membership fee—what constitutes eligibility appears to be primarily associated with an aspiration toward a career in engineering, supporting HES's mission of promoting the success of Latinos in science, technology, engineering, and mathematics (STEM), and feeling a sense of welcome from the organization. For example, I met a white male engineering student at the Regional Leadership Development Conference and he explained that he had joined HES on his campus because he enjoyed their events (Observation, field notes, 3/2-4/17). This resonated with a couple other references I'd heard from other non-Latinx HES members who said that they were members despite not being Latino/Hispanic (see Chapter 4).

The majority of HES members are college students, with professional members as the next largest group. The high school demographic is growing as more chapters are

established at the high school level and the middle school demographic is relatively small as there are only several middle school HES chapters in the New York area. The professional members initiate the majority of activities open to the NYC area. Additionally, the professional chapter sponsors the Regional Leadership Development conference and facilitates the sponsorship of corporations that participate in the event.

HES's professional members have backgrounds in a wide range of engineering fields: computer science, chemical engineering, industrial engineering, civil engineering and mechanical engineering the foremost among them. Professionals occupy a wide range of engineering-related jobs ranging from IT consultants with government departments to project engineers at large industrial plants such as Procter and Gamble. As the corporate-engineering partnership is prevalent, many HES members also work in management positions in NYC's largest construction companies (e.g. Turner Construction, Tishman Construction etc.) and investment firms such as Goldman Sachs. As one of the women I interviewed pointed out, engineers are ideal candidates to serve in management or other leadership positions because "you're an engineering mind...it's very good, so many CEOs are engineers and it's...because [of] how you think about things, so you can resolve any problem" (Victoria, Interview, 3/4/17). I realized early on that engineering is a very broad field with numerous related occupations. Ranging from corporate to government to private contract settings, engineers work in various industries and assume a wide variety of roles in the field and in management. Thus, "to be an engineer" is a broad identity.

That being said, my observations of and conversations with HES members revealed that there are some cultural trends in engineering: ways of dressing, career



aspirations, and ways of thinking that typify what it means to be an engineer. Regarding appearance and mode of dress, it was common to observe students and professionals in business or business casual attire at the professional networking, career fair, and conference events. The only exception was at the high school STEM nights and college fairs where HES volunteers wore HES t-shirts and casual attire. I asked a HES member, a male recent college graduate now working at AKF Group LLC, an engineering consulting firm, about the apparent dress code, especially as compared to other scientists who may dress more casually or have lab-related uniforms, and he said that, yes, business attire was the norm due in part to the industry/business-related nature of engineers' work. As I grew to learn, engineering employment is primarily corporate or industrial so while the field-related garb of reflector vests/jackets and hardhats is donned as needed among the few managers and contractors in the field, the majority of HES members I encountered worked in office settings and so dressed accordingly.

Regarding career aspirations and ways of thinking, the business/corporate culture also had an impact. As an outsider to STEM generally and to engineering specifically, I was struck by the business/corporate feel of the HES events that I attended. Starting with my first observation, I noticed that business were often literally present at HES events. Given that my first observation was at a mock career fair, this presence was pronounced and triggered many questions for me regarding engineering culture as it related to HES members:

I walked around to see what the labels [on the tables where students could go to speak with company representatives] said: Landlease, Goldman Sachs, Associated Tech, Inc., Procter and Gamble (P & G), Department of Design and Construction, Con Edison, Turner Construction, Greenman-Peterson, Inc, Prime Engineering, Euro-Center USA, Inc., AKF Group LLC... There was a feeling of energy as the P

& G table was set up (color, movement, activity). (Between the labels and the P & G display, I felt a strong business presence. It struck me how this was an engineering career fair and the strong emphasis on working for businesses. How might this differ from other STEM career fairs? What are career options for engineers that aren't business-related? Now, thinking about it, what is the relationship between business and STEM – thinking about the push for increasing #'s of STEM graduates – this could reflect vested business interests? To what extent does an organization like HES empower its students and to what extent does it groom its students to become a cog in the machine? Or can one be an empowered cog?) Two NYU students were walking around the ballroom and approached me and introduced themselves: Rosa and Sergio from the NYU [HES] chapter...[Rosa] also explained [among other aspects of HES] (did I ask about it?) that since P & G was the main sponsor of the event, they had a prominent display. (Observation, & conversation, field notes, 10/22/16)

Here, all of the job opportunities – or potential opportunities as this was a mock career fair and businesses had volunteered to send representatives to give students a sense of what a real career fair would look and feel like – were corporate or government-based. Thus, to be an engineer relates to being in business or in government. For HES members, programming such as the mock career fair groomed them accordingly – including explicit knowledge of businesses that are interested in hiring Latinx engineers and implicit knowledge about the power of sponsors allowed to advertise freely in the form of a pyramid of free company products (i.e. the P & G display featured diapers, toilet paper, paper towels, soap etc. that were offered as free giveaway prizes as part of a “jingle trivia game” at the end of the career fair) (Observation, field notes, 10/22/16).

Reflective of the Latinx population in the U.S., HES members came from a wide variety of countries. The demographic breakdown of U.S.-born vs. international Latinx/Hispanic HES members is not readily available, yet my conversations and observations in the field revealed that the majority of HES members were either immigrants themselves or first-generation Americans. The members' cultural/ethnic backgrounds are meaningful to the extent that HES as a Hispanic-serving organization

strives to meet the needs of its members and so needs to have structures in place that accommodate its members' diversity. The recent former chair of the National Board of Directors, in a conversation following our interview, expressed concerns about HES's focus from an organizational perspective, wondering to what extent they focus programming on U.S.-born Hispanics who have challenges distinct from foreign-born Hispanics (Conversation, 4/6/2017). While further research is needed to identify trends in challenges particular to either group, it is notable that members of HES's leadership are cognizant of the role that immigrant-status/nationality plays in one's educational and professional experience and desire to address these particularities. Interaction with HES members brought to light the significance of one's family experience and the trend in upward social mobility that many members experienced first-hand. At one professional networking event, I recorded the following: "[His] Family grew up selling shaved ice treats on street corners [in home country]...now he's preparing to launch his own engineering construction firm" (Conversation, field notes 10/26/16). The others in that conversation shared similar stories regarding being in a very different place financially than where they or their parents had come from.

The camaraderie born from sharing similar cultural and economic backgrounds served to tie HES members together such that otherwise divisive or distinctive cultural differences became secondary to their shared HES membership. One HES member remarked that although different waves of various Latinx groups came through HES periodically (i.e. one year all Mexicans, another year all Dominicans) yet when they come here to the U.S., and join HES as professionals, they all stick together and are all the same (Conversation, field notes 10/26/16). The HES *familia* becomes a space where

HES members are bound by a shared identity as immigrants or children of immigrants striving for greater economic success than their parents may have experienced and committed to achieving their career goals even as they raise others up in the process. The common usage of the hashtag “#we are familia” for HES photos many of HES.org’s social media posts is thus understandable.

As I noted while in the field, the level of volunteerism appears to be high as each HES event is run on a volunteer basis by a variety of collegiate and professional members. While there were several HES members who were at multiple events I observed, I also ended up meeting someone new each time I returned to the field. Inquiring about the tendency to volunteer, I asked several professional members about their motivation: a sense of family and wanting to give back were two reasons given (Conversation, field notes 10/26/16). As explored further in the analysis of forms of capital my interviewees used, such motivation to volunteer appeared to be consistent among my interviewees as well as among members I met during observations.

### Women in HES

To better understand how the women I interviewed use various forms of capital, it may be helpful to briefly explore how women are positioned within the larger HES organization as well as the experience of some women in HES-NYC specifically. At the national level, a “HEStina” movement began with a Latinas track at the 2015 annual conference. Drawing from the “I look like an engineer” campaign (started in 2015 by Isis Anchalee at OneLogin – unrelated to HES [Kircher, 2015]), a group of Latinas in HES initiated several workshops at the national conference on the theme of Latinas in

engineering and sources of support for their academic and career success. The movement continued with social media features of various Latinas in HES that included photographs and hashtags including “#I look like an engineer” and/or “#HEStinas” as well as brief summaries of their professional backgrounds and achievements. Youtube videos and tweets continued the movement through the annual conferences in 2016 and 2017.

In the context of HES-NYC, the Regional Leadership Development conference also featured a Latinas track; however, the focus was on featuring successful female HES members without explicit references to challenges facing Latinas in STEM. The president explained that the organizing committee agreed that the most effective way to promote the success of Latinas in engineering was simply to show that Latinas *can be* and *are* successful engineers; as a result, 2017’s conference featured Latinas talking about leadership and other career skills in a general way. Upon hearing this approach, and observing one of the Latinas giving her talk, I wasn’t sure if this effectively communicated Latinas’ success or empowerment; however, it did successfully ensure that Latinas were featured prominently as speakers and facilitators.

It is important to note that the absence of specific references to being a “HEStina” in a given Latina track program didn’t mean that explicit references to being a Latina in STEM weren’t made in other conference spaces: Observing one of my interviewees facilitating a panel of professionals who had navigated changes in their career trajectories, I was struck by her periodic references to being brown and female (and short) as a means of connecting with the audience and highlighting obstacles she faced as she too navigated changes in jobs and career paths. The panel she was facilitating was not part of the Latina track; however, she ably integrated her social identity into her

facilitation and so made explicit the challenges involved in being a Latina in STEM (Observation, field notes, 3/2-4/17).

Another component of the broader discourse on Latinas in STEM within the context of HES is the role of corporate sponsors, as seen at the local level in the mock career example I cited above. Many of the hashtag references and the conference workshop advertising were initiated by companies collaborating with HES for recruitment purposes. Driven by diversity and inclusion goals and requirements, large corporations such as General Motors and Accenture actively participated in the social media drive calling for Latinas in HES to check out their workshops, “leadership” events etc. at the conferences. While HES executive board members also drove the social media discourse around “Be Bold and Strong” and “HEStina strong!” a review of tweets and Facebook posts showed that companies were as active in the dialogue.

The president of HES-NYC alluded to the top-down nature of the organization’s goals related to women, saying that it was a fairly recent movement in an organization that posted nearly 50% female leadership. He explained that the organization has historically always been welcoming to women and has presented a cultural alternative to the male-dominated world of engineering or the machismo Hispanic culture. That the then newly-appointed CEO and the COO, as well as the recent former chair of the board are all women is a testament to this statement as well as the numerous professional and collegiate chapter executives I observed either online or in person who identified as Latinas. The HES-NYC president explained the logic behind the 50/50 leadership within the organization: “I would 100% say being a Latina has a lot to do with that and just the struggles and the challenges and just the natural leadership roles that women who are

Latinas are put into, but of course, I'm not an expert but that's my observation" (Interview, 7/21/2017). While the "struggles and the challenges" are explored in greater detail in Chapter 7, it is of note that it appears to be a source of strength that is common knowledge to the extent that the HES-NYC president, a male, casually referenced it without being directly asked about why HES's 50/50 leadership statistics were unsurprising even if unusual within engineering more broadly.

To put the 50/50 leadership reference into perspective: at the mock career fair I did a rough count midway through the program and observed eight female students and 23 male students in attendance; at the professional networking I attended, I counted an approximate total of 66 attendees, 16 of whom appeared to be female. Several of my interviewees mentioned being one of two women (of color or at all) in company leadership teams of 20 individuals. Each of these rough counts reflects an approximate 20-25% female representation, mirroring the national average percentage of female engineering graduates. Thus the substantial percentage of female leaders is an attribute of the organization worthy of further exploration; future research can explore factors related to organizational culture and climate that may contribute to higher than expected numbers of women in leadership roles.

Also, the context of the HES-NYC president's comment should be explored before turning to an overview of the interviewees. At the end of the interview, when asked if there was anything else he wanted me to know to better understand his experience or his thoughts on the topic of Latinas in engineering, he said he wanted to share a bit about his upbringing. His mom had gotten divorced after having three children and realized she needed to provide for them:

So, she kind of faced the challenge the hard way where she didn't have a career or even the educational background so she took kind of any job she could find. And kind of her career path was in maintenance, she was a cleaning lady for her entire career but I think at least in our family that was kind of a pivotal point because my mom kind of learned the hard way that, sure she got married and had kids, but what happens as a back-up, right? So...it was real interesting, as much as my mom went through that experience...within the family, her direction changed and she became the advocate for all the girls in the family to not follow that path and go on to get an education and...what's real interesting is she was the one that would always say, you know, it's kind of funny, you can always find a new husband, right? You can't find an education or a career...So anyway that was the environment I was raised in, right? So it was an environment definitely of inclusiveness, it was an environment of women have, or *should have* the opportunity to do anything they want but that the key was getting an education and going to college. (John, Interview, 7/21/17)

While the president doesn't *make* HES-NYC what it is – the members do as well as other contextual factors – that an HES-NYC administrator attributes his current understanding of the importance of education for girls in particular to his mother's experience is notable. He understands “inclusiveness” in a very personal way and his discourse on the strength that Latinas have in particular and the Latino community bears generally displays an understanding of the struggle they've faced and how they've needed to learn from that struggle:

I think it's unfortunate, but just, many times you learn through the hardships of others. But... unfortunately within the Latino community there's a ton of hardships so we've had a lot to learn over the years. But...I think the key is taking those hardships and making, creating valuable lessons out of them. (John, Interview, 7/21/17)

Resonating with the sense of *familia* discussed earlier, this statement displays a sense of shared hardship that actually strengthens the Latino community to the extent that “valuable lessons” are learned. That HES-NYC's leadership and members alike reference a shared or common struggle demonstrates the significance of this aspect of their cultural background to their understanding of being HES members.



## Interviewees

As a reminder, my ten primary interviewees were all current HES members who graduated with a B.S. in an Engineering field at least five years prior to the project's start (2016) and who had since been working or schooling in an engineering-related field. They ranged in age from late 20's to late 40's. My three secondary interviewees included the HES-NYC president as well as two key informants both of whom were Latina and had graduated less than five years before the project's start. What follows is a demographic overview of my interviewees including a brief summary of my observations of and/or my interactions with them as applicable. Please note that my level of interaction with each participant was different: some women I met and spoke with outside of the interview context while others I only spoke with over the phone, having never met them in person. Rather than attempt to offer uniform detail about each one, I include all of the information I had available based on my time in the field and the information each provided me. It is hoped that such an overview gives the reader some sense of who my primary research participants are before delving into a deeper exploration, in Chapters 6 and 7, of the various forms of capital they have used as they have navigated their careers in engineering-related fields and the ways in which their experience as HES members, as explored in Chapter 8, has mediated their capital use.

### *Overview of Primary Interviewees*

(See Appendix F for Interviewee Demographics).

#### *Mary*

Mary was my first interviewee and our interview took place at a chess table in a nook on the edge of the downstairs lobby area of the Brooklyn hotel where the 2017 Regional Leadership Development Conference (RLDC) for HES's "Northeast Region" was being held. My primary contact at the conference—a long-time HES member who was helping to run the conference—was talking with her and introduced us. I shared with her my project "elevator speech" and asked if she might be available at some point to talk about her experience. She said she would be happy to talk and suggested – "should we just speak now?" and I said that would be great. She was done for the day and heading out and so it was a good time to talk, she explained (Conversation, field notes 3/3/2017). I quickly explained that I had 10 questions and the conversation shouldn't take more than 45 minutes (Interview memo, 3/23/2017).

I had observed Mary during a panel on the topic of navigating career transitions. There were 3 individuals on the panel and a facilitator. Both she and the facilitator were female. She was the quieter, apparently more reserved of the two yet spoke confidently about the unexpected turns her career path had taken, ending up in a current executive position that she hadn't anticipated occupying (Observation, field notes, 3/3/17). Speaking to a mixed audience, she didn't directly reference being female though did refer to being one of few Hispanics in her area of the company (Observation, field notes, 3/3/17).

She was of average height, had long, curly hair (of significance as she referred to during her interview), wore a sweater and slacks, and had visible, though moderately applied, make-up. She appeared “white” in racial background (see Chapter 3 for further discussion on racial categorization) and spoke quickly. She made direct eye contact with me periodically and spoke comfortably and with conviction throughout the interview.

As I learned in the interview, Mary had come to the U.S. from Colombia with her mother when she was three years old. She had first lived in Queens – “where all the Colombians are” and then moved to West New York, NJ, where it was relatively safer compared to NYC at the time (1981). She described where she grew up as “99% Hispanic.” It was a mix of cultures, as she described and as everyone spoke Spanish – at the bank, in stores etc.; her mom didn’t need to learn English and so relied on Mary as her translator.

She grew up enjoying math and science and had a high school guidance counselor who had her take a career path test and the results showed that chemical engineering could be a possibility. This led her to choose chemical engineering as a major. She described how her guidance counselor took an interest in her based on a connection she developed with him (having given him an autographed picture of a community organizer that he admired – through her volunteer connection to said organizer’s organization) and so offered her plenty of advice regarding school choice and funding options. She ended up choosing Stevens Institute of Technology in NJ as it was the economic, proximal option. She was given provisional admission based on below average SAT scores and a math background lacking calculus. As a pre-requisite to starting as a Freshman at Stevens, she participated in a Summer Bridge program (STEP) that prepared her

academically for the engineering program. She developed lasting friendships through STEP and as a Freshman joined HES. She attributes her involvement in STEP and HES with setting and achieving her ambitious career goals, including succeeding in being a college senior with multiple job offers. Since graduating college in 2001, she worked as a chemical engineer at Colgate, then in procurement at another company before moving to Bacardi Martini where she is now the director of procurement and, as she puts it, “I don’t think I’m done” (Mary, Interview 3/3/18).

### *Camila*

Camila was my sole fellow current graduate student interviewee. As an engineering education PhD student with a social justice orientation, Camila’s perspective on the role that social identity can play in shaping one’s experience in engineering resonated strongly with my project focus. I met Camila, like Mary, at the Regional Conference and was able to interview her onsite. Below is my recollection of meeting her, drawn from my field notes:

As I exited the hallway, a young woman in a white buttoned-down shirt and knee-length black leather skirt said “You, I’m supposed to talk to you.” I caught myself and turned to check in with her. She mentioned that [a female HES-NYC member] had said we should talk, that I was doing graduate research. Yes! Yes, I was. I asked her about who she was, her background. She explained that she was a doctoral student studying engineering education, focusing on ethics. Cool! I replied. We both were smiley, and chatty – kindred grad student spirits. (It felt nice to talk with another grad student who understood, at least to some extent, what I was trying to do with my project). She even asked the question: so, what frameworks are you working with? I got caught off-guard – you mean theoretical frameworks? Yes. Capital. Like social capital? Yes, I said, also science capital. She asked about Funds of Knowledge. I said I had read about this yet wasn’t applying it directly to my project. (I found out later she had used this framework earlier on in her studies). We talked about ASEE [American Society for Engineering Education], Futures/Frontiers in Education and their merits as conferences to attend, that may be relevant to my work and her experience there.

She was getting ready, I think, to take her prelims this summer and then do the proposal following, focusing on ethics. Hearing about her background, I said – oh! You could be an interview candidate – would you be willing to do an interview? I apologized for being so direct yet hoped she understood. She laughed – “I get it, you need data!” She said she didn’t want to skew my data given her perspective as a grad student studying engineering education and I said, no! It will add a variety of perspectives! She said she could talk now and I checked my phone - ~2:30PM, just enough time to interview her and be ready for a 3:30 interview with [Victoria]. Yes, let’s do it – thank you! I’ll buy you a cup of coffee. So we headed upstairs to Starbucks and grabbed a seat – a mochaccino (or some other fancy Starbucks drink – mocha macchiato?) for her and steamed coconut milk for me. We started. (Conversation, field notes 3/3/17)

Reading back over this account, I recall that I felt an immediate connection with Camila due to her graduate student status. Especially since we had overlapping research interests, I felt like we could easily have a conversation about our research and could possibly collaborate in the future. That she was eligible to be a research participant felt like a bonus. I looked forward to hearing about her experience and to staying connected. Unlike many of the Latina engineers I had met where I needed to inquire as to the nature of their work—a world foreign to me—Camila was a case where our trajectories had similarities and we spoke a similar language regarding the content of our work (e.g. prelims, conferences, theoretical frameworks, capital etc.). Also, her willingness to participate in the project with the understanding of its value to me: “I get it, you need data!” felt validating.

During the course of the interview, I learned that Camila had been born and raised in the Dominican Republic into a family that owned a construction company. She thus grew up visiting construction sites and found herself interested in how things worked from a young age:

I found myself interested, like when they took me to the worksites, to the like actual construction sites, I would see myself trying to look at the structure of it,

like - if they were up the cinderblocks and they had the steel bars in it, like I would look and try to see “Oh, how does this go?” “How does this other thing go?” So I got interested because of that. (Camila, Interview, 3/3/18)

She explained that her male siblings and cousins were all civil engineers while the females were architects; that she wanted to pursue civil engineering was thus an exception: “...traditionally all males in my family have been civil engineers in structural analysis and all the females have been architects. So it’s a good merge...synergy. But then I was the first female in my family to choose to do civil engineering instead. So...that was interesting...a lot of back and forth with that” (Camila, Interview, 3/3/18). She received a scholarship to study in the U.S. and so moved to Utah to attend Utah State University to do an undergraduate degree in civil engineering and a Master’s degree in environmental engineering. A research assistantship (during her Master’s) in engineering education focused on the experiences of Latino adolescents tasked with completing a community design project as well as work as a remediation engineer following her Master’s confirmed her desire to pursue a PhD in engineering education to help her achieve her short- and long-term goals:

For the short-term...I want to go back go back to industry and work for the EPA [Environmental Protection Agency] as part of their office for community development programs...my longer –...maybe 5 years goal...10 maybe at most...I want to come back to academia and...I do want to be in an administrative position. ...[W]hether that be within a college of engineering directing all their diversity programs, or...at the university level...participating in their university-wide diversity programs (Camila, Interview, 3/3/18).

Camila was scheduled to complete her preliminary exams in the summer of 2017 and then begin work on her proposal. She had recently switched advisors due to a fall-out – personal and political (described to some extent in the following chapter) – she had with her previous advisor. She was at the Regional Leadership Development Conference to

help run the track for graduate students: “I put together a graduate track for this regional conference...[T]he students that went – we had a little feedback session. And they told me how much value they got out of the workshops and the panelists and the track – the different things they’d attended with regards to the graduate track. And that just made me feel really good” (Camila, Interview, 3/3/18).

### *Victoria*

Victoria was another conference contact. I had first met her at an evening professional networking event where HES-NYC’s president introduced me to potential interviewees. She was one of two women I met there whom I ended up interviewing. I recall that I noticed that she was wearing make-up, was middle-aged, and had a warm smile. She explained that she was the vice president of the HES-Boston professional chapter and handed me her card saying I could contact her so we could speak further. I asked if we could perhaps speak later at the conference and she said she wasn’t sure of her schedule but I could text her the following day to see if she had time. We also met over lunch during the conference and I recalled her conversation with Pilar, who ended up also doing an interview and who was serving as the HES Board chair at the time: “Victoria introduced herself as computer engineer – I mentioned that she served as a professional VP as well. Pilar reacted with interest (in facial expression). She said she was part of Boston chapter” (Conversation, field notes, 3/3/17). My notes from their conversation are as follows:

Victoria speaking with Pilar about her involvement in ALPFA [Association of Latino Professionals For America] est. 1972—bridge between Latino students and professionals, first national Latino professional org in U.S.] “What were you doing there?” Pilar asked (almost accusatorily/teasingly). It was there that she met

somebody from HES and she knew it was something she wanted to get involved in. At ALPFA, [Victoria] had created a role for herself as an IT consultant, effectively, because the systems they were using were very much out-of-date and so she offered at first to help and then they kept her on to help with systems at the national level. Pilar expressed much interest in this [as] I recall at the end of the lunch (Observation, field notes, 3/3/17).

I remembered being struck by the obvious social capital exchange as Pilar said they should keep in touch.

I texted Victoria the following day and she confirmed that she could meet to speak on Saturday (the next day) following the career fair. She ended up being free about 30 minutes earlier than we planned to meet and asked if we could meet then yet I had snagged the interview with Camila and so responded saying that our original time was fine. I luckily ended up finishing Camila's interview a few minutes before Victoria's appointment and so their paths didn't appear to cross, and anonymity was, I hoped, preserved. As we spoke, I felt that I needed to pay especially close attention to what she was saying so I could understand through her accent the words she was saying and the thoughts she was expressing; I struggled to understand her to a greater extent than in my prior or subsequent interviews.

Victoria was born and raised in Mexico. She had attended high school "in the 80s when computers were new things" and had taken computer classes that interested her and "made [her] realize that that could be something that [she] would like to do. And, actually...and it was good money there. Because I'm from Mexico so we are always looking for a career that can give you a good income" (Victoria, Interview, 3/3/18). She had already had an interest in electrical engineering, wanting to fix things as a child and



stated “And actually I wanted to be pilot. But it was really more about the machines that I could see that attracted me, so I said, “computer engineer!” (Victoria, Interview, 3/3/18).

Victoria attended university at ITAM (Instituto Tecnológico Autonomo de México), “the Harvard of Mexico” and obtained her Bachelor’s and Master’s in computer engineering. Following university, she worked as a software developer and then as a consultant for JP Morgan. Having worked for some time, she “decided that, to continue growing as a professional I needed to [improve] my English. I always suffer with the English but I said let me do this so I quit my job (laughs) I went to Vancouver and studied there for 8 months, went back to Mexico and I said, ‘okay, now, what’s next?’” (Victoria, Interview, 3/3/18). At this point, around 2000, a financial firm “created a program to go to Mexico and interview a lot of people there and actually they hired 15 people from Mexico” (Victoria, Interview, 3/3/18). She then immigrated to the U.S. from Mexico on a visa secured by the financial firm and worked with them for 11 years before she got burned out “because [she] wanted new things” (Victoria, Interview, 3/3/18). She then started what she described as a “new journey” as an IT consultant to a variety of non-profit organizations, starting with ALFPA, an association for Latino professionals. At the time of the interview, she was in between contracts and so was at the HES regional conference in part (she was also the VP for the Boston professional chapter) to identify possible job opportunities related either to her considered pursuit of independent IT consulting for for-profit companies or an established IT position at a company.

*Ana*

Ana was the first HES member whom I interviewed without having met or seen her prior to the interview. One of my key informants, also a secondary interviewee, had emailed a group of women whom she knew met my interviewee criteria and thought would have useful insights to share for my project; Ana was the first woman to respond to the initial email/Facebook invitations. We met in her office, the significance of which I described in my field notes as follows: “I did this interview at her office and so it felt like a combination of field research and interviewing – it is the only interviewee that I have seen in her place of work – something that I had hoped for as part of better understanding the context in which my primary participants find themselves in” (Observation, field notes 3/9/17). My dream research design was to observe my interviewees in workplace settings in addition to HES settings so as to have a more well-rounded view of their lives as Latinas in engineering. Generally, time constraints did not allow for this; as a result, to be able to see an interviewee in her office and even interacting several times with her co-workers, those she managed, was truly illuminating.

I described my arrival at her office as follows:

I arrived at 10:33AM at --- E. 41st St, after just a short walk from Grand Central Station, and a quick stop at Starbucks for my coconut milk mocha (1 shot, 1 pump mocha...1 tall cup of deliciousness to accompany me on this energy-exerting trip into the city at 8 months pregnant!) – having offered to get a coffee/tea for my interviewee. Her response: “no dear I’m fine see you soon/We have coffee here plain black if you are interested” – so kind! I said I was set. I walked through the cool, city-scented air down 41st St. past many restaurants and shops and crossed the street to a building under construction. She had said that her office was at their current project – I’m not sure I realized that she meant an actual construction project *still* under construction.

There were 2 security guards (both apparently of African descent) who peered up at me as I entered – I explained that I was there to see ---- ----- and that she was

expecting me...she was on – 24th floor. They said I would need to call her so I did and she said just to sign in and come up. One of the security guards led me to the sign-in book where I filled in my name, destination, and time of arrival and then he said that he would fill in the rest.

I asked if I could now just go up and he said yes. I walked along the cardboard lined floor, blue tape and all, toward the elevator bank for floors 12-2? and went to push the button – trying to decipher what I should do – seeing numbers, I pressed 24. The same security guard came to where I was standing and said that, no, I should push the button on the other side of the bank – I asked if only one side was working, he said yes. The buttons were also outlined in wood, as though the finishing fixture still needed to be added.

The elevator doors opened just after he pushed the button and I entered the plywood-paneled space, looking for where to push the floor – no numbers! Oh right. New(-to-me) elevator system. I just waited, and hoped, for the elevator to bring me to the 24th floor.

The doors opened to the other set of elevators and then, to my right, a wide open cement-floored space: the half of the room to my left with boxes lining the windowed walls, puddles of water on the floor and the side to my right with several dark wood cubicles and 3-4 glassed-in offices along the far windowed-wall. There were about 4 people working at computers – 2 at the cubicles and 2 in the offices. I wondered who my interviewee was – not the man or the white woman I saw so perhaps the dark-haired woman working in an office with her back to me? The male, Hispanic-looking, looked up and I caught his eye and explained that I was looking for ----- . He said she had just stepped out and gestured towards a space to my far right, explaining I could wait there.

I said thank you and turned to what appeared to be a conferencing area with six large plastic conference tables pushed together to form a large table and a white board with “One team = one dream” – Hanh Jakubaszek. Underneath: “ – signed [Hanh] Jakubaszek. Also “Teamwork makes the dream work.” Two pictures of dogs and what appeared to be children’s drawings of tigers and some writing at the bottom of the board. (Observation, field notes 3/9/17).

Reading these notes nearly a year in hindsight I can see that I was clearly an outsider in Ana’s space. New technology (those elevators!), space that looked uninhabitable (puddles on the floor) yet was clearly a functioning workspace (cubicles, people working, glassed-in offices), and a conference room with team development lingo on the whiteboard – “teamwork makes the dream work” [looked this up, from John Maxwell, a leadership “expert”]. All of this in a high-rise mid-town Manhattan building that I was sure would

end up looking posh, modern; it felt like a space that was up-and-coming, urban, and professional—like many of the HES members I had met. I recalled meeting Ana:

After waiting at the table for a few minutes...I saw who I assumed to be my interviewee appear from the elevator hallway. She spoke with one of the people at the desk and then walked toward me. She was tall and wore a fitted skirt, blouse and heels. (From written notes: She was wearing a dark pink suit – blazer and skirt to knee – and dark heels. I was struck by her height.) Hair was up in a ponytail – she had a striking presence that reminded me of the well-dressed, professional-looking, made-up women I had observed at the RLDC conference. She greeted me with a smile and hug (I think) and apologized explaining “of course something came up just when we were supposed to meet.” I said it was not problem, just glad that I was able to get there prior to 10:45AM [our scheduled meeting time]. She was holding a Starbucks cup of coffee. She offered water/coffee and I said I was set (I had my Starbucks mug with me).

She suggested we go to her office so I collected my bag and folder and recorder and pen and coffee...She led me to her office, one of the glassed in office areas. At some point I remarked it was a great location. She said the other offices had an even better view of the Chrysler Building.

We sat at her desk – many papers, pictures of her nieces/nephews (I think I confirmed this as she made references later to not being married or having children).

She apologized for the clutter on her desk – I said it was totally fine, understandable. She asked about keeping her door open or closed – I said it was fine [either way]. She explained about interviewing a young woman recently and some of her team were shouting/celebrating about something in the next office over and she had to bang on the wall to tell them to “shhhh!” as it was giving the wrong impression. The interviewee laughed about it – I also joked that maybe it gave a good impression—fun work environment.

One of her co-workers—an Asian female?—walked in and asked her to help her with fastening/fixing the back of her skirt. She greeted me and asked who I was. She asked [Ana] – “Oh, is she a sub?” [sub? Subcontractor?] “Or one of your babysitting jobs?” [Ana] laughed and explained that I was a researcher in Urban Education, the guest she had told the team about and for whom she asked that they be on their best behavior. The woman hadn’t gotten the message. There was a brief convo.[conversation] about my being pregnant (positionality again here), my study etc.

She recalled a time where workers were goofing around in a neighboring office and she had to remind them of office decorum. She laughed as she described this and other aspects of her office culture. She made references to wanting to support those on her team, to help them grow. She was lenient with them yet also wanted

them to take the work seriously. Some of the guys she had been with for years. Now she was manager and still close with them.

We started the interview and paused partway as another person came in to ask her to sign off on a document. She signed as we continued speaking. Multi-tasking at its best. (Observation and conversation, field notes 3/9/17 & 6/21/17)

As a result of being in Ana's workspace, I was able to see her interact with a couple of co-workers – fastening a skirt, signing a document – and relaying information about the day-to-day aspects of her work: workers loudly celebrating when she was interviewing a prospective job candidate, workers joking around at another time, the view of the Chrysler building from other offices in the building and so got a glimpse into her quotidian experience. This was unique among my interviewees and an invaluable addition to my research experience.

During the interview, Ana explained that she grew up in Ecuador to parents both of whom were doctors and who supported whatever she and her siblings chose as long as they chose something: “whatever you choose, you know, it’s okay as long as it...makes sense to you” and they encouraged the importance of education: “also pushing us...for my parents it was always very important, education. They didn’t care what we went to school for – they wanted us to go do school” (Ana, Interview, 3/5/17). Ana described choosing engineering as a Junior in high school in Ecuador. She had chosen engineering over economics due to a desire to have more of a challenge: “I did the pre-economics...and even though I was a junior I found it easy enough and I was like “Oh, this is not so bad! I could do this” and I said “Well, I need something a little more challenging,”...“It’s all math. I mean I like math but...something a little more challenging” so that’s how I decided to go into engineering” (Ana, Interview, 3/5/17). She explained how she had chosen schooling the U.S.:

I've always been very independent and I explored the options of moving abroad and studying abroad and that's what brought me to move to NY. So I moved right after high school graduation, when I was 18 and I applied to City College. I did research...I needed something affordable...I couldn't afford an Ivy League school (laughs) and so I looked into colleges that were affordable, CUNY colleges and also...the good CUNY engineering school. [S]o Staten Island came up and...City College came and I chose City College just because of commuting. It was easier to commute. (Ana, Interview, 3/6/17)

She explained that she lived with extended family at first and then on her own before her siblings joined her in the U.S. for their schooling. She described being drawn to civil engineering ("because I like to see things and touch things") yet chose electrical engineering because "my mentality was like if I chose...civil engineering...I could only go into construction and...I didn't want to limit my options just because...I needed to find a job...so...thinking on the future if I go into electrical engineering I could still go into construction but if that doesn't work out...there's more options, you know, to, to choose from" (Ana, Interview, 3/6/17).

Following college graduation, Ana worked for Turner Construction for approximately eight years and then moved to Tishman Construction approximately five years ago and is currently a project director there. She described Turner as being her dream job in college to the extent that she "used to bleed 'Turner blue,' [She] grew up and they made [her] a professional [there] and [she] will always be thankful...to them for that" (Ana, Interview, 3/6/17). Her desire for greater challenge in her work led her to seek possible alternative employment elsewhere, thus leading her to Turner's competitor, Tishman. She described her surprise at her current position – "I never imagined to end up where I am here today" and described the mixed emotion she felt doing less of what she really enjoyed doing: "the more you move up, the less you stop doing what you like. I do enjoy work – I truly enjoy working on the field, knowing the details and...every

interaction...and...the more responsibilities I get, the less I get to do that (laughs)” yet feeling satisfaction in having a positive, impactful role on those she managed:

...what I like about this role is the impact on people...the impact on the people that I work with everyday, I feel that if I had just a random role...it wouldn't allow me to have as much – *perhaps* I could – but it wouldn't allow me to have as much *impact* as I have now, so that's why I...really like the role, the opportunity that it presents to help others. So...that's something that I do enjoy (Ana, Interview, 3/6/17).

Ana described being able to see herself continuing to work in her current role or another similar position on future projects – as projects similar to hers tend to last two to three years and she hoped to start a family in the future:

...maybe after this project, another one, another two projects like this, yes...Usually projects take two to three years, so probably another project like this with this role and I'll be ready to, ah, take the next step. Regardless of what it is, you know? So I do have personal goals as well, so it just has to all fit at the time...I'm very responsible and I do work very long hours. I want to start a family one day and...depend[ing] on what happens three years from now, it might be different. My priorities might be different...Do I have ambitions professionally? Do I want to continue to grow? Yes, but you know it all has to work out with other personal goals as well. (Ana, Interview, 3/6/17)

Ana thus foresees that, while happy in her current role and expecting to continue working in a similar position in the future, she will need to balance it with other life goals.

### *Isabel*

Isabel was an HES member whom I had met and spoken with at a HES event prior to the start of my project, in the spring of 2016. Having seen her only from afar at the professional networking event I observed in the fall of 2016, I was glad to have met her again at a “Girls in Science” event at the Intrepid Museum in Manhattan. She was dressed in business casual attire at both professional networking events (button down shirt) and donned a HES shirt for the Intrepid event. She had shoulder-length, dark curly

hair and was “white Hispanic” in appearance. I recalled our meeting at the Intrepid event as follows:

I then made my way to the HES table (the next table over from the water table [where I currently was, with my children]) and talked with ---- for a bit, giving her a hug, saying it was nice to see her. She recognized me. (I had noted earlier how compared to Juana’s (pseudonym) openness/gregariousness, she was a bit more reserved. Standing at the table watching though still talking to some families as they approached. Was thinking about this compared to Marielena [pseudonym given to one of my secondary participants] too, also quiet in her interactions with families. Not shy yet less “hey! Come on over!” than Juana who is very openly friendly and verbally so). We chatted about the experiment, the fair. I eventually said I needed to ask her something – I wasn’t sure if she recalled my mentioning that I planned to start research of HES and interviewing people and that time had arrived (I hadn’t spoken to her directly since Spring 2016 when I chatted with her at the professional networking events). Would she be willing to do an interview? (Sweating a bit at this point? I really dislike asking this of people – positionality here?) “Sure,” she smiled. I said it would take about 45 minutes, I had tried to cut it down from an hour, realizing that was too long. I said we could talk over the phone/skype – was there any time that was good for her during the week or on the weekend? She said she got off work at 6PM every day and from where she worked to home, she could talk any time therein. I said, great, I would email her with a couple days and then we could make the plan. (Observation/Conversation, field notes 3/11/17)

It is notable here that Isabel appeared “reserved” perhaps only in comparison to other women I had met in HES, such as Juana who was consistently expressive in her interactions with me and with others whom I observed her interacting with. We held our interview over the phone several weeks later, after two email invitations and rescheduling once due to her work commitments. The interview sound quality was somewhat poor and I recalled being tired at the time: “I felt this interview was somewhat rushed, the sound quality was poor, and I was feeling tired” (Interview memo, 4/5/17).

Isabel described loving chemistry sets, Legos, and other building toys from a young age and being skilled in math and science:



I would say it actually started at a very early age. I was the kid who instead of the latest toy or doll...I wanted science kits....so between middle school and upper school there was a transition to accelerated math and science programs and I remember going to my teacher, my homeroom advisor saying “yeah, I don’t know if I’m going to make it” and he just turned to me and was like “(her name), you’re in these programs, just submit the forms, it’s a formality, but yes we all already know you’re going into these programs”...in elementary school I was assigned to different competitions that were math and science-oriented. Science fairs, mail away math programs, different competitions from a very early age and those were always my teachers so they would know about these competitions and say that I should sign up and I participated, did well, and moved on (Isabel, Interview, 4/5/17).

Following encouragement from her mom and her aunt, as well as general support from her teachers, Isabel took couple engineering courses prior to college to confirm her interest and then ended up choosing chemical engineering as her major at the University of Pennsylvania. She described her career trajectory following college as one involving a combination of seizing opportunities and then various opportunities just happening to line up:

...after graduation I was having difficulty finding a job. I did have one lined up but then when I received the details of the offer I turned it down and I returned home and then began going to other schools’ career fairs to see what opportunities there were available. At that one, I met someone who was very pleased with my initiative and ended up getting a new job in two weeks and starting in two weeks...There I ended up being an assistant and working on some very large projects and as they went from design into construction, one of my mentors went away on leave so then I was able to take a growth position and receive additional responsibility and then again someone else took another position elsewhere so I was able to get more responsibility there and that happened a couple of times to the point where I ended filling in for my supervisor’s role partly because he did not like the politics of how things were being restructured because he would have to share a role with a counter-part – one was on the design side, one was on the construction side so he ended up being very hands-off which gave me an opportunity to step in. After that, I was given my own projects to run.... (Isabel, Interview, 4/5/17)

Disagreements with management at that job led her to consider other opportunities so she ended up pursuing a Master's degree in public administration at Columbia. At the end of her Master's program, she:

...ran into a former colleague who was now working in a completely different area of focus, who mentioned that he had openings in his job and after that I was interviewed and set up a start date for right after graduation. I was with that job for a year and a half and then he proceeded onto another career...and then I assumed his role so then I ended up leading the program that I was hired to do and that leads me to my current job. (Isabel, Interview, 4/5/17)

She now works as a Deputy Director of NYC's Office of Housing Recovery on a project for an area affected by Hurricane Sandy. At the time of the interview she had been reflecting a lot on possible next career steps, considering options related to management or policy:

Given where I am now, it's a project-based environment and we're scheduled to be completed within another year. I have to start figuring out what I want next. And I'm at a very interesting point where do I choose to continue along more of a program management and division management or do I choose to go a little higher and get into policy-level decisions? And it's very tough because that's where there's a split between doing work and envisioning work to be enacted by others. I'm not completely certain how removed I want to be from the work that's actually being performed.... (Isabel, Interview, 4/5/17)

Here, Isabel expresses concern about a career feature that Ana had noted – the farther up you go (i.e. “policy-level decisions”) the more “removed” one becomes “from the work that's actually being performed” so she felt she was in the midst of deciding where she wanted to position herself. She also talked about prioritizing her work schedule so she could have balance with other areas of her life and attributes the ability to do so to working at a city job:

[I]n my current job where I'm working on a given day until 6 or 7 on any given now, but at the same time I'm considering working until 6 or 7 really late, where I know other peers have worked until 10 or 11. So that is where I'm able to see,

“wow, yes, I’m going to work a long day, but it’s not as long as some others. I still have time to relax. I still have time off and when I need to I’ll just step back and just work my regular schedule, I’ll plan an extended weekend, even if I just stay home and it’s okay with the city job.... (Isabel, Interview, 4/5/17)

Her sense of flexibility and balance were striking given the notoriously long hours many engineers work yet such balance doesn’t seem to prevent a comparable sense of career success or financial achievement to engineers who work longer hours in corporate or other settings; Isabel remarked that

...those who took more corporate routes, that there are some who have very flashy careers, um, a lot higher salaries and...whereas I looked for something a bit more stable, that’s why city employment, a bit more work-life balance, shorter hours, being able to do all of what I wanted to do personally and career-wise. Now...13 years out of undergrad it’s interesting to see how a lot of us have gotten to the same points no matter which...way we went, whether it was more corporate, now they may have scaled back, maybe they have gotten to such a position where they do have more of a balance, then some others have gone on their own and started their own companies so they adjust the hours to what they want to do and then there’s another group that has, who has chosen to also go into city employment. But overall we’re all in a similar position where if we want to travel, we can; if we want to enjoy certain things, we can...so that has been a good piece of it to see that no matter how we started after undergrad, we came back together. (Isabel, Interview, 4/5/17)

Isabel’s reference to various routes within engineering highlighted the variety of career paths in the general field as well as the common aspect of financial stability.

### *Pilar*

I first met Pilar at the Regional Leadership Development conference in March 2017. She sat at the same table where I was sitting during the professionals’ lunch. My recollection of first meeting her is as follows:

Another woman prepared to sit at the table behind ours and then turned her chair around to join us (still, all women – not young/recent college grads – at the table). The other table appeared to have two young professional men and one young professional female. (It occurs to me now that she may have sat with us as much

because we were older-looking as because we were female...or any other of myriad reasons). I asked what her role in HES was as I'd observed she was wearing a "fancy" gold name badge pin that I'd seen other HES e-board members and national rep.'s wear. She introduced herself as Pilar, she laughed a bit. She said, yes, she was on the HES Board (I just looked her up – she's the Chair of the Board, wow. Cool.). She introduced herself to others at the table. (Observation, field notes 3/3/17)

I saw her in her leadership role here, speaking in a calm, measured tone and directly connecting with every single person at our table. In addition to her exchange with Victoria, I had also observed exchanges with other women at the table (recall, it was a table with all women): "Lisa explained that she was with National Grid – Pilar said she was happy they could be there (I grew to understand [later, through another HES member] that National Grid was a sponsor of the event [i.e. conference])" (Observation, field notes 3/3/17). She connected with Lisa further around Lisa's lapsed HES membership:

[Lisa] mentioned apologetically that she wasn't currently an active member of HES but with the National Grid connection she looked forward to getting active again. Her husband was a lifetime member yet once she had started work and had a family, taking care of the house/children, she wasn't able to stay involved...[Pilar] reassured her that it was fine. She was glad she was here (perhaps reference to National Grid's sponsorship of the event?). Lisa humble in tone, [Pilar] too, yet Lisa the one who was apologetic, [Pilar] gentle, accepting. (Observation/Conversation, field notes 3/3/17)

Here, Pilar appeared to enact her role as a leader in HES by directly responding to an explanation from a former member regarding her lapsed membership. While a few other women chimed in, Pilar's response was the most authoritative. I explained how later in the lunch, I was able to tell Pilar about my project:

I explained that I was an educational researcher, not really part of HES, [l]ooking at factors associated with persistence among women in STEM. She showed interested facial expression. I think I also mentioned that I hoped to do interviews with women who were at least five years into their careers. She joked (as did a couple other women I spoke with – can it be more than five years?) She

responded that she may not be the best candidate, she may be an outlier, since she was coming from Colombia where engineering was seen completely differently. There, the idea job options were doctor, lawyer, or engineer. It was seen differently than in the U.S. where engineering wasn't looked as highly upon or was less understood/well-known as far as professions. She told some of her story: how she came to the U.S. as a student (don't recall at what level – would need to follow up in interview) and was treated really differently than back home. I said I didn't mind outliers! I would love to do an interview if she was willing. She said to shoot her an email. (Conversation, field notes 3/3/17)

During the course of the lunch, I described how “Other moments...came up”:

...references to engineers being awkward, her being a typical engineer (she had earlier dropped part of her sandwich on the ground – it was a wrap so the veggies scattered a bit on the ground. I also noticed that she was a bit socially awkward: smiling, yet somewhat self-conscious. Interesting to me since I viewed her in a position of power, on the board, an accomplished professional engineer – a higher social status than I, in my view). She explained that she knew other women who may be interested [in my project] if I had information to share about my study. I brought out my massive binder to show her the consent form so she could have a sense of my study (talk about socially awkward...) She skimmed through it and said if I had a short blurb to send that would be helpful. I offered to do a 2-3 sentence write up that she could forward. I further explained the criteria: 5+ years into engineering careers, B.S. in Engin. field, HES member, Latina. “Oh, they need to members of HES?” Yes, I explained that that way they would be part of a common network and help me better analyze the data. I joked about the interviews possibly lasting up to an hour yet I could scale it down to 45 mins if need be. She made a face at the hour description. When we actually made the plan for me to email her to set up a time to talk, she checked: “45 minutes?” with a glimmer in her eye. Yes, 45 minutes. She gave me her card (Conversation, field notes 3/3/17).

Having connected about an interview, I was pleased that we happened to sit together at the conference. An additional notable aspect from meeting her was a brief discussion at the table regarding our children: “Pilar talked about her four year old daughter and how she was already trying to expose her to engineering – taking [her] to engineering events/activities” (Observation/conversation, field notes 3/3/17). Another woman and I also mentioned our children. Following the luncheon, I recalled seeing Pilar at the end of

the conference as she was preparing to catch a flight home. She appeared somewhat tall and thin, with curly hair, dressed in a suit.

I emailed Pilar shortly after the conference and we were able to schedule an interview for early April. Following our interview, she also kindly forwarded my “blurb” to a group of seven women she knew in HES, citing that it was a pleasant experience (Pilar, Email Communication, 6/14/17). A couple women responded to her email, and one of them ended up being interviewed.

Pilar had grown up in Venezuela to parents both of whom had science backgrounds (science degrees in college). As the valedictorian of her class, she was interested in math and science and decided to pursue a degree in engineering, a highly-valued field in the Venezuelan context: “engineering was a very sought-after career, just as lawyers and doctors are” (Pilar, Interview, 4/6/17). She describes her trajectory as follows:

I finished my engineering actually in France with a scholarship and I came to the U.S. for grad school and...have been working for 17 years so I’m definitely well into my career. I worked for my first 8 years...as a research and development engineer, doing product development and then in 2008 I transitioned to technical management. I was managing technology groups...for 4 years and then in 2012 I became a second-line manager entailed of technical teams so most of the people at my level we all have engineering degrees as backgrounds, just we’re managing very technical teams. Last year I did move into product and process quality assurance which is a much broader role. I finished my executive MBA in December...so as I advance in my career I’m getting a little bit farther away from technology but definitely the first 15 years of my career were very very much related to technology.... (Pilar, Interview, 4/6/17)

Here I heard resonance with what both Mary and Ana had referred to with regard to advancing in their careers—Pilar described “getting a little bit further away from technology” as she advanced in her career. She explained that she envisioned the next

stage of her career involving working on the boards of a for-profit company as well as a non-profit, as she did at present, as she transitioned to the next stage of her career:

“Ultimately I would like to 10 years from now to retire from a full-time job and just to serve on a for-profit and not-for-profit board. In order to do that, given the experience that I have, that helps me understand corporations and changes and transitions in new areas of technology” (Pilar, Interview, 3/6/18).

Pilar described getting involved with HES to help the Hispanic population where she worked in Kentucky following her Master’s program in the U.S. She had attended their national conference in 2009 as a recruiter and, she explains:

...during that conference we learned about the pre-college program that would bring in high school students...to a program that is concurrent with a program that happens for undergrads and professionals at the conference. And also at that conference they had announced that the HES conference was going to Cincinnati in 2010. So I got involved with HES and...started a professional chapter in order to bring students from KY to the national conference in Cincinnati. There is a large population of very bright, successful, elementary, middle, and high school students that are Hispanics here in KY and they just need role models and need support and...in order to be able to pursue college and pursue really careers that can provide them with a lot of opportunities. They’re really great people that will benefit from HES’s work, so that’s why I got involved with HES to help the Hispanic population in KY. (Pilar, Interview, 3/6/18)

She has since been involved with HES, including as a Board member for 10 years.

### *Rosa*

Rosa was another interviewee whom I had observed at the regional conference. She had responded to an interview invitation sent by Pilar following our interview. I had recalled how dynamic and engaging she was as a facilitator of the professionals’ panel I observed. She also was able to integrate references to aspects of her social identity—

Latina, dark-skinned, and short—into her accounts of her experience as a Latina in engineering (Observation, field notes, 3/3/17).

Rosa's interview was particularly memorable in part because her "Storytelling was powerful, including integration of humor" (Interview memo, 11/4/17). I laughed throughout the interview as she recounted her experience growing up in NY as the first-generation daughter of Dominican immigrant parents. She described how, because her parents spoke Spanish at home and because her family was overall "mathematically inclined", math was the only subject in which they supported her and thus it "was the only class that [she] ever knew that [her] answers were always right" (Interview, Rosa, 6/19/17). She excelled in math throughout middle and high school, including being advanced a grade ahead in math in middle school. She explains, "I grew up just basically tinkering. I'm always the one that needed to know how things worked. "Why did that light turn on? Why did it turn off?" Etc. so I was just always gravitated toward that space" and she was one of few interviewees who referenced the significance of the era in which she grew up: "...I actually went to school during the birth of the computer...during that time in school so the Commodore 64...things like that, I had exposure to that at a young age" (Rosa, Interview, 6/19/17).

Rosa attended Stony Brook University at her uncle's suggestion since her father didn't wish for her to travel/move to any of the universities at which she had been accepted, including those with scholarship offers (Cooper Union, City College and Florida Institute of Technology). As her father insisted that Stony Brook was her only option (he consistently expressed concern that she not pursue engineering as it was a "man's field"), she ended up applying the spring of her senior year and attributed her



acceptance to her grades and “the grace of God” (Rosa, Interview, 6/19/17). She described her college experience as challenging because she was in the minority in terms of both her class and cultural background: “it was just really stressful...again, one of two girls in the class...the usual. Not many Latinas in the school – there were Latinas but not in engineering” (Rosa, Interview, 6/19/17). College was also challenging due to financial constraints and needing to balance school and work commitments. She described struggling to pay for food and books:

It was very crazy, my college years, actually. If it wasn't for the pretzel guy on campus I don't know how I would've lived. That's how I got lunch every day, especially when I didn't have any money, because...I'd get paid on work-study so I was like “I get paid in two weeks – I can give you the money then!” He'd be like “no problem.” He was like the sweetest guy – a lot of people got through college because of that guy...Sometimes I didn't have money for books so I would borrow books from people to do homework and then sometimes if they sold it back way early I was able to buy it back before finals and then cram like a day before or two days before on the exam...and I was working – I had little part-time jobs that were sustaining me through college. For me to not just pay my tuition but also my books and then for me to eat every day, so and then my gas for my car and then you have to pay insurance on the car. (Rosa, Interview, 6/19/17)

Thanks to the pretzel guy, effective cramming, and steady encouragement from her mom among others, Rosa graduated with a degree in (what would now be considered) computer science in 1990.

Rosa then began a career as a software developer before transitioning to technical support. She described this as being a choice that helped achieve her general career goal of “I want to be happy” and fit her personality: “Where I'm doing a hybrid role because I don't like the solitude of development and working in a lab on projects by yourself...and then I'm nerdy...to begin with – you don't put me in a room with...no friends because

then I'm not going to have no friends so I need that interaction with people" (Rosa, Interview, 6/19/17).

Early on in her career, Rosa pursued a Master's degree and then a PhD due to her mom's encouragement. She described the critical role that her mom's wish played after she passed away:

...when I started my Master's, my mom passed away and one of the things that she wanted was for me to actually finish school and that's ultimately what kept me focused on actually finishing up my degrees and, and just doing what I had to do. Because she was alive for my Master's and then when I went back to school to do my PhD...that's when she passed away...so I ended up just getting a second Master's in Columbia, Teachers College and then I quit the day after that. (Rosa, Interview, 6/19/17)

Rosa anticipates remaining in a job position similar to the one she currently has:

"a hybrid role where you deal with technology and with people" because, she describes,

even though I've been in the same role in this particular job, the technology itself has changed...I'm also testing future stuff as well ...so I get my hands on Windows X where other people may not touch it until it comes out so there's a lot of...beta-testing that I'm a part of. So those are the types of things I see for myself in the future. I like being in that space, of just being challenged. (Rosa, Interview, 6/19/17)

The preference for "being challenged" is a theme among interviewees that will be explored in the following two chapters yet is notable here as it is central to Rosa's vision of her future. Rosa's future career goals also include mentoring, which she explains "fulfills me as a person" (Rosa, Interview, 6/19/17). Rosa was involved in HES starting in college and continues to be involved at present—as observed at the regional conference.

### *Alexandra*

Alexandra was another interviewee whom I had never met or observed, and who had responded to an interview invitation Esther had sent out on my behalf. We spoke over the phone. She moved from the Dominican Republic to the U.S. in 1999 to attend university at City College. She grew up in a family of engineers – her dad’s major was civil engineering, two of her sisters did computer science (one as a major, the other as a minor), and her two brothers also went into engineering fields (Alexandra, Interview, 6/29/17).

She initially wanted to study civil engineering yet guidance from a college advisor and a course in electrical engineering that she didn’t like led her to consider and end up choosing computer engineering. As she described, “I did four years and a half in City College and after doing computer science, I went to the career fair and I got hired by my company 12 years ago. And the rest is history” (Alexandra, Interview, 6/29/17). She has since worked as a government contractor doing different projects related to software development and project management. She explained that she was one of the few Hispanic women in her IT group. She has now reached a point where, as she says, “I’ve done what I think I had to do in this area” and so is now starting her own information technology and business solutions company that will offer public and government consulting.

She attributed her success in college primarily to her involvement with HES because they provided a community of peers that helped her to continue: “you see all the people that have the same questions that you have, they have the same goals that you

have and they are dealing with the same struggles. You're like, 'you know what? I'm not alone. So, I need to continue. I cannot – if they're not giving up then I don't have a reason to give up'" (Alexandra, Interview, 6/29/17).

### *Mónica*

I had met Mónica at the same professional networking event at the regional conference where I met Ana. John had introduced us (Observation, field notes, 3/2/17). During our first meeting, Mónica had described her experience balancing raising a family of three children while pursuing her career goals (Conversation, field notes, 3/2/17). I recall being struck by the focus and determination she expressed as she recounted how she had succeeded in advancing in her career at Mercedes Benz while also having quality time with her spouse and three children *and* having a social life (Conversation, field notes, 3/2/17).

During her interview, which took place over the phone following invitations from both myself and Pilar on my behalf, Mónica described moving to the U.S. at the age of 16 and first pursuing an Associate's degree – so she could develop proficiency in English – and then a Bachelor's in Computer Science. Like Ana and Rosa described regarding the era in which they attended high school and college, "computers were – technology was like the new buzz word out there" (Mónica, Interview, 6/31/17).

Mónica has been in a computer science-related role since college and plans to keep growing professionally for as long as possible, for, as she explained "the day that I stop learning, that day I'm dead" (Mónica, Interview, 6/31/17). She also spends a significant portion of her time volunteering and mentoring for a variety of organizations

that center on girls/women in STEM, or STEM retention generally speaking, including HES. She attributes her success to supportive significant others as well as a certain mindset: “The one thing that I always have, I always have this positive mindset” in terms of her job – deciding to like it – and her co-workers (Mónica, Interview, 6/31/17).

### *Nicolyn*

My final primary interviewee was another contact I’d made through Pilar’s Facebook invitation. I had never met her and we spoke over the phone. She currently resides in Texas and works in the defense industry as “an individual contributor” and is thus on a management track.

She first became interested in engineering when she joined the “future engineers club” led by her tenth grade geometry teacher who had an engineering background. She was able to attend competitions and she explains that this was her “first exposure to being on a team in engineering” (Nicolyn, Interview, 8/2/17). She then attended college for an industrial engineering degree.

She described herself as a first-generation college student and so experienced college as a test in managing personal freedom and staying on track academically. She was able to graduate in five years with a degree in industrial engineering. Like Alexandra, she attributes successfully completing her college degree despite numerous family emergencies to support she received from family and to her involvement in HES.

### *Overview of Secondary Interviewees*

My secondary interviewees each played a crucial role in my research project as well as in HES:

#### *Marielena*

Marielena was the HES member I observed most frequently at HES outreach events centered around high school and college students. HES had tables at the STEM nights at the New York Hall of Science in Queens (NYSci STEM nights) and Marielena was at the few that I observed as well as one that I chose not to observe because it overlapped with the regional conference. She had a degree in chemical engineering from Columbia University and had grown up in Queens, to parents who had immigrated to the U.S. and who didn't have college degrees. She had joined HES in college, had served on the executive board during college and started volunteering with them regularly after college.

During my observations, I noticed that she had a quiet presence generally yet engaged confidently and frequently with youth and adults who approached the HES table at the events she volunteered at:

At this point another mother and her daughter (presumably...) approached the table, making the statement "Ooooh, science!" [Marielena] greeted her warmly and confidently with a smile, stepping toward her. The mother explained that her daughter wanted to be a vet...and [Marielena] hesitated a bit before introducing herself (name, organization member etc.) and explaining "well, she could take biology, some math..." She explained how HES could be useful to her daughter (network, providing guidance about classes, navigating college....). They spoke for about 5 minutes. (Observation, field notes, 11/19/16)

This was one instance of several where she was a voice for HES, connecting others to the organization. I also observed that she tended to speak with girls/women who approached the table – they appeared to approach her. I cannot say that this was because she was female; however, it was at trend at at least one of the events I observed: “[Marielena] was talking with a mother-daughter pair (wow, yes, can see a trend now...[Marielena] tended to talk with females; [Andrew—pseudonym] males...gendered pattern)” (Observation, field notes, 11/19/16). She had also been featured on a tri-fold board display at the Intrepid Girls in Science event, identified as a successful Latina engineer in HES.

### *Esther*

Esther was one of my first HES contacts before I officially began my project and remained a key informant throughout my research, offering to link me up with prospective interviewees and to share her thoughts about women in HES as well as issues Latinas in STEM face more broadly. She was also a politically active individual, including an appearance on Van Jones’ show regarding her experience as a Deferred Action for Childhood Arrivals (DACA) recipient and a Twitter encounter she had with a congressman – as recounted by the HES-NYC president during one of our conversations and confirmed with a Google search:

[Esther] came up – was on CNN, talked about her experience as a DACA [recipient], potential deportee. Encounter with [congressman]. Now viral on Twitter, social media. Being asked to do many events, getting overwhelmed. Articulate, strong opinions, passionate. They may plan HES event around it, for after the holidays – too much with Christmas and Cena (Conversation, field notes, (12/09/16).

Here, Esther’s personal political activism overlapped with her involvement in HES as the organization was willing to support her in her efforts. The only explicit connection to

immigration that I had seen was references to national immigrant heritage month at an event I had attended prior to my project start; otherwise, the only political references I had heard were during Camila's description of the graduate student track at the regional conference:

And then this morning we had another similar session that we called *caffe con leche* and...part was just having a safe space, an open conversation, to just discuss their concerns, about...being a minority population in engineering, things that might be happening in their campuses. Concerns about the recent executive orders...(Camila, Interview, 3/3/2017).

Even this reference was vague: "recent executive orders," used to refer to the current administration's approach to immigration and DACA recipients in particular. Yet it was enough to convey the significance of the current historical moment HES occupied. Esther was particularly vocal and HES-NYC's president was willing to offer support at a time convenient for the organization (i.e. after the holidays).

Esther had come to the U.S. at the age of 7. She had been a strong math and science student and had received considerable support starting in high school from an architecture teacher who hired her to work for him to help draft plans. This real-life experience gave Esther the confidence from a young age that she handle highly technical tasks: "it really has helped me to build just my own confidence in myself and the decisions that I make" (Esther, Interview, 4/9/17). She attended college for Mechanical Engineering and now works in the tech industry for Samsung.

### *John*

John was a key informant as well and was serving as the president of the HES-NYC professional chapter. He had also served on the National Board of Directors and the regional leadership council as well as other local roles in HES. He was my primary



connection to the organization and served as my key “gatekeeper”: it was his permission that I needed to observe HES-NYC events. He was at five of the nine events that I observed so I was able to see him throughout the course of my project in addition to a phone conversation and our interview. I observed that he was always actively engaged with others around him and had a friendly demeanor: “We [my children and I] approached [John], who was chatting intermittently with other HES volunteers. He greeted me as usual with a hug and light kiss on the cheek (again, a common greeting between HES males and females and between females)” (Observation, 3/11/17). I recall being struck by how he was consistently enjoying himself: “[John] and [Andrew—pseudonym] stopped to take selfies in front of the expansive gingerbread house display” and actively supporting many HES events – in addition to the five events I observed him at, he had also attended a couple other events in the Fall that I wasn’t able to observe and he was the primary organizer behind the regional conference:

Then he got into the conference – he needed to raise [\$xxx] in 1.5 weeks. 92 day countdown to the conference...I asked if there was a planning committee or if it was just him. He said it was him – he did the vision and then had college chapters implement it. Hard for college chapters to have the vision, broader perspective...About 500 people expected to attend. (Conversation, field notes, 12/9/16)

He had even worked on the printed conference program. Having helped to organize conference before, I sympathized and wondered why he didn’t seek more assistance at the planning/managing level. At the same time, it was clear that he was dedicated (as observed through how many events he attended in person). I recall also being struck by his presence: tall and able to speak to anyone – HES members, staff people at the conference and other events I observed him at, youth at STEM nights, me – in a kind,

encouraging tone. John had a background in IT and was seeking a new job (by choice – he was seeking something new) at the time I interviewed him in June of 2016.

### Summary

Overall, my participants reflected the age and occupational diversity of HES. The prevalence of women born outside the U.S. became apparent: six of 10 participants were born outside of the U.S. in addition to Esther and Marielena. Several grew up in the 80's in a technological era distinct from the present. They all had significant HES involvement and all overcame some kind of obstacles to arrive at the present point in their careers. What follows are two chapters exploring various forms of capital female interviewees applied along their trajectories through engineering; the subsequent chapter explores the role that HES played in Latinas' access to and application of capital.

## CHAPTER 6

### SCIENCE CAPITAL AND LATINA ENGINEERS

My research questions aimed to investigate how Latinas in engineering navigate their trajectories through their schooling and careers as they strive to attain their academic and professional goals. In focusing on women who have attained at least a Bachelor's degree in their field, I gained insight into the challenges and successes they have faced in their schooling and in their jobs on account of their social identity, including their gender, race/ethnicity and social class. My study sheds light on the complexities of science identity among Latinas in a range of subfields within engineering and how they navigate personal and structural constraints they encounter in the course of their trajectories through science.

As a reminder, my first research question is:

What forms of capital do women of color utilize as they strive to succeed?

- a. What currently existing structures facilitate/inhibit capital production and use?
- b. What other forces play a role?

Interview data collected in response to the first question confirm prior research that has revealed the obstacles that many Latinas face on account of their social identity during their careers as scientists or engineers. Interview data on Latinas' experience of attaining a degree in a science, technology, engineering, and mathematics (STEM) field (i.e. as a symbol of success) in which they are severely underrepresented sets a strong foundation for learning more about women of color in science broadly, including the obstacles they face and the means they develop to transform those obstacles. Interviews and observation data also expand on prior research on the relationship between possession of capital (e.g.

science/cultural/social) and persistence in STEM (e.g. Archer et al., 2015; Claussen & Osborne, 2012; Yosso, 2005) and provide context for exploring the phenomenon of *la facultad* as it relates to the various forms of capital found to be positively associated with persistence among women students in engineering (e.g. Camacho & Lord, 2013) and STEM generally (e.g. Tate & Linn, 2005; Samuelson & Litzler, 2016).

Over the course of approximately six months, I had the opportunity to speak with and observe study participants both individually and in the context of HES in an effort to better understand the common challenges that Latinas face in the predominantly male space of engineering and forms of capital they utilize to transform potential stumbling blocks into steppingstones for their success. In the following chapter, I will explore the main forms of capital that I either heard women refer to directly in interviews and in the field or observed during HES events. Capital sources included encouraging mentors, structural supports during college, family support as well as specific personality traits to which they attributed their career goal attainment. Although varied, the common forms of capital that Latinas utilized could be categorized along several strands, identified in prior research: science capital, social capital, cultural capital, and *la facultad*. As participants described their trajectories through engineering, they frequently referred to challenges they experienced in relation to their social identity and the supports they accessed to overcome those challenges; what was clear was that through enacting their agency and striving to overcome potential obstacles to their success, they were able to maintain a strong sense of their science identities over time.

## Science Identity

Before exploring the forms of capital that HES members utilized, it is critical to offer a summary of trends in science identification that I observed and that participants referred to directly or indirectly in the field or interviews. In the space of HES, cultural identity is generally viewed as an asset that binds its members together. Science identity combines with shared cultural identity to foster connections that are simultaneously professional and cultural in nature. Exploring science identity in the context of a support network founded on shared cultural identities and common professional interests revealed possibilities for creating a coherent identity as an engineer in which one's cultural background and one's identity and career aspirations can support each other rather than exist in conflict.

Given the ambiguous, dynamic nature of identity generally (e.g. Brubaker & Cooper, 2000; Gee, 2000), science identity can be a useful concept in science education research as it explains the interactions between social (i.e. personal) and structural aspects of identity formation (Herrera et al. 2012). It is thus potentially a near-holistic lens through which to analyze and understand persistence—i.e. trajectories—among underrepresented women of color in STEM such as Latinas in engineering (Herrera et al., 2012). In alignment with Carlone and Johnson's usage of a structure-agency framework (Carlone & Johnson, 2007), Herrera et al. (2012) emphasize an interactionist model of science identity wherein the interplay of societal, disciplinary, and social structural forces and their impact on science identity development remain central (Herrera et al., 2012). The interactionist approach is key to understanding how women of color in STEM fields perceive themselves to be scientists and the obstacles they feel they face in their pursuit

of becoming scientists. Per Herrera et al.'s findings, attention must be paid to both intersectionality (Crenshaw, 1989) and context (e.g. Shanahan, 2009) to fully understand how science identity forms in relation to other aspects of one's identity and in the context of social structures (Herrera et al., 2012; Shanahan, 2009).

As a culturally-oriented professional organization, HES provides a network wherein the interplay of societal, disciplinary, and social structural forces shapes the science identity of its members in direct ways. At the societal level, HES is one of few national organizations with a focus on engineers and so not only fills a gap in addressing the needs of Hispanic engineers but also offers a potentially influential voice in the national discourse on the need for diversifying America's STEM workforce. At the disciplinary level, HES is, again, one of few minority-serving engineering organizations and so offers a critical resource, together with other national organizations serving underrepresented groups—National Society of Black Engineers (NSBE) and the Society for Women Engineers (SWE) for example—to engineers from these groups. Social structural forces can be felt at the level of HES's programming which is designed to address the specific needs of Hispanics and Latinas who wish to pursue careers in engineering. At the micro level, science identities of individual members are shaped directly through participation in various HES events, yet an interactionist model of identification can still be seen: as members navigate their identities as Hispanics/Latinos in this historical moment, they find a haven in the HES *familia* where they can be proudly Hispanic *and* an engineer without subverting one aspect of their identity to another. In periodically highlighting its members, HES as an organization legitimizes who they are as collegiate or professional engineers as well as validates their cultural heritage. Thus,

the HES structure itself – in the form of professional networking events, conferences, college chapters, high school events and more – creates a Hispanic engineer culture such that a potential either/or binary view of identity fails to typify its members; instead, to be part of HES allows its members to be fully themselves.

Data showed that HES members strongly identify as Latin@ engineers in STEM. To be a HES member, as explored in Chapter 4, itself establishes an identity of being an engineer, or *ingenier@*, as depicted in HES-NYC's Facebook page photo (as of 1/21/18) where three female HES members are pictured interacting with children at a high school STEM event. Socioculturally comparable to the title of "Doctor" in the U.S., "Ingeniero" in Latin culture occupies a place of prestige and distinction (Camacho & Lord, 2013). One interviewee described the process by which she chose to join HES in college: having been a part of several honors and leadership-related clubs in high school, she realized what she was looking for:

...being part of those organizations in high school made me – almost made it automatic to look for them in college. So my freshman year when I was at City College that was the first thing that I did...So they had a fair and...it was kind of like a job interview where I was interviewing all of them like "tell me about what you do" like "what does your calendar look like?" before I settled on an organization that I wanted to volunteer at because I understood that it was valuable for the network, for being with people that are just as motivated as you, people that can help you when you are struggling, can help you find resources. So for me HES was that organization in College. (Esther, Interview, 4/9/17)

This participant herself drew on her own capital (i.e. prior experience) and exercised her agency in choosing to join HES (to be explored further in Chapter 8), a space in which she felt she could move forward toward her career goals. Here, choosing to join HES itself reflects a strong science identity. She wanted the network (i.e. social capital),

wanted to be around equally driven individuals (fellow aspiring engineers) and those who could offer support or connect her with resources (i.e. social capital).

Strong science identity was also observed among long-time HES members who describe ways in which HES has been critical to their personal development. One participant explained: “HES was a turning point for me. Having that support system, that background of a community that understands *you*” (Nicolyn, Interview, 8/2/17) while another said “HES to me, you know, it was a very important time in my life, especially it was the help and the community that I needed when I continued college and throughout my years” (Alexandra, Interview, 6/29/17).

### Capital

Generally, the concept of capital is connected to Bourdieusian conceptions of culture as a field in which one’s identity is constituted and at times caught in conflict between one’s agency and structural constraints. In this conceptual framework, identification involves individuals’ enactment of aspirations that may seem incongruent with their immediate circumstances and involves improvised ways of being that go against cultural expectations (Holland et al., 1998). Thinking of such enactment in relation to capital is useful for it explains the potential value and impact of individuals’ attempts to redefine themselves in spaces wherein access to capital may be uneven due to individuals’ varying social positions. In the context of this study, engineering acts as a culture, or a field (in the Bourdieusian sense), in which Latinas strive to achieve career success and a sense of personal fulfillment. In striving to achieve these goals, they constitute their (science) identities through action in a space (i.e. engineering) that at times involves conflict between what they desire to achieve (i.e. career success) and



structural constraints (i.e. articulations of power) that impede or slow down achievement. The forms of capital they utilize vary according to the source of capital (e.g. social – school, peers etc.; cultural – family, community etc.), the nature of the structural constraint (i.e. sexist attitudes, economic status etc.) and the habitus of each individual.

Below, I explore common forms of capital that played a role in women’s career trajectories. The most common forms generally fell into categories established in prior research including science capital that often overlapped with related forms of social and cultural capital, as well as forms of capital that reflected *la facultad*. Each of these were found in all interviews and throughout observations (see Table 9: *Forms of Capital Participants Mentioned* for summary). Those related directly to membership in HES, other forms that could not be easily categorized as well as participants’ allusions to forms of support that would require further inquiry to confidently code for capital (i.e. “Capital-related Observations”) were also noted. *HES capital* will be discussed in Chapter 8 in relation to my second research question and so will not be highlighted here. Additionally, *other forms* and *capital-related observations* will be touched upon in Chapter 9 in relation to emerging themes. Overall, my data support prior research that has identified particular sources of capital found to be strong among Hispanic/Latinx students in college generally: altruistic motivations for studying science (Carlone & Johnson, 2007; Ceglie & Settlege, 2016) and other forms of community cultural wealth including strong family ties (which can also dissuade persistence) and motivation to succeed for the sake of one’s community/family (Cole & Espinoza, 2008; Yosso, 2005). Findings related to *science capital*, *social capital* and *cultural capital* are organized according to a “science capital”

Table 9

*Forms of Capital Participants Mentioned*

Capital Type	Frequency	Distribution
Science	90	All (10) primary All (3) secondary Observations
Social	96	All (10) primary All (3) secondary Observations
Cultural	83	All (10) primary All (3) secondary Observations
<i>La facultad</i>	57	All (10) primary All (3) secondary Observations
HES	47	9 out of 10 All (3) secondary Observations
Other forms	63	N/A
Capital-related Observations	33	N/A

theoretical framework, which is outlined below. Findings related to *la facultad* are discussed at the end of the chapter.

*Science Capital*

Science-related capital was a frequently referenced form of capital among the women I interviewed and in the HES events I observed. Each of the ten primary interviewees cited multiple forms of science capital that they drew upon as they navigated their trajectories through engineering. In the case of Latinas in engineering, the

concept of science capital helps us better understand their underrepresentation by acting as an analytical tool that is science-specific, in contrast to notions of social and cultural capital that span various fields.

As a reminder, science capital was first theorized as “scientific capital” by Bourdieu, who discussed it in relation to his well-known theory of general “capital” that had roots in a humanities-based framework (i.e. such that cultural capital was primarily theorized in terms of the arts). Bourdieu described scientific capital as follows:

Scientific capital is a set of properties which are the product of acts of knowledge and recognition performed by agents engaged in the scientific field and therefore endowed with the specific categories of perception that enable them to make the pertinent distinctions, in accordance with the principle of pertinence that is constitutive of the *nomos* of the field [...] Scientific capital functions as a symbolic capital of recognition that is primarily, sometimes exclusively, valid within the limits of the field (although it can be converted into other kinds of capital, economic capital in particular). (Bourdieu, 2004, p.55)

One can see here the strong resonance of Bourdieu’s “scientific capital” with Carlone and Johnson’s “science identity” framework. Just as recognition is central to having a strong science identity, so too is recognition interconnected with science capital. Among the women that I interviewed, there were various forms of symbolic capital that rendered them “successful” in engineering. Being a HES member in itself indicates that one has self-identified as an engineer and has presented oneself as an engineer to be recognized by peers. In each of their workplaces, they had occupied at least a team-level leadership role which required applying knowledge to tasks for which they were evaluated by managers and teammates in an effort to be recognized as legitimate, if not highly skilled, engineers. As women experienced career success, recognition was often, as Bourdieu

explained, converted into economic capital, whether in the form of promotion or salary (Bourdieu, 1986).

Expanding on Bourdieu's "scientific capital", science education researchers Drs. Louise Archer, Emily Dawson and Jennifer DeWitt, program evaluation researcher, Dr. Amy Seakin, and scholar of diversity and inclusion, Dr. Billy Wong, drew from a five-year, longitudinal study of middle school aged students in England to put forth a theoretical framework of science capital divided across cultural, behavioral/practical, and social forms of capital:

- Science-Related Cultural Capital (Including dimensions of *scientific literacy*; *science dispositions*, and *scientific forms of knowledge about the transferability of science qualifications*);
- Science-Related Behaviors and Practices (*science media consumption*; *visiting informal science learning environments*);
- Science-Related Social Capital (*parental scientific knowledge, talking to others about science*) (Archer, Dawson, DeWitt, Seakin & Wong, 2015).

Science capital conveys the (scientific) knowledge, skills, and attitudes individuals may take up and apply as they aspire to become successful scientists (Archer et al., 2015; Harper & Newman, 2010). Critics view science capital as simply a form of cultural capital and as a concept which obscures rather than illuminates the social inequalities that result in stratified capital possession (Jensen & Wright, 2015). While Archer et al. did not fully explore the relationship between science capital and the habitus of their research participants or the field their research participants occupied, it is important to acknowledge the interrelated nature of capital, field, and habitus in Bourdieu's theoretical framework (Jensen & Wright, 2015, p. 1144). While future research can explore the relationship between capital, habitus, and field in the experience of Latinas in engineering more fully, it suffices here to note that each research participants' use of science capital

was mediated by her habitus and the extent to which her habitus aligned with the norms of the engineering spaces (i.e. various fields) she occupied.

Despite the limited attention paid to the theoretical context of science capital, it is a useful conceptual tool for understanding factors associated with aspirations toward a career in STEM. Explaining the concept in simple terms, and utilizing the social media outlet of Youtube, Archer and her colleagues at Kings College explain that science capital involves four key components:

1. What you know (knowledge).
2. How you think (skills).
3. What you do (attitudes).
4. Who you know (experiences) (kingscollegelondon, 2015).

According to the Kings College team, sources of science capital include: school, family/home, outside-of-school activities, and everyday life experiences. Furthermore, Archer and her colleagues identify eight dimensions (identified above in the science capital framework) of science capital found to be positively associated with professional science participation: scientific literacy, science-related attitudes, values and dispositions, knowledge about the transferability of science, science media consumption, participation in out of school science learning contexts, family science skills, knowledge, and qualifications, knowing people in science-related roles, and talking about science in everyday life (kingscollegelondon, 2015).

Reviewing my data showed that, although my study participants were from a different demographic than the focus of the Kings College study, the science capital

theoretical framework is fitting for two primary reasons: The first reason is, given the recollections of study participants, I did in fact hear of forms of science capital that many of them had access to as middle and high school students (the focus of the Kings College study). Interview data revealed that each of the interviewees tapped into forms of science capital starting in childhood and observation data showed that HES events often provided sources of science capital to its members, including women and girls. The second reason is that study participants represent the “success stories” among the demographic that science capital and other equity-oriented science educators seek to more effectively serve. Given that the women I interviewed have actually chosen to pursue professional science participation, it is informative to look back along their recollected trajectories to learn about aspects of science capital they acknowledge as being important to their present career. What follows is an exploration of how my data revealed aspects of science capital within the aforementioned science capital theoretical framework (i.e. cultural, behavioral/practical, and social – each with various dimensions) as well as how my findings revealed other elements of cultural, behavioral/practical, and social capital.

### *Science-Related Cultural Capital*

*Scientific literacy.* The first dimension of science capital, “scientific literacy,” was by far the most frequently referenced in the data (40 references - 45% of Science-capital coded references). Whether recalling loving science and math from a young age or tinkering with mechanical objects or playing with chemistry sets, many participants had interest in and knowledge of science as a child. For some, despite the challenging nature of the material in high school and college, a career in engineering was their desired goal because “it...made the most sense to me” (Isabel, Interview, 4/5/17) or, as another

participant said, referring to math, “it was always something that I had a knack for” (Rosa, Interview, 6/19/17). Many participants referred to exposure they’d had to science in school; for example, one interviewee, now a computer scientist, referred to school being the first place she was exposed to computers, which then sparked her interest in computer science. The sources of literacy included school, work experience, and conferences. While work experience isn’t directly addressed in Archer et al.’s model, it compares to extracurricular experiences that K-16 may have in that it exposed my study participants to different facets of engineering and gave them insight into goals they wanted to pursue (e.g. a PhD in engineering education or a specific job position). Another participant, also a computer scientist, referred to how her work experience gave her the opportunity to tackle and succeed on a large project, thereby building her confidence – a hallmark of science literacy:

I only had two months to complete the project, the project that was supposed to be scheduled to happen in 6 months. So I’m very proud of that, of having that project going live and without a hitch, okay? When I say without a hitch...I was the project manager, I was the tester, I was the business analyst, I was everything, like all the parts on that project and even though I had some help from interns...I had to supervise their work no matter what...they would do something let’s say with data in an excel file, I would go back in myself and double check. And there was a lot of data involved, and that I was the leader and everything checked out no problem. (Mónica, Interview, 7/31/17)

Here, her knowledge of computer engineering broadly – though with this particular project she was actually unfamiliar with the specific content – and her commitment to seeing the project through to completion (“I may not be...fully familiar with the project or know everything about the project but if my name is written down as I’m the one responsible for it, I’m accountable for that, so I have to make sure that regardless I need

to deliver...”) enabled her to add to her science capital, thereby strengthening her science identity.

*Aspirational capital.* Examples of “aspirational capital,” a form of science-related cultural capital although not directly referred to Archer et al.’s framework, also appeared in participants’ responses. “Aspirational capital” (Yosso, 2005), involves successful students’ use of “invisible strategies” (Tierney & Auerbach, 2006) to overcome seemingly insurmountable barriers (e.g. inadequate academic preparation) based on interest and strong structural supports. Invisible strategies refer to students’ ability to prioritize or value their interest in STEM even if they don’t do well in a given class/on a test (Tierney & Auerbach, 2006). Data showed specific examples of participants struggling in a given college class and perhaps even taking a class 2-3 times based on their interest in attaining an engineering degree and often with the assistance of their fellow HES members, other peers, student organizations or family (i.e. strong structural supports). One participant explained how a combination of challenging classes and emergency family situations contributed to her going on academic probation, losing her scholarship and almost forced her to drop out of her undergraduate program yet what kept her in school “was, my faith, my family. That’s really what it came down to. Having their support, encouragement and saying “yes, you can do this” you know, stuff happens and you pick it up and keep going” (Nicolyn, Interview, 8/2/17). This participant ended up finishing her undergraduate degree and going on to complete a Master’s degree in engineering as well: “So I was able to finish undergrad and would have never considered going to grad school if it wasn’t for my HES family. There, just hearing stories, their encouragement really motivated me to go back to school and finish strong” (Nicolyn,



Interview, 8/2/17). Another participant described how confidence in her abilities contributed to her attaining a higher degree of professional success than some of her peers:

...if I looked at minority and specifically the women that joined [HES] around the same time that I did, I have definitely done better and I do think ...it's just that I have confidence in my abilities and what I can do and that has been really an eye-opening thing for me because sometimes I wonder if I had grown up in the U.S. if I would actually have gone into a STEM career just because I see women that are absolutely brilliant and that lack confidence just because they have internalized a lot of the comments and jokes they have heard all of their lives. (Pilar, Interview, 4/6/17)

Pilar attributes doing better professionally than her minority/female peers to having “confidence in [her] abilities and what [she] can do.” Her confidence in her abilities, which she implies is rooted in a different cultural context that doesn’t joke about women’s intelligence as in the U.S. (a topic to be explored in Chapter 7), enables her to achieve her career goals. Through drawing on the currency of her cultural knowledge that gave her confidence in her abilities, she can succeed in an environment that may not be conducive to her success. Here, the participant displays an internal “resilience or resourcefulness” at a professional level that researchers have found many students of color in STEM develop in response to their circumstances (Herrera et al., 2012).

A critical form of science-related cultural capital that links strongly with the “family skills etc.” dimension of science-related social capital involves family ties that motivate students of color to strive to succeed in STEM. These are distinct from specific science skills/backgrounds that family members may possess and instead include dedication and loyalty to one’s family and their interests and needs. The most commonly referenced strong family tie related to participants’ mothers. The participant who cited

her family as being a big source of support when she nearly dropped out explained that her “mom especially was always [her] biggest cheerleader” (Nicolyn, Interview, 8/2/17). She recalls “I would be in the computer lab super late at night and I remember her coming with me and just reading a magazine just to stay with me, to help me stay awake and that moral support, it just meant the world” (Nicolyn, Interview, 8/2/17). Here the family tie itself was a form of capital in that her mom’s presence “meant the world” and enabled her to persist through many hours of studying. Another participant referred to her mother’s words of encouragement as she encountered difficult classes “My mom was always trying to push me forward. And it was really my mom, I think, just like ‘you need your education so you’ll land on your feet. Whatever life throws you, you’re going to land on your feet’” (Rosa, Interview, 6/19/17). For this participant in particular, her mother’s words of encouragement acted as capital that kept her pursuing her degree and ultimately pursuing a Master’s. She explains that her mom passed away when she started her Master’s “and one of the things that she wanted was for me to actually finish school and that’s ultimately what kept me focused on actually finishing up my degrees and, and just doing what I had to do” (Rosa, Interview, 6/19/17). The strong family bond here, reflected in her mother’s wish, propelled this participant to complete her degree.

While multiple other forms of science-related cultural capital were observed, it suffices to note here that my findings consistently reflected what prior research has shown contributes to the persistence of students of color in STEM. For Latinas in engineering, various forms of science-related capital enabled them to complete engineering degrees and continue to foster their professional development in at-times

“chilly” working environments. Further research can more deeply interrogate forms of capital particularly pertinent for Latinas as they pursue engineering careers.

### *Science-Related Behaviors and Practices*

*Visiting informal science learning environments.* This dimension was most visible in participants’ references to clubs they participated in during college and in advice they offered to fellow Latinas considering pursuing a degree and/or career in engineering. One participant advised, “...don’t become part of those groups just because you want to have fun and you want to go on the trips and so on...join those groups to get something, you know, productively... become part of an EBoard [Executive Board] or some sort of leadership role in the organization...gaining those leadership roles early on in your career, earlier in your life [is] very important” (Ana, Interview, 4/5/17). Here, she links this college-level dimension of science capital with developing leadership skills which are directly related to a strong science identity.

### *Science-Related Social Capital*

*Parental scientific knowledge and talking to others about science.* This dimension of science capital overlaps with cultural capital found to be common among Latino students who persist in STEM and so has already been explored in an earlier section focused on cultural capital; however, it is important to note here that many participants did refer to having family members with science-related jobs and interests. Ranging from having parents who spoke no English and so were only able to assist with math—and who happened to have strong math skills and interest in mechanics and electronics—to having multiple immediate family members who were engineers, approximately half (4) of the participants had either an immediate or extended family member with a STEM

background. The impact of having family in STEM was explained in terms of piquing their interest and inspiring them; for example, one participant explained that “what inspired me was actually my aunt” (Alexandra, Interview, 6/29/17). This is significant, particularly among Latinas in engineering as it not only supports what current scholarship has shown regarding this dimension of science capital but highlights the potential significance of having family in STEM for underrepresented groups. The potential impact on underrepresented students of having family in STEM is worth exploring further.

Related to the dimension of having family with STEM backgrounds/interests is having meaningful connections with other potential STEM resources in their community. This dimension overlaps with social capital, and so will be explored in the subsequent section on social capital. This was the most frequently cited dimension of science capital following science literacy, with 19 references found in the data. Participants referenced managers, teachers, and mentors each of whom had backgrounds in STEM and so acted as role models for participants as they strove toward achieving engineering degrees and career goals.

While participants didn’t mention chatting about engineering in everyday conversations – this could perhaps be a target question for future research on science capital among engineers – they did refer to specific instances when they were encouraged to continue to pursue science as well as times that they were a source of encouragement for others. One participant explains, “the PI of the project that I worked in was my best support. She was always like ‘You need to do this,’ ‘Now you need to do this,’ ‘you need to be in an engineering education program’ and she has been my greatest advocate” (Camila, Interview, 3/4/17). An adult mentor counseled her to continue her education and

she did indeed begin a PhD program in engineering education several years following her work with this PI. As far as being a source of encouragement themselves, several participants referred to serving as a mentor to younger engineers and even to co-workers; one participant even referred to the need to do increased outreach: “encouraging the youth, exposing these kids to you...and also, you know, we’re part of the problem too, perhaps there [are] not enough people going back to these...smaller group of segregated people and say “hey, this is what I do, come meet me” (Ana, Interview, 4/5/17). Here, she takes responsibility for the need to expose students to the work of an engineer, perhaps fostering their engineering aspirations.

### *Other Dimensions*

Three dimensions didn’t feature prominently in my data: “science-related attitudes, values, and dispositions,” “knowledge about the transferability of science,” and “science media consumption.” Perhaps this occurred because my study participants were already well into their careers. The King’s College team defines the “science-related attitudes” etc. dimension in terms of the extent to which a young person views science as relevant to everyday life (i.e. science is ‘everywhere’) and the “transferability” dimension refers to students’ ability to understand that scientific skills may be transferred to other fields of endeavor (kingscollegelondon, 2015). While participants referred to useful attitudes they had developed as engineers, this was within the context of being successful in STEM and not related to everyday life. These attitudes will be explored at the end of this section. Regarding the “transferability” dimension, the main relevant finding in the data had to do with some participants’ insight into how their skills as engineers were valuable for management roles. While the data are too limited for conclusive analysis, participants’ references to “an engineering mind” and the trend of Chief Executive

Officers' (CEOs') having engineering backgrounds show that future research could reveal relationships between engineering and other STEM skills and leadership roles. Regarding "science media consumption," only two participants referenced common media representations of engineers as male and/or "nerdy;" while prior research (Banchefsky et al., 2016) has highlighted the power of such images in circumscribing students' views of themselves as potential scientists, most participants didn't reference media as a source of inspiration or deterrence and a larger group of individuals would need to be interviewed to learn more about the potential role of science media in persistence among Latinas in engineering.

Participants referenced numerous forms of individual and organizational support they received from elementary school up through their professional careers. Individual supports included teachers, managers, and, most commonly, mentors. Whether having a mentor or serving as a mentor, nearly each woman talked about the importance of mentorship to helping them achieve their career goals. As one participant explained, "I also mentor and I am a mentee as well, you should always have that dual relationship where you're getting mentored and you're growing, but you're also giving back" (Nicolyn, Interview, 8/2/17). One participant even mentioned having the same mentor since she was in junior college:

I have a mentor that I met her [when] I was 17 or 19...she's not related to technology [participant's field] at all and she kind of gave me advice, helped me out with scholarships and up to this day I keep in touch with her. And I talk to her on a monthly basis, and we email each other sometimes. And I know her since 17 so imagine, we're talking about 30 years about. (Mónica, Interview, 7/31/17)

Here, the longevity itself is a testimony to the significant role a mentor can play in one's life. To add to research that shows the positive association between having meaningful

relationships with individuals with a science background, the role of mentors would be worthy of exploration in relation to a science capital framework, as it has been explored in depth in other related scholarship (Espinosa, 2011).

Interviewees referred to participation in minority and/or engineering-focused student organizations during their college years and noted specifically how their participation helped them stay up studying for long hours (the norm in engineering) and persist in challenging courses. Being around like-minded individuals, such as in HES, enabled them to maintain focus on their ultimate goal of graduating and entering the engineering workforce. One notable example was a peer group that formed in a summer pre-college bridge program that has remained a unit since:

My immediate friends that we built in the summer program... We met in 1996, so...fast forward – 20-16, 20-17, it's been 20 years and we're still friends. So, we're growing up, and we're learning from each other, we're not experts. And each one of us has started a family or changed careers or had health issues or whatever, but we've kind of leaned on each other and that helped us continue to push each other. (Mary, Interview, 3/3/17)

To see that peer groups sustain their important role in professional engineers' lives indicates how crucial it may be to ensure access to this source of capital early on in STEM students' trajectories. Findings showed that a combination of individual and organizational supports strengthened participants' efforts to succeed in their chosen career path.

### *Altruistic Motivations*

Research has shown altruism to be manifest at least in part in the sense of giving back to one's community, particularly among female students of color (Johnson et al., 2011; Tran, 2011). This desire to give back has been shown to be a source of capital itself in supporting students to persist in STEM. My data support this finding. Several women talked about wanting to complete their engineering degrees because of the sacrifices their

parents had made and to pave the way for Latinas and other minorities in STEM following them. One participant noted the need for Latinas to volunteer their time to do outreach in their community, helping to raise awareness about engineering careers “because those of us who have gone through it, who have had this experience, who have this additional knowledge also owe something back to make sure that it moves forward, to share that information with others, to mentor people, to take the time out because otherwise we’re going – they’re just going to repeat the same struggle” (Isabel, Interview, 4/5/17). Here, she refers to the “struggle,” the “experience” shared by Latinas in STEM as a motivating factor in itself for staying in the field, inviting others to join and, in doing so, improve the experience of future Latina engineers. While this will be explored to a greater extent in the following chapter, it is notable here that giving back was a consistent theme in my findings. As Victoria described, a desire to help Latinas and improve their status is critical to her volunteer work as an IT advisor:

...while I was working, I, I started to be part of [ALPFA—Association of Latino Professionals For America]. So I was the VP of IT in the Boston chapter...so, it helped me a lot to be that connection with Latino professionals, feel connected and things like that because I had done all these kind of systems and applications that are completely different for the corporate world, I was in it for free, for fun because I wanted to help Latinas...so for me it was, I wanted people [to] change how they see you, so for me it was the perfect outlet to do that. HES is the perfect outlet for me to do that because I want people change...[how] they see us for first time. (Victoria, Interview, 3/3/17)

Her desire to change perceptions of Latinas motivated her to do volunteer work that ultimately led to a career transition into independent IT consulting.

Another participant described how what she appreciated about her role as a manager (i.e. boss) was the ability it gave her to have an impact on her community. She



described an experience she had when she was able to help a fellow HES member get an internship at her company:

I meet people at random places, conferences and...some people come and say “oh [do] you know if there’s an opportunity this summer?” someone that I mentored through HES asked me if she could get an internship and then we had the opportunity here and I talked, “I met this young lady, I was truly impressed, so you think we could bring her on board?” And they were like “absolutely!” you know, it just happened...it was pure luck for her, it was pure luck that a position was available, it was pure luck that I remembered her, but having that impact on my community...that I have that reach now...I feel that if I had just a random role it wouldn’t allow me...to have as much impact as I have now, so that’s why I...really like the role, the opportunity that it presents to help others. (Ana, Interview, 4/5/17)

Here, the participant directly links her professional role with giving back to the community. Despite not loving the particulars of her job, mentioned earlier in the interview, she liked how the role enabled her to help others. Here, being able to help was a source of aspirational capital that contributed to her continuing on in her job. Another participant framed her persistence powerfully: “I want to be able to stay in the field so I can help remove obstacles and help people not make the same mistakes I did” (Nicolyn, Interview, 8/2/17). For professional Latinas in engineering, the sense of altruism found among younger Latina students holds true as well.

### *La Facultad*

While all forms of cultural and social capital are related to an individual’s social identity, *la facultad* is rooted in one’s awareness of how one’s social identity may conflict with one’s desired other identities (e.g. professional etc.) Prior research on persistence among women of color in STEM has shown that, in order to succeed as scientists, participants realized that they had to navigate many social situations that were inherently unjust and in which they felt their social roles as women of color, that

intersectional framing of their identity, overrode their identities as scientists or were seen by others as contrary to their science identities (Johnson et al., 2011). In other words, they felt they were perceived as women and of color before—and perhaps instead of—as legitimate scientists. The capability of *la facultad* is thus a form of capital that involves the confluence of having a strong science identity (i.e. recognition of oneself as a scientist, recognition by significant others as a scientist, and demonstrated ability in the sciences) and accessing one's assets to apply them to one's actual circumstances. In line with both intersectionality and double consciousness, *la facultad* entails a mental acuity that itself requires a liberation from a fear – or any negative, paralyzing view – that may circumscribe the beliefs and actions of those who are the “other.” Thus, fear, as well as opposition, difficulty, crisis, as a component of *la facultad* acts as a motivator and a liberator - a call to action that empowers women to overcome obstacles, destroying barriers to self-actualization as well as collective transformation. Important too is that a hostile environment is actually a critical component of the development of *la facultad*. If one is in an environment in which one feels completely supported, recognized, and acknowledged, then one need not look beneath the surface to identify how one is being perceived and possibly being discriminated against. This is not to wish a hostile environment upon anyone; rather, it is to acknowledge its role in the development of a faculty, a form of capital such as *la facultad* that can empower women to change potential stumbling blocks into steppingstones.

While *la facultad* was not the most frequently mentioned form of capital that participants spoke of, it was consistently referred to during interviews. Each participant referred to the role that gender and culture (sometimes related to race/ethnicity) played in

their experience in engineering. First, women noted the environment they were in and the challenge of being in that environment: “especially as a professional engineer you are working in an environment where it’s male-dominated” (Pilar, Interview, 4/6/17) and,

I think one of the challenges that everybody talks about is the fact that you know when you are a woman and you are Hispanic I think that it’s harder for us to be in the engineering field. People might see you, on account you don’t prove yourself, that you know what you’re doing, that you are, you know, good at what you do. I think people still look at you like ‘hmm, you know this is a woman. I wonder, does she know as much as a male at her level would know?’” (Alexandra, Interview, 6/29/17)

What they did with this knowledge is what constituted *la facultad*; this same participant explained:

And to me, that’s a challenge but also it makes me happy to see that every time that I get assigned a new project it doesn’t matter if I know how to do it or not, I get it done, that my boss is happy and that the customer and my team is happy. And we’ve built this relationship where they know that no matter what challenges I get, I’m going to achieve them. So they know that they can trust me as much as they can trust any other person, male, or in the field. (Alexandra, Interview, 6/29/17)

Because she “get[s] it done” no matter what the task is, she is able to demonstrate her ability – revealing her strong science identity – and earn trust. Another participant referred to the time investment required to build this trust as a result of her social position:

And you see that, yes because they see you as a Latina, Mexican...people that were not trusting you. [O]r, you see that ‘okay, she doesn’t know’ but, at the end, you do your work and your work...says it for itself. And then at the end, everybody knew me, everybody liked me. But it was a process. So...maybe other person would have faster connection with your co-workers, for me...it took me a little more time. But even it took more time, I think it give me a better connection then other people, so – because it took me that hard to do it, so then I have a better connection because I made the people change their minds about me. (Victoria, Interview, 3/4/17)

Here, with time, she felt accepted. She was aware of how others may perceive her and that caused her to focus on letting her work speak for itself. This is simultaneously

empowering and problematic as it shows how she felt confident in her ability while also revealing a sense of *needing* to prove herself. Another participant elaborated on this drive to do better because of her social position as a woman in engineering:

I think that, for professional women, what keeps them in line and trying to do better and better is the fact that we want to...abolish the stereotypical that we cannot do things...maybe women you know what went through it and I can do it. Blocking what the stereotype is. Also the need of making a difference is another thing that gets them there. They want to feel like they can do what they do what they try to propose in their lives. (Alexandra, Interview, 6/29/17)

Alexandra implies a sense of empowerment, using language like “abolish the stereotypical” and “I can do it.” She thus turns the challenge into an opportunity to prove herself.

Another participant (a secondary interviewee, a woman with an engineering degree, four years into a tech career at the time of this writing) explained that simply acknowledging the “elephant in the room” was an empowering step:

I mean I think when it comes...to being a woman, to trying to get into STEM or Engineering...the first thing that you need to do is acknowledge that there’s an elephant in the room, right? You are going to be one of very few females in your classroom and to not be scared by it, to not be discouraged by it, but just to accept that there’s not a lot of you in the room and that that doesn’t mean, it’s not a reflection on your capabilities, your ability to learn. It’s none of that. If anything it’s a sign of, you know, deciding to be that person in the room of, one, being a leader and being confident in yourself and sticking with it, but always having that awareness that, yes, you have to operate under the lens that you are one of few in the group. That *may* make people feel uncomfortable, but there will be ways to manage that and still be successful but you need to accept it *because* it will make other people uncomfortable it will change how you approach them, but it doesn’t mean that you can *not* approach people, it just means that you need that sense of awareness when you interact with them. (Esther, Interview, 4/9/17)

This “awareness” conveys *la facultad*, such that women are empowered to use their agency to address the challenge of being the only or one of few women. This doesn’t remove the need for systemic change; rather, it highlights the possibility for greater

numbers of underrepresented females to enter STEM fields with increased confidence born from the experience of those who have gone before them.

### Summary

This chapter began with restating my primary research question:

What forms of capital do women of color utilize as they strive to succeed?

- a. What currently existing structures facilitate/inhibit capital production and use?
- b. What other forces play a role?

The theoretical framework of science capital offered a structure in which to analyze findings pertinent to this question. Generally, the Latinas that I spoke with and observed utilized various forms of science-related cultural capital, science-related behavioral/practical capital, and science-related social capital. Structures that facilitate capital use include academic and cultural student organizations, professional networks, mentors, and family members. The main structures that participants implied inhibited their capital use were the general presence of a male-dominated (further explored in Chapter 8). Further data collection and analysis are required to more deeply understand other forces that play a role in facilitating or inhibiting women's capital use. Science capital proved to be a useful conceptual tool to better understand women's capital use and helped illuminate various forms of capital that Latinas in this study took up and applied throughout their trajectories in engineering.

## CHAPTER 7

### “STRUGGLE” AS CAPITAL

In addition to various forms of science capital, additional data analysis revealed an “emic” understanding of forms of capital Latinas in HES utilize as they strive for success in their careers. The prominent thread throughout my interviewees’ experience was a sense of the multi-faceted struggle/challenge involved in striving for success in engineering. Perceptions varied around the nature of the struggle and the role of one’s social identity in shaping that struggle and these varied perceptions are what I will explore below. The central themes are: There was consistent acknowledgement that there was struggle and hard work involved in reaching the points in their career that they had so far achieved; the role of obstacles was critical to their success; the struggle they experienced was in many ways peculiar to being a Latina in engineering *in the U.S.*; and giving back to one’s peers, one’s community, one’s family is part of the struggle. Each of these strands weave together to form a common thread of experience that connects each of my interviewees as Latinas in engineering in the U.S. The sense of struggle is significant in that it, on the one hand, necessitates access to various forms of capital in order to work through challenges and either overcome them or transform them into opportunities, and, on the other hand, produces new forms of capital such that the struggle itself is vital to one’s success.

#### Struggle/Challenge

The primary theme generated from a hunch based on the etic coding of capital-related findings and then subsequent analysis of my coded data for themes related to “struggle,” “challenge,” and “fight” – was that engineering is hard and requires hard

work to succeed. One finding that resonated with my “hunch” was another outsider’s thoughts – yet someone with far more exposure to Latina engineers’ experience than I: John, HES-NYC’s president, described the challenge involved in women’s succeeding in engineering when offering hypothetical advice to Latinas considering pursuing a science, technology, engineering, and mathematics (STEM) degree:

So in my advice it’s, one, truly understand what are your interests, what are your goals and pursue those, right? And the reason I say that is, engineering is a challenge, right? It is hard. And anyone I advise to go into engineering it’s because you really want to do this and for me, forget about... what your grades were or...what school you want to go to, what you studied, if you really want to do this, you’ll overcome any of the challenges. (John, Interview, 7/21/17)

In John’s view, engineering itself is a challenge: “It is hard” so you have to *really* want to do it; this desire to do engineering, with the implication that doing it entails moving along a trajectory through the field of engineering, will enable an individual to “overcome any of the challenges.” In many ways, the analysis that follows is a test of this statement – did interviewees pursue their careers, despite all of the challenges involved, because they really wanted to do engineering? Was that the primary motivating factor?

Another statement that John made shed light on the importance of hard work and the significance of women’s fight to succeed in engineering:

...the women who do succeed, for the most part because...they have the drive and they don’t say no or they find opportunities where they can succeed...So perhaps this door is closed, but I’m going to go around the corner and take the side entrance. So that “just say ‘no’” attitude, um, or “don’t take ‘no’ as an answer” attitude...is the primary...I see women go where they are because...they’ve had to fight for it. (John, Interview, 7/21/17)

Here, one can see that, in John’s view, women who succeed have done so because they “don’t take no” for an answer, presumably in response to blocked opportunities. While John didn’t explicitly mention sexism or sexist attitudes (or racism for that matter) as

sources of the barriers women face, he does allude to obstacles they may face and how they may approach those obstacles: “perhaps this door is closed, but I’m going to go around the corner and take the side entrance...” While the need for “tak[ing] the side entrance” is highly problematic and epitomizes the prevailing male culture of engineering (Camacho & Lord, 2013a) it also implies a resourcefulness, a *fight*, that John has observed Latinas exhibit as they strive for success. His comments stood out to me and serve as an intriguing voice to add to the discourse emerging from initial findings from my interviewees’ actual experiences with striving for and achieving success.

*“I like being...challenged”*

One key component of several of my interviewees’ descriptions of their trajectories and how they approached challenges and successes along the way was that they, in general, *liked* challenges. For some participants, “challenge” was an attribute that drew them to engineering in the first place as in the case of Ana who describes how she chose engineering in high school in Ecuador: “So I did the pre-economics and...even though I was a junior I found it easy enough and I was like ‘Oh, this is not so bad! I could do this’ and I said ‘Well, I need something a little more challenging,’ ... ‘It’s all math. I mean I like math but...something a little more challenging’ so that’s how I decided to go into engineering” (Ana, Interview, 4/5/17). Nicolyn described a similar attraction to engineering, including the awareness that not many women or people of color pursued engineering:

I just always liked things different. And, especially, you know late ‘90’s, early 2000’s, like I said, there were not very many women or people of color in these fields so it was definitely different. I always liked solving problems and was never scared of a challenge. So those...experiences kind of drew me to engineering. I



also took different career paths [tests?] to see where I would fit and they always came out as engineering was a good fit for you. (Nicolyn, Interview, 8/2/17)

Nicolyn explains here how both the challenge of engineering itself (i.e. solving problems) and the social context (“not very many women or people of color in these fields”) during the time of her studies helped lead her to choosing engineering as a potential career path. Challenge – including the challenge of underrepresentation – was itself a motivating factor in pursuing an engineering career.

Enjoying the challenge of one’s work was also a theme, as in the case of Rosa who envisions staying in her line of work as an IT project manager: “I see myself still staying in that space because that’s where I feel most productive, where I’m actually using what I know to, 1, help people but also, 2, be challenged. I don’t like being in a job where it’s dummy work, I like being - and that’s something that’s driven me my whole life – I like being in that space, of just being challenged” (Rosa, 6/19/17). Ana’s enjoyment of challenge carried through also to seeking new job opportunities, even turning down offers because they weren’t what she wanted – and part of what she wanted was a challenge:

I went to a couple of interviews, I turned some down – I was like “no, I’m not interested.” Some people offered me the same money that I was making – I had to challenge. I was too young – perhaps I needed a lot more...but I had the opportunity to say “no thanks, I’m not interested”...And people were like “no??” I’m like “nope.” I know what I want and I want an opportunity and I want a challenge...I’m not leaving what I know and my family for, you know, for - for nothing that is not what I want. (Ana, Interview, 4/5/17)

Ana here refers to a mindset around challenges: she knows what she wants and so she accepts nothing less.

*“We are fighters”*

Other women also described mental attributes related to challenges – not necessarily enjoying them as Ana and Rosa described, yet having mindsets that help them embrace or overcome a challenging situation and succeed. The “trouble,” the hard work involved in success is tied to a belief that conditions can improve and that hard work can bring about results. One participant referred to “the struggle” and explained that Latinas are “fighters” due to their cultural background and common experiences they share rooted in limited economic resources:

...one of the things that makes us kind of apart from the others is our background, our cultural background...that we are people that come from family that either they never had school and they never had the opportunity and we are, in most cases...the first ones to go to college. So we bring that struggle with us and we are fighters. So we, we know what it's like not to have a piece of bread on the table. Some of us know that – or we have seen it. So for us it's not something, it's not new, you know? So we fight, we know ...what hard work is so no matter what kind of struggle we find on the way we feel like “I can do that, that's nothing” so, that's what I think about us as a community. (Mónica, Interview, 7/31/17)

Here her community's experience with struggle, economic in this case, becomes a source of capital such that knowing “what it's like not to have a piece of bread on the table” – either through personal experience or having heard about it from family – prepares her and, in her view, other Latinas to fight for what they want: “So we fight, we know what hard work is so no matter what kind of struggle we find on the way we feel like ‘I can do that, that's nothing.’” Related to cultural capital, experiencing challenges trains one to face them again and develops the mentality that “I can do that, that's nothing.” This is a valuable form of capital that is shaped by a shared cultural, economic experience that many Latinas in engineering may have access to. Here, Mónica draws directly upon her community's cultural wealth (Yosso, 2005) and expresses a *la facultad*-related insight: “so no matter what kind of struggle we find on the way we feel like ‘I can do that, that's

nothing” (Mónica, Interview, 7/31/17). Drawing upon her cultural capital, she develops another form of capital related to *la facultad* that empowers her to develop this mindset that she can “fight” no matter the circumstance. Being a woman and being Latina in engineering is thus simply another struggle to overcome and not an insurmountable barrier to stop her progress.

Nicolyn refers to this community cultural capital rooted in experience with challenge and struggle too, noting how balancing work/school and various family responsibilities may be the norm for many students of color and thus work/school may present more of a challenge than for other students with perhaps fewer responsibilities; however, a “keep on going” attitude enables them to achieve their goals. As she explains,

I think a lot of students in other demographics are able to just concentrate on school and that’s it. I think... a lot of students of color end up staying close to home because of those home obligations. So they’re wearing multiple hats...they’re having to take care of maybe siblings or...other family members, and take on other household responsibilities. So that’s definitely a challenge. But yeah, you just have to pick up where you’re at...and keep on going. (Nicolyn, Interview, 8/2/17)

This mindset of needing to “keep on going” is born in part due to the struggle many students of color, in her view, may experience due to their family responsibilities perhaps for a combination of socioeconomic and cultural reasons. It adds to the notion of “struggle” that Latinas in engineering may experience in that it accounts for specific personal circumstances that they may need to navigate and yet also overcome: “you just have to pick up where you’re at...” As Mónica explains, “for us it’s not something...new” as, in her experience, Latinas come from a cultural-historical background in which individuals become accustomed to hard work – as John also described.

Related to this sense of cultural struggle that Latinas are accustomed to, Rosa stated the need to “woman up” in the face of challenges. She talked about her experience having to work several part-time jobs in college while taking a full course load and not always being sure *how* she would manage and so just took things one day at a time. Her college experience and her approach to the challenging circumstances therein now help her at work:

But when I was in college...you learn a lot of things. You end up taking a lot of adult decisions at a very young age and you grow up fast – you have to, you have no choice, you have to woman up really fast and say “you know what? I’ve got to make it through the semester. I don’t know how I’m going to do it – I’m just going to take things one day at a time.” And that’s how I made it through every semester...and it’s helped me today. At work, yeah, even when I get thrown things from left field I just work through it. But a lot of that is the preparation I got (laughs) when I was younger.... (Rosa, Interview, 6/19/17)

Rosa attributes her ability to “just work through” challenges (i.e. “things from left field”) at work now as an adult to having to problem-solve in college, “woman up” and just “take things one day at a time.” Her own experience with and approach to challenge as a youth becomes a source of capital that she can draw upon as an adult. So, to fight, to struggle for Rosa, as for Mónica, Nicolyn, and Ana, is in some ways an aspect of their identity. Navigating struggle and challenge over time turns into a form of capital that they can tap into as they navigate their career trajectories.

*“I’m Going to Show You...”*

Just as participants described their familiarity with challenge, they also described how specific challenges propelled them along their trajectories; obstacles were, in fact, critical to their success. Camila, the engineering education graduate student, described how a direct experience with racism inspired her to work harder. She recounts the experience here:

...when I was in industry...the office that I was assigned to was in St. Louis, MO...[I]t was a smaller office with not a lot of diverse employees, in terms of their racial diversity and gender...I was actually the one and only racially diverse minority person in there. Like they didn't have any African Americans. And St. Louis has a big population of African Americans. It's interesting, because I actually happened to be there when...Ferguson, happened and the, the company is like a block away from the courthouse and so they had to like, you know, we couldn't go to the office for like a week or so, two weeks. So that was very interesting, so, but...what disappointed me the most when I was...in the company was that I was really looked at as a diversity hire, you know, just "let's just check those boxes" and "oh, you cannot say that I'm not diverse, look we have this one person"...so...I had a colleague...face to face tell me "you don't deserve to be here, they just hired you because...you are Hispanic, you speak Spanish...you're a woman, so they needed you here" and then I went bananas, I flipped out at him (laughing)...and I remember telling him..."you have all the opportunities in the world in this country, you have everything at your fingertips and you're telling me that you don't like me because I speak Spanish when you could've learned another language?"...How many languages don't they teach...in high school? I learned English because I had to. Not because I wanted to... It was a matter of...you can [be] successful, or not, if you learn English. Because you can't work anywhere if you don't, back home. And I was really, really mad. But that particular experience actually made me push even harder, that one. I was like "I'm going to show you". (Camila, Interview, 3/3/17)

Here, Camila explains in detail the social context of the company in which she worked and it is this context that highlights the role that race *still plays* in our neighborhoods and workplaces. In Camila's experience, she was accused of being *just* a diversity hire, hired solely because of certain aspects of her social identity. Camila has a nuanced understanding of her being able to speak English as a necessary skill she developed for career advancement purposes *and* as an asset compared to being able to speak only one language. This incident did not cause her to doubt her status in the company; rather, it "actually made [her] push even harder." While it is important to problematize the feeling of needing to prove oneself (i.e. reminiscent of "prove-it-again" bias (Williams et al., 2014)) to another co-worker who may be viewing you through a deficit – or simply racist or sexist – lens, it is also a powerful form of capital to be able to use such experiences as fuel to propel oneself further along one's path.

Ana, quoted earlier in this chapter regarding seeking out challenges, also shared with me the experience that prompted her to consider leaving her prior position, which was at a different company. She explained that her boss, in a conversation where she expressed that she would like to take on more responsibility and perhaps even assume a different role in the company, reacted by saying “you’re reaching too far”:

...it was a challenge because someone that I respected and I looked up to a lot told me “you’re reaching too far” and for a minute I actually believed him... – but till this day I’m extremely thankful to him because he pushed me to the edge and he pushed me so, so far that I didn’t even know... what I knew at the time and what was I ready for... So, it was pure luck... a lot of people told me, with time there’s two things with your career: “You have to be good and you have to be lucky” and at that time... perhaps I was good but I wasn’t lucky either but it just happened to be luck – I interviewed for a certain position, I was supposed to help a person but he resigned so then they offered me the position... the client that I was going to work for... 10 years ago I had worked with the same lady... She remembered me, she was excited, she said “she’s great, she’s going to be great” so everything just worked out. It was luck, you know? They had to rush to hire me because ...the person had quit so I needed to come and fill in the position. So, as I was saying, it’s a lot of luck but it’s also, you know, like looking first. And I would say, I always say “I’m only as successful today, thanks to this man that told me... ‘you’re reaching too far’ ... And I was like “Okay, I am? So let me jump!” (Ana, Interview, 4/5/17)

Ana describes the experience primarily in terms of the luck that was involved in getting her next position yet the brief mention of “it’s a lot of luck but it’s also looking first” reveals the role of proactivity. In this case, part of that proactivity was her reaction to being told she was reaching too far: “Okay, I am? So let me jump!” shows that she responded to the challenge with the desire to act, to pursue her goal. Ana’s gratitude for this incident demonstrates that she had a mindset towards challenges such that the challenge itself became a form of capital that inspired action – in this case action that moved her farther along her desired career trajectory toward her next job that she currently occupies and enjoys.

Before engaging in an exploration of the contextualized nature of the struggle participants described, an important exception to the general sense of struggle women experienced needs to be highlighted: Alexandra, formerly a government contracted IT specialist now starting her own company, acknowledged the challenge of pursuing an engineering degree yet maintained the mindset that it was a process, not a struggle. She recalls her college experience:

...when I was in school I always remembered the nights that I spent programming (laughs) [E: (laughs)] with my friends...[W]e knew that once we had a project, or a very interesting project or exam it was going to be an all-nighter so we just...would go buy food and go to either [their HES college chapter] and just study all night or go to my friends' house and just make fun, we'd just cook and eat and have coffee, we'd talk. And we would know that at the end of the day we were going to make it. So that's very, to *me*, I didn't see it as a struggle but as part of a process that we had to go through these things. (Alexandra, Interview, 6/29/17)

For Alexandra, the process of studying hard was mitigated by her belief that “at the end of the day we were going to make it” and “I didn't see it as a struggle but as part of a process that we had to go through these things.” The need to “study all night” implies a certain level of difficulty and could be compared to challenges described elsewhere in this chapter; so to view it as a process reflects an alternative view of challenges. Such a view doesn't contradict others' description of their hard work as a challenge; rather, it adds to a developing understanding of how Latinas in engineering experience their field and the efforts they exert as they strive for success.

### *Underrepresentation as An American Problem*

As they recounted their experience along their trajectories in engineering, several women pointed out that the issue of underrepresentation of Latinas in engineering is primarily, if not solely, an American issue. Starting with “Latina” as an American social construct, for Latinas, clearly, do not occupy a minority status in Latin American

countries (though there is a predominant machismo culture that several participants referred to) and referring to the prestigious role that engineers occupy in many Latin American societies, participants explained that the obstacles they face related to their gender and race/ethnicity are on account of the American social context. There are two key aspects important to understand: the social positions my participants occupy and the role of engineers in society are context-dependent such that *who my participants are as engineers in the U.S. is largely defined by American gendered and raced notions of STEM and STEM capabilities*. And the extent to which a Latina defines herself also as an American may dictate how empowered she feels in her struggle to succeed in an American context.

Several participants either directly stated or indirectly implied that the issue I was exploring, the underrepresentation of Latinas in engineering, was just an American issue. Victoria, the computer engineer working as an independent IT consultant and looking for more permanent work at the time of our interview, explained: "...it's a huge deal, the problem but how we are going to manage at some point that it is a policy. So, because, it's just an American problem. Because I remember I was in Sun Life and [they asked] "What is Canada doing?" "Well, we don't need to do anything, we are the ones that is very \*#@!ed up, so (laughs)..." (Victoria, Interview, 3/3/17). Here, Victoria implies that the problem is "just...American" – even in Canada, in her view, the issue of promoting diversity is a non-issue. Mary, a manager in procurement at Bacardi, touched on the American nature of the "Latino" construct:

...The whole, "I'm Latino" in Latin America doesn't mean anything. They're like, "what are you talking about..." But you grow up here and, you, not only do you grow up here but you go through the stereotypes and you go through



discrimination...I did go through discrimination, I did get harassed, I did go through all that. I get it and I felt it and it sucks. I know you don't understand what I mean ["you" referring to Latinos born and raised outside the U.S.], but this is the reality. This is how it is. They [first generation immigrants from Latin American countries] go through that once they've been here for awhile, right? Which is different because I think also within the U.S. you start getting labeled, like, "you're first generation" or "you're second generation assimilated Latina" and etc. etc. etc....

... If you come with your company and you're brought here with the paperwork and the visa and you're working within the field, your assimilation to the U.S. is night and day to somebody who has to start from scratch. It doesn't matter if you're a doctor, a lawyer or an engineer, you have to start from the bottom up and maybe, you'll be like the guy who start Chobani, right? With a dream, and you know, but it's not like that for everybody. (Mary, Interview, 3/3/17)

Obviously, a Latinx is likely not a "minority" in his/her/their native Latin American country (except perhaps in a racial sense depending on their background); as a result, the labeling is particular to being an ethnic minority in the U.S. The socialization process of "go[ing] through the stereotypes and...through discrimination" or getting harassed, as Mary refers to, is the disturbing aspect. Thus, assimilating into American culture from the social position of needing "to start from the bottom up" (as her mother had needed to, despite having gone to school in her home country of Colombia) as opposed to someone such as her mentor who was brought to the U.S. with the paperwork and the visa, with her company, is truly "night and day." Juxtaposing these experiences, Mary was able to appreciate the value in not having had to grow up in such a culture or having had to assimilate fully as her mother had. Mary explained,

...so that perception that 'she's Latina and 'she's a minority' she [her mentor] never came with. She didn't come with it but she did feel it – there's a difference. Me and my mom, we felt it and we had to deal with it and had to work with it and then had to figure it out. So it's very different – but it's a different perspective that's what I think helps when people come with different perspectives. 'Who cares if you're Hispanic, who cares?' Who cares? (Mary, Interview, 4/3/17)

Thus not having grown up experiencing the meaning behind the labels of “Hispanic” or “Latino” in a U.S. context enables one to say “who cares?” regarding one’s Hispanic identity and contrasts with the experience that Mary explained that she and others who have grown up in the U.S. where they have had “to deal with it” and “work with it and then...figure it out.” This insight adds another layer of nuance to the HES Board member’s hunch that HES needed to reflect further on how its programming was serving U.S.-born Latinx members in particular. For Latinas born and raised in the U.S., they may be dealing with a set of labels—and related negative experiences—that their foreign-born counterparts may not (though they too likely grapple with issues unique to living and working in the U.S. as international Latinas) and so need to be understood and have their needs met accordingly. It is significant that Mary describes the difference in perspectives as helpful and drew strength from the experience of her mentor who suggested “Who cares if you’re Hispanic?” referring to the need to work hard regardless of any labels. She attributes such guidance from mentors with helping her to get where she is today:

I specifically looked for mentors that were higher level, to “just tell me about yourself? How did you get to where you are? What was the adversity you’ve gone through?” And they are just doing it to share but it’s helped me understand it’s not easy for everybody and that’s really been my support...then now at my current company, I’m very lucky that my mentor is also my boss, which is very, very, very lucky. And she’s gone through a lot of adversity and, and, coming from a different country – actually she’s also from Colombia, but I think, that that’s what’s helped over the years to get me to where I am. (Mary, Interview, 4/3/17)

Here Mary draws strength from the understanding that “it’s not easy for everybody” and is grateful for a current mentor who has “gone through a lot of adversity” in addition to having come from another country. Considering Mary’s personal experience with adversity in relation to her feeling supported by encouragement from mentors who have

also experienced struggles – whether similar to or different than her own – may be useful for understanding how she translates her sense of struggle into inspiration for continue to work toward her career goals, getting her to where she is today. Mary’s understanding that *everyone* experiences adversity and that’s a normal part of growing in one’s career, while also having a sense of the variety of perspectives of the role one’s social identity plays in one’s experience of adversity – whether one’s social identity is experienced as a problem (i.e. as she experienced it – something to “deal with...and...work with”) or as something about which one can simply say “who cares?” illuminates the complex nature of translating struggle into success.

Another account that displays the Western/American cultural rootedness of women’s underrepresentation in STEM is Pilar’s account of her experience with a professor’s sexist attitude in an undergraduate engineering program in France, which she described in relation to growing up in Venezuela and then living in the U.S. after:

...so in Venezuela even though it was a very macho culture, there was a lot of really equality and respect especially for women, so I had been valedictorian and I had never heard anything about, you know, “you’re smart for a woman” or any comment, or such a comment. I mean I think they’re expectation in Venezuela was that, you know, being a woman you’re just as smart and, yeah...there were a lot more traditional roles as far as the home, who cooks and who is the homemaker and such but then when I got the scholarship in France, when I was able to get into pre-engineering, the pre-engineering program which is very challenging...I was surprised to find out that there was a lot more men than women. That was the first time that I really realized that outside of and in Europe, especially in Western countries in Europe and the U.S. when you look at STEM careers there is overwhelming disparity between women and men. So when I was at the first, at the end of the first semester of that program I remember the math professor who was a gentleman standing up in front of his class – we were a class of about 30 and there were, um, there were about 6 women in the class and the professor stood up in front of the class and told the guys – well he told the whole class because we were all in there but specifically addressing the men in the class, told them “5 of the women have – the women have 5 out of the 10 top spots, how are you letting this happen?” And to me that was very eye-opening because I

really didn't realize until then that there was a lot of cultural perception of differences of intelligence between men and women. And what was very, what was more, more surprising to me is that there's this, the females that were 1st, 2nd, and 3rd in the class, if you actually asked them because...I think I had the 6th or 7th spot out of the 10. If you asked them if they were going into engineering, even though they were top of the class, they would tell you like "oh no" they were going to be math professors because they didn't think they were capable of being engineers, which is very shocking to me. And they're outstanding math professors...but they could have outstanding scientists and engineers. And I think a lot of those comments really get to people. (Pilar, Interview, 4/6/17)

Pilar's insight into the cultural distinctions between Venezuelan and American/European contexts illuminates the gendered nature of engineering: in Venezuela, Pilar recalls that her gender was a non-issue whereas in her undergraduate studies in France she had an instructor explicitly question the male students' intelligence in relation to the women's demonstrated aptitude. If this overt sexist attitude weren't troubling enough, that the women themselves "didn't think they were capable of being engineers"—which shocked Pilar, coming from a different cultural context in which, in her experience, women's intelligence was apparently questioned less, if at all – is highly problematic and implies perhaps a form of internalized sexism or a reaction perhaps to the "chilly" climate that research has found typifies engineering culture (Camacho & Lord, 2013).

Regarding the more favorable social status of engineers outside the U.S., Pilar also talked about the use of "Engineer" as a title:

...because I grew up in Venezuela... I do think the community environment was very conducive of looking up to engineers. I remember when I was studying engineering, actually I did an internship in Mexico and we actually would be called "Engineer" and then your last name just because people are so proud of the title of engineer, which is not what is the case here in the U.S. So I do think that growing up in a Hispanic community abroad...and just the respect for engineers was a big player in the sense that's a really good career to pursue. (Pilar, Interview, 4/6/17)

In such a context, issues of outreach and lack of exposure to engineering are non-issues; to aspire to a career in engineering is within the cultural norms of countries such as Venezuela whereas engineering is “a really good career to pursue.” Engineering in Pilar’s understanding is associated with prestige and distinction, as the role of engineer in Latin societies can be likened to the role of doctors and lawyers in the U.S. (Camacho & Lord, 2013). While this may not be a universal norm, as reflected in the experience of participants whose parents don’t understand engineering as a legitimate career choice for women or don’t understand the career at all, the distinguished status it occupies in the experience of some participants is notable.

Thinking about the issue of underrepresentation of Latinas in engineering as uniquely “American” resonates with a sense of *la facultad* and key findings around forms of capital women apply as they strive for success in engineering. Cultural forces of sexism and ethnocentrism if not racism shape my participants’ experience as engineers in the U.S.; those coming from immigrant backgrounds had the perspective that the environment in engineering in the U.S. was particularly unwelcoming compared to the environments they recall or are aware of in Latin American countries. Awareness of the contextualized nature of their experience as Latina engineers acts as a *la facultad*-related capital that enables them to be “shocked” or at least dismissive of the norm of underrepresentation of Latinas in engineering *in the U.S.*

### *Persistence as Resistance: Giving Back and Being*

#### *“A Role Model for...The Next Generation”*

A final thematic strand that arose in participants’ accounts of their trajectories was the significance of giving back either as a manifestation of an altruistic desire to reduce

the struggle for others or as an outcome, a natural result, of having experienced the struggle oneself. Findings revealed that participants recall the wisdom that others have shared with them and attribute their success in part to others taking time to give back, or share, with them. That others took time to support them acts as a form of capital that propelled them to aspire to persist but as a form of capital that ignited in them the desire to inspire others to persist.

As far as a legacy of giving back and sharing one's experience as a source of motivation and inspiration, Mónica describes how a single experience of hearing a fellow Latina engineer share her experience continues to motivate her in her work:

...[Describing a conference session:] this particular session there was a group of Latinas...talking about careers. They were talking about their personal challenges working in a male-dominated field. And listening to this lady saying...“you need to be confident, you need to fight for what you want”...and I got so enthusiastic and so energetic after that session that I that I just became somebody else after that session to tell you the truth...I realized “no, this is it” I know I can, I know I’m better than this [referring to having been afraid to speak up in her workplace due to perceived limited English skills]. And when I came back to work...I was another person. I started being more confident...more assertive and that changed me forever...[Referring to attending this conference annually] the reason why I go is because I go there I see all these women that have gone through the same struggles that I have and that keeps just feeding myself the energy, the passion, the motivation. And that is what has helped me out, it helped me a lot [in her career]. (Mónica, Interview, 7/31/17)

Mónica describes how hearing a peer talking about her challenges and encouraging the audience to “be confident” and “fight for what you want” was enough to inspire her to become “another person,” to aspire to be more confident and assertive. Other participants attributed their persistence in overcoming challenges to altruistic desires to give back to their families who sacrificed greatly so they could succeed. Mary explains,

...it partly comes from your family and your community and where it comes from and I think seeing my mom...trying to come to this country to do a better life for herself and, for her kids...that’s been motivating to the point where if I can take

care of my mom, kind of like how (Rosa - referring to Rosa's account of taking care of her grandmother – an account she shared at the regional conference) was saying about taking care of her grandma, right? They all gave up so much, right? So that you want to give back to them, and I tie that in to going back to my college and I still go back to the [summer STEM prep.] program and I still give workshops and I started a [summer STEM prep. program] foundation, like scholarship.... (Mary, Interview, 3/3/17)

Because others have sacrificed for her, she wants to give back to them, both directly (taking care of her mom) and for the next generation of Latina engineers after her, as in the case of the scholarship she started.

The women I interviewed illuminated the importance of sharing one's struggle so that others can learn from it. They articulated the value of giving back to others and revealed their awareness of the role that others' sacrifices played in their trajectories. Mary describes the importance of others' sharing their wisdom, referencing wisdom Rosa had shared during a panel at the regional conference:

...everything I've learned is because I heard other people say it – other people said it, right? Other people have shared their struggle; we all go through that. But when you hear it from somebody who's done it and accomplished it, then you're taking away, you're learning from them, you know, 'make sure you do x,' like what [Rosa] was saying, "make sure you do this," "make sure you [do] that," but people still have to come back and say those things. And if you don't hear them, or if you don't give back, then it's never going to be a community to help each other out. 'I got to my point and I'm gonna be happy.' (Mary, Interview, 3/3/17)

Here, Mary highlights the role of agency in capital flow: choosing to take time to share one's wisdom. It is only in the sharing of one's struggle/hardship/sacrifice that one's struggle itself, as well as the associated mindsets that empowered one to work through said struggle, can become a source of capital. Explaining further, Mary notes the necessity of sharing one's struggle as one advances in one's career:

Everybody that continues to move up the ladder, that continues to be successful, they have to give back. Because if they don't – like for example, that lady, that

one student that was a senior, if she didn't share her story when I was a freshman, I wouldn't have had those nuggets to know "I need to be in her shoes and I need to start now." (Mary, Interview, 3/3/17)

Here, Mary recollects the significance of hearing others' struggles and advice in enabling her to "move up the ladder." If this struggle, as a form of capital, hadn't been made accessible to her she may not have reached her then-current point in her career. This sharing, in Mary's view, is an obligation for those who have been successful.

The importance of being a role model was another motivating factor for persistence. Alexandra also described how aspiring to persist is intertwined with wanting to inspire others, to be a role model – particularly valuable in Hispanic culture that places great value on relationships with others; she explains: "They want to be a role model for the kids, for the new generation – and that may be something especially when you're a first-generation college student. You went through the trouble – you do not want to quit and then your kids can see that you went through it but you're just home, not doing anything – you can do it" (Alexandra, Interview, 6/29/17). Related to altruistic tendencies observed in prior research (Ceglie & Settlage, 2015) and explored in Chapter 6—recall Isabel's call to action:

because those of us who have gone through it, who have had this experience, who have this additional knowledge also owe something back to make sure that it moves forward, to share that information with others, to mentor people, to take the time out because otherwise we're going – they're just going to repeat the same struggle. (Isabel, Interview, 4/5/17)

Here persistence is associated with an outward-looking orientation toward being a role model, whether for one's own children or "the new generation." Not only does one need to go through the trouble of trying, but one needs to stay the course, one cannot quit one's career. In giving hypothetical advice to Latinas considering pursuing a degree in STEM,



Camila discussed role modeling in terms of “break[ing] a vicious cycle” in which underrepresentation persists because individuals don’t see likenesses of themselves in their desired career and historically haven’t been allowed to belong, not only *feeling* like they don’t belong:

I feel like for us Hispanics...being able to develop a personal bond...with people is very, very important. So I would try to tell them to think of themselves as future role models and...I feel like that’s a very powerful argument among Hispanic populations, to be like, “we are not...represented accordingly in engineering” because historically, we haven’t been...allowed to belong. You know (laughs). Same with African Americans, you know, like, they had their own schools, you know? Like they had HBCU’s [Historically Black Colleges and Universities] that were created for the purpose of keeping people apart...So, you feel like you don’t belong because historically you haven’t...And women as well...Haden’t been allowed to go to school, and then you were...So, if you feel like that it’s because we haven’t! So I would be like, you can change that by staying – by pulling through...and getting role models and mentors for yourself as well as being a role model and a mentor for somebody else. And then we can break that vicious cycle. (Camila, Interview, 3/3/17)

“...[Y]ou can change that by staying” presents persistence as resistance to social forces that would otherwise deter Latinas from pursuing and persisting in engineering-related careers. The persistence that participants described relates to *la facultad* yet also illuminates another distinct, vital, aspect of choosing to work through a struggle that one either enjoys or understands as the norm of a career: if they don’t choose to stay in engineering, who will? If not them, who will fight to change the culture, the climate?

Rosa and Mónica used language around the legacy before them and their role in “paying it forward.” Rosa describes her need to be a mentor:

And I mentor a lot of people here as TAs or just people who are interning here with us...so I also mentor young girls as well. And sometimes boys, but mostly its girl interns because there’s not enough women in IT, especially in the finance field. So I end up mentoring a lot of people...which...fulfills me as a person...I know that we stand on the shoulders of those that came before us and...there are still people coming after us and if you can’t make the way for someone else then I

don't know what you're doing because it's not fair for the generation after. We're in this world for such a short time and you don't know how short you've got sometimes [A particularly meaningful statement in the context of her mother having passed away when Rosa was a young adult] And when I turn around...I don't want anyone struggling the way I did. (Rosa, Interview, 6/19/17)

Mónica discusses how the fact that she struggled inspires her to be a role model through mentoring others: "I know how some of these kids...don't have a role model in their family, in most cases. So I somehow I feel like it is my duty, this is my way of paying it forward, you know" (Mónica, Interview, 7/31/17)? Reflecting on the past and hoping for the future, both Rosa and Mónica describe how their desire to give back is vital to changing the field for the next generation of Latina engineers. Ana summed up her motivation to encourage others by putting it in relation to the support she received: "I'm a big fan of encouraging and supporting people because I think I always had that, you know...my parents never said 'oh no, you know, you cannot be engineer, that's not for girls'" (Ana, Interview, 4/5/17). Her mentorship is thus a direct result of support she felt she received.

### Summary

Looking at the dynamic between the struggle—or process—that participants faced, the role of specific obstacles therein and their awareness of the multi-faceted nature of the struggle (cultural context, the value and even benefit of a challenge) and the role of giving back in the success of generations of Latina engineers reveals an interconnected web in which challenges and related mindsets become capital that participants can draw upon as they strive for success. Each of the themes discussed in this chapter are in some ways extensions of forms of capital discussed in Chapter 6; for example, awareness of the contextualized nature of the struggle they face—and the role

of culture, history, and social identity in that struggle—in some ways constitutes a form of *la facultad* (Carlone & Johnson, 2007). Also, the value of giving back constitutes a form of cultural capital as relationships and highly valuing one's community relate to altruistic motivations found to be common among Latino students and students of color broadly speaking (Ceglie & Settlage, 2016). The wisdom participants gleaned from the sharing of struggles on the part of Latinas who tread the path of engineering or other fields before them could be viewed as a form of social capital in that connections with these women inspired them along their career paths. Highlighting the emic understanding that the women I interviewed developed regarding their experience in engineering and how they navigated their trajectories elucidates forms of capital particularly valuable to Latinas in engineering. Facing obstacles not only with the awareness that obstacles are part of any journey but with the ability to transform obstacles into inspiration for working harder and the understanding that overcoming them is crucial both to repaying the debt of sacrifice of those who came before and paving the way for those who will come after is a phenomenon that women in my study experienced and is worthy of exploration as a distinct theoretical framework for persistence.

## CHAPTER 8

### HISPANIC ENGINEERS' SOCIETY (HES) CAPITAL

In designing and carrying out this study, I hoped that the organizational context of HES could act as an indicator of participants' science identity – their membership a sign that they identified as engineers and actively engaged in professional development that increase their confidence and contributed toward their recognition by others (Carlone & Johnson, 2007). From a logistical standpoint, HES provided a network of research participants including the women I hoped would be the central focus of my study as well as their peers who could share their perspectives on the issue of underrepresentation. Thus, in studying the various forms of capital Latinas employ as they strive for success in science, technology, engineering, and mathematics (STEM), it is critical to also ask about the role that HES plays in their access to that capital. My first research question examines the ways in which the Latina engineers I interviewed used forms of capital along their career trajectories and in relation to the unique circumstances of their lives. Generalized findings arose based on themes, common strands, that emerged through reviewing and categorizing their experiences. HES in some ways provides another common strand, a point of comparison. While each participant walks along a unique path through engineering and STEM, her HES membership is a personal attribute that all participants share. While participants all identify as engineers, their HES membership is a narrower identification that marks their identity as engineers, as Hispanics/Latinas and as Hispanic/Latina engineers.

To understand how HES and membership therein may influence Latinas' access to capital thus involves learning about how HES seeks to foster the professional development and success of its members, including Latinas, and how Latinas engage with HES in its role as an organization that aims to support them. While some attention to the former question was given in Chapters 4 and 5, there is further exploration here of how HES supports women in its organization, as observed in programming initiated or co-sponsored by the HES-NYC chapter and how women in HES perceive the organization, with a particular focus on the experience of women I interviewed. As seen in Chapter 7, research participants' experiences are context-specific; thus, I am employing a situated analysis here as well: to better understand how HES mediates its female members' capital use requires an awareness of where HES is situated in the broader context of engineering culture in the U.S. My original research question was:

What role does the organization play in women's access to various forms of capital and how they use capital?

a) What other forces play a role?

To better understand the role that HES plays in women's access to various forms of capital and how they use capital, it will be helpful to give an overview of research participants' perceptions of "other forces" that shape their context as well as the context of HES. As Chapters 6 and 7 have shown, participants' capital use was largely shaped by their gender and cultural identity as well as their awareness of the male-dominated, U.S. context-specific nature of engineering and the drive they had to persist, in part, to make engineering more welcome for the next generation of Latina – and other female and minority - engineers. It will be useful then, here, to understand participants' perceptions of what it means to be an engineer and the sources of those perceptions. Examining the

picture that emerges as a result of the various voices that contribute to women's understanding of who an engineer is enables the reader to see the constructed nature of engineering identity and thus better understand the role that HES, as an organization designed to foster the engineering identity development of Hispanic engineers specifically, plays in Latina members' trajectories through engineering.

### Forces That Shape HESTinas' Capital Use

The women I spoke with noted the persistent dominant male image in the field, whether citing simply the demographic reality of engineers and engineering students being mostly men or the culture being masculine and not welcoming to women or the feminine. A sense of engineering culture emerges from many levels according to participants: At the level of U.S. society dominant norms prevail regarding gender and intelligence as they relate to STEM, at the level of STEM discourse and careers the image of an engineer as a male, abounds, and among peers and family, engineering is often viewed as "a man's world." Latinas in pursuit of careers in engineering, as seen in Chapters 6 and 7, thus have myriad discursive obstacles to overcome as they create space for themselves in a world many others perceive not to be theirs. How HES mediates these obstacles either directly or through giving Latinas the tools to do so is thus critical to explore.

### *Demographic Reality: "I Guess It Makes Me One of the Few"*

Mary talked about the numbers that reveal the reality of the gender disparity at the college level through to the workplace. She explains that she kept track of the numbers first because "it was interesting" but also as a reminder to herself if she was speaking "I need to know what I'm talking about."

So it was 6 to 1 men to women in my university which was only 2000 students, right? Then I started in [name of company] in a department that was 20 men and 2 women, all engineers... The department got downsized. A lot them retired early but the 2 women stayed, and she is from Nigeria and I'm from Colombia. And then I switched departments to a manufacturing site in Kentucky where (laughing) I became the 0.6% of the plant Latina – I looked it up...two of the Spanish people in the entire plant. Everybody else was white and then you had 10% African Americans. Then I came back to NY and NY was more diverse...and I kept track of those numbers but only because...I just knew that...if I'm speaking, speaking up then I need to know what I'm talking about. That's the first part and then they need to understand and get me and I need to keep being vocal. Switching...companies, I went to a department of 60 and there was 2 African American and 3 Hispanic.... (Mary, Interview, 3/3/17)

Given the fewness of women and people of color, the need for managing perceptions may become greater: “they need to understand and get me” even as the need to speak up persists: “I need to keep being vocal.” As explored to a greater extent later in the chapter, the numbers create a cultural reality that, in turn, to some extent dictates how women need to be. Nicolyn talked about a demographic reality similar to Mary's overview, referring specifically to the workplace: “You look around the room and...most meetings if there's 20 people in the room it is 18 Caucasian men that are over 50 and 2 others (laughs). So, the numbers are getting better but especially if you're talking about a leadership meeting, right? Then it's worse at that level” (Nicolyn, Interview, 8/2/17). Rosa also recalled being one of two in college: “one of two girls in the class, you know, the usual” she said when she described her college experience (Rosa, Interview, 6/19/17). Pilar used the term “disparity” to describe the discrepancy between men and women in the field:

...when I came to the U.S...also in grad school, there were 2 females and 15 males and this was chemical engineering, which...in general has a lot more balance at the undergraduate level but when you go to the grad level, again a huge disparity between males and females... then when I started working again, there became a disparity between women and men. (Pilar, Interview, 4/5/17)

Alexandra mentioned that there were “barely any” in IT, though there are others in her particular group (not common among most of the women I interviewed): “In my group, there are Hispanic, Hispanic women, I have encountered a few of them. I do actually have barely any in any of the IT fields which I guess it makes me one of the few” (Alexandra, Interview, 6/29/17). Looking at stereotypes regarding engineers and dominant norms around engineering and gender at the macro level of society as well as the micro level of peers and family may shed light on why Latinas may, generally, be “one of the few.”

*In the Field: “It’s a [White] Man’s World”*

Victoria referred to hearing people say, in reference to engineering, “it’s a man’s world” and her reaction was: “so what? [That’s] Better...” – being one of few was a desirable feeling for her, though this was not the case with all of the women I interviewed. The perception that engineering, and therefore engineers, are predominantly male was common among participants as well as my key informants. Marielena, in her fourth year of work as an industrial engineer following college, explained: “I just feel like when people think of engineers, they think of men and males. I think it’s a mostly male-dominat[ed] major...” yet she pointed out that a sense of judgment related to gender didn’t seem to arise until she entered the workplace:

...but, I mean, I think at the class level, like my teachers never really...judged me on the fact that I was a female...But I feel like...where there’s really a judgment, it really is when you’re looking for a job and in the workplace, I feel like there’s a difference when it comes to male engineers and female engineers. In civil engineering, mechanical engineering, chemical engineering like wherever you go, like whatever company is hiring engineers, they mostly look for, I feel like at least, they look for men. Like because if I were to go into the oil industry with a chemical engineering degree of course there are opportunities for females because the company wants to hire women engineers because they can’t report that they



have none but I feel like even, like once you do get the job, like if you get the job, it's as if you're probably not seen as good enough as a male engineer only because of the fact that you're female. Even though you have the job it's as if – “okay, but you're a female, and there's like 10 guys here, I'll ask a guy to do it as opposed to a female because, like, the guy is a guy” (laughs). At least that's...kind of how I feel it is in the workplace, I could be wrong but that's how I see it. (Marielena, Interview, 3/5/17)

The feeling that Marielena articulates here indicates the “chilly” climate identified in prior research on Latinas’ experience in engineering at the undergraduate level (Camacho & Lord, 2013) and in the workplace (Williams, Li, Rincon & Finn, 2016). An awareness of being hired “because [the company] can’t report that they have [no women]” adds to the sense that engineering is generally a male space in which men are the optimal choice for a given job and women are viewed as inferior: “I’ll ask a guy to do it as opposed to a female because...the guy is a guy” and, as a woman, you may not be “seen as good enough as a male engineer only because of the fact that you’re female.” While neither Marielena, nor other participants, went into details regarding a sense of inferiority among women in engineering, this sense of engineering being a “man’s world” (Victoria’s words) connects with the sense of having to prove oneself, as seen in Chapter 7, and begs a need for a space in which Latinas may feel validated in their identities as engineers. In the sense of not being represented either culturally—feminine attributes are foreign at best, looked down upon at worst—and demographically—other women or Hispanics simply aren’t there—Latinas lack a space in which they can be *Latina* engineers; HES thus may fill a potential void in that it provides a space where a critical mass of Latinas can gather and share their experience.

Other participants referred to the dominant male culture in terms of the presence of a “bro” thing or a “bro” culture that excludes women. Rosa, a core participant, and

Esther, a secondary participant, both used the term “bro” to highlight aspects of their work experience in which they felt that their presence as women was not welcome. In describing her experience at work compared to her male peers, Rosa highlights the simultaneous social exclusion and engineering skill acknowledgement that occurs on account of – or in spite of – her being female:

...A lot of people just have like had it easier because most of my peers are males. And, you know, that whole **bro connection**. Sometimes like—and even at this job, like I’ll come in and the guys will have drinks that night or the night before and I only find out after the fact or literally right when they’re leaving. So I don’t get an extended invitation because I’m not “one of the guys” which to me is fine. I don’t really care because I’m not a drinker but just the fact that...it’s just made evident that I’m not “one of the guys”? So that kind of puts a, like a dent in the - “oh, things are not really changed”, I’m not really considered part of the team but at least intellectually they have grown to respect my knowledge and what I know and what I bring to the table...But at least that way, when there is a problem or an issue, I do get brought in on those things so...the social aspect I don’t care about because you’re not doing anything for me there, right? Because you’re just hanging out. But it does foster their relationships, it makes them stronger, their relationships. So that part, you know, you think about it, once you know somebody you’re able to get along with them better. That also helps in the job, where other aspects it wouldn’t help you, but for me, at least intellectually and when it comes to the work I’m still consulted, I’m still brought in on things so I’m like “okay, at least, you know,...where it counts, I’m being consulted and I’m respected in my work” which to me is also a big thing. (Rosa, Interview, 6/19/17)

Here one can see that Rosa holds social exclusion and professional recognition in tension with one another, the latter almost mitigating the likely impact of the former: “But at least...” Esther used the term “traditional” to describe gendered norms that persist in engineering: “...there’s a very traditional point of view on how women behave in society and the roles in the family so I think in traditional engineering that’s the group that women have to...figure out how to engage to move up in the different management levels and up to the executive office because again a very traditional older generation” and compared this to an more modern breed of gendered culture:

...whereas in tech I think that you have a lot of younger CEOs [Chief Executive Officers], a lot of – the people that are in charge are much younger and, although they may not hold that culture of like “woman belongs in the house and the man belongs working” they still have a very, almost like fraternity type mentality about how you network and build teams in the tech space. So you’re still up against those thoughts...they don’t know how to interact with women, they don’t know how to like engage with them but just the generational gap I think between traditional engineering and tech is very different. Think of Mark Zuckerberg, he’s the leader of this giant company and he’s very young, he definitely doesn’t hold those traditional views but I think at the end of the day the people around him are very much like him and so there’s this like, what they call this “bro” culture that they feel comfortable in that makes it hard for women to break into and to show what they, the skills that they have in order to push forward. (Esther, Interview, 4/9/17)

Both Rosa and Esther describe a “bro” culture – whether the older, “traditional” culture of engineering in which women are not “one of the guys” or even the “woman belongs in the house” or the newer culture that Esther noted in particular where similarities between successful tech professions (e.g. Mark Zuckerberg) create a culture “hard for women to break into” and succeed.

One of the implications of such a “bro” culture or the perception that engineering is a “man’s world” is that women, and related feminine attributes, need to change or are unwelcome. Marielena, speaking from the point of view as a Latina engineer, if several years younger than the core group of participants in the study, explains that “you...need to act really manly or change” to succeed at work:

I feel like as a female working in those type of environments, you really need to act really manly or change, like you can’t be a very girly girl at work...you have to have tough skin, like the way you talk to people, like the way you come across...the way a personality is, like it has to be very different at work than how it would be in your personal life because you want to be respected. And I feel like getting respect as a female is very different than getting respect as a male. Especially in a male dominating workplace. So that to me is something that I see is a struggle. (Marielena, Interview, 3/5/17)

In Marielena's view, femininity stands in contrast to masculinity of the profession.

Masculine norms of behavior – tough skin for example – dominate so, as a woman, you have to change your presentation of self, “you can't be very girly girl.” The “bro” culture these women refer to is consistent with the underrepresentation of women in engineering and technology (as described by Esther as well) and the perception that the culture itself is a barrier for women to navigate (Corbett & Hill, 2017; Williams et al., 2016). Different in nature from the struggle that drew many participants to engineering itself and perhaps even the allure of being one of a few women or racial/ethnic minorities and therefore breaking ground, this struggle appears to require women to change who they are, to not be themselves.

Camila, the engineering education graduate student, explains how she encounters a similar view among her peers in industry when trying to have conversations with them about the need for expanding notions of who can be an engineer:

...[W]ith my engineering friends that are still practicing in industry, it's been...hard. Because I don't think we see eye to eye anymore in terms of...everything that I've learned now [referring to her graduate studies]. A lot of the times, I try to engage these kinds of conversations and...I mean, not that they have to be interested in everything I say (laughs) but at least...I'm trying...to help them change their mindsets as well. Because a lot of them do still think, “Oh, women, so emotional, they should not be in the workplace.” (Camila, Interview, 3/4/17)

The perception that emotions shouldn't be in the workplace was echoed by Mary who referenced how she too navigated this sense that women are emotional and learned with the help of others to be less emotional in the interest of just getting the job done. Mary describes how her husband, also an engineer, helped her “let it go” in an effort to “concentrate on what needed to get done.”

...when we were both at the same company he knew the same people that I was working with and I would get very emotional as a woman, and he's not...men are not emotional when it comes to work, we're very passionate about "Well, they said this, and they took away that" (in distressed tone) and he's like "Let it go" I'm like "But I can't let it go!" so with him I learned to like, let it go, and just concentrate on what needed to get done. (Mary, Interview, 3/3/17)

Even on a micro level, reducing or eliminating the perceived feminine attribute of being emotional is viewed as part of getting the job done. Emotions are not viewed as a legitimate aspect of one's work. In the context of Marielena's and Mary's experience, such reduction is necessary to career success.

### *Being a Woman: Not Getting "Asked to Lunch"*

Esther also described the preferential treatment that aids in professional advancement among male engineers/tech professionals and perhaps slows the advancement of women. The quandary she presents is multi-faceted:

I mean the men in general I think it's just, they definitely have, because the majority of people that are in management or higher are men, they have a much easier time getting access to people in the higher positions as their mentors without asking for it, and not feeling uncomfortable. I think it just naturally happened. You know one of the things that I've noticed in my last, which was my first corporate job, there were a lot of people that joined at the time that I did but out of all of us that joined, it was very clear that like only the men were asked to lunch by the vice president. He would take them out to chat but the vice president wouldn't do that with any of the women new hires and...I'm sure it's for different reasons, right? Like one he's probably uncomfortable, two he's scared of how that looks that he's like a man taking a woman out to lunch, that he might build a bad reputation like there's all these, there's definitely this awkwardness with how men and women interact in office space, in a career space in a professional world. And so I think that that's a limiting factor in how quickly we get access to people that they validate our skills and also guide us into improving in areas that we need to improve on in order to do a good job at work. So I think that definitely slows our progress (laughs a bit) in the career world regardless of what major, of what field you're in, what industry you're in. And...so men have an easier time coming into that fold and getting those, developing the resources to be able to advance. (Esther, Interview, 4/9/17)

Succeeding as a woman in engineering – or any field according to Esther – is thus a matter of not being “asked to lunch” whether it’s because a given male supervisor feels “uncomfortable” or “awkward” interacting with you in the first place or fears the perceptions that may arise as a result of a man taking a woman out to lunch.

*Being of Color: “You Have to Fight Harder, You Have to Speak Louder”*

In addition to the gendered norms in engineering, race/ethnicity is also perceived to play a role in one’s success as a Latina. In fact, Pilar even brought up the term “double whammy” in relation to the challenges minority women experience:

As far as being a minority...I do feel that...they have basically a double whammy so they have all the stereotypes as far as being a woman in the U.S. and then they have other stereotypes of Hispanics: day-laborers and not educated people in the U.S. So when you combine those two I really think that that’s a reason why you have very few women of color that pursue a STEM careers in engineering. (Pilar, Interview, 4/6/17)

The “double whammy” calls to mind Malcom’s “Double Bind” here (Malcom et al., 1976). According to a seasoned female professional in STEM, women of color in STEM in the U.S. *still* experience challenges (e.g. in this case, stereotypes) on account of their identities. Speaking regarding professional advancement yet highlighting the role of race/ethnicity in particular, Nicolyn recalls an instance where a white female counterpart appeared to receive preferential treatment in her interview process due to cultural norms she shared with the interviewer (in this case, wine):

...even in my current job, I heard stories of my counterparts who are not of color, who talked about their interview process and how they just literally talked about wine in their interviews (laughs) where I had a whole panel interview of getting...drilled. And I was an internal candidate in my current role whereas this person I’m talking about was an external candidate...It’s just crazy, you know? Just getting into [name of company] was 6 panel interviews, you know? And maybe that’s just [name of company], I don’t know, but in this other case that’s, because she told me...how she got in. It’s just...you have to fight harder, you

have to speak louder... You have to prove yourself more. (Nicolyn, Interview, 8/2/17)

While the experience of having to prove oneself more has already been explored in the context of *la facultad* and related forms of capital, it is important to note here the structural circumstances surrounding the feeling of needing “to fight harder, to speak louder” than one’s white peers.

*“In The U.S...”*

Before delving into the role that HES plays in the “man’s world” in which women may not be “asked to lunch” and in which women of color specifically may need to “fight harder [and]...speak louder,” it is key to highlight again the perception among some participants (Pilar, Victoria, and Ana specifically) that the negation or subordination of women’s intelligence is a primarily American phenomenon. As explored in Chapter 7, the problem of underrepresentation is in some ways a uniquely American trend both because “Latinx” is an American construct and because being a female in STEM appears to be stigmatized to a greater extent in the U.S. compared to other countries. In relation to the dominant, gendered norms in engineering as study participants experienced, the significance of the U.S. context lies in how women’s intelligence is framed in society broadly speaking. Pilar juxtaposes, once again, growing up among female role models in STEM and then witnessing here in the U.S. the absence of those role models and explains that “there’s a lot of cultural things going on.”

...I think here in the U.S., when I volunteer, a lot of the schools they often, you see a lot of the STEM teachers are males. And you see some of the females early in elementary very often making statements that they don’t really like math which is mind-boggling of course to me. So, so I mean I do feel like we’re going to have to make some changes and make sure that women are more targeted when they are child, for, as smart people and people capable of doing science...I think there’s a lot of cultural things going on. (Pilar, Interview, 4/6/17)

She describes underrepresentation a multifaceted phenomenon that starts in childhood and highlights the need to make sure that girls are targeted “as smart people...capable of doing science” as opposed to people from whom the comment “[I] don’t really like math” is commonly heard. Pilar describes further that change will have to happen at the level of U.S. society:

...but I do think the U.S. as a society we’re going to have to make some changes and I do think that...we need to fight stereotypes...there is a lot of work to be [done]...so that men respect women intellectually. So...all these jokes about women being dumb should become completely unacceptable. I mean...I never heard about blonde jokes until I got to the U.S....so all of that just needs to become unacceptable...but I do think it’s women and men – I remember women telling me “I would never want to work for a woman” and I was like “What?!” (Pilar, Interview, 4/5/17)

Pilar’s surprise, coming from Venezuela, at jokes regarding women’s intelligence is telling: the notion of a “blonde joke” is foreign to her because she doesn’t recall growing up in a setting where her intelligence was questioned in relation to her gender identity. Observations such as this are useful in framing the broader social context surrounding HES and the potential role it may play in mediating Latinas’ capital use as they navigate gendered norms within not only their field but society at large.

## HES Capital

### *The HEStina Movement*



Figure 2: HEStina Media on Twitter. Retrieved from HES National Twitter feed 3/18/18.



Revisiting the “HEStina” movement provides a useful starting point for framing the role that HES plays in shaping Latinas’ capital use as they pursue engineering careers. The “#Ilooklikeanengineer” Twitter campaign reflects a connection between Latinas in HES and engineering culture more broadly. HES’s campaign draws from the “I look like an engineer” campaign (started in 2015 by Isis Anchalee at OneLogin – unrelated to HES (Kircher, 2015)) and was started by a group of Latinas in HES who initiated several workshops at the 2015 HES national conference on the theme of Latinas in engineering and sources of support for their academic and career success. The movement continued with social media features of various Latinas in HES that included photographs and hashtags including “#I look like an engineer” and/or “#HEStinas” (see *Figure 2: HEStina Media on Twitter*) as well as brief summaries of their professional backgrounds and achievements. Youtube videos and Tweets continued the movement through the annual conferences in 2016 and 2017. The features showcased the achievements of a variety of women in HES. The media campaign gave the message that women in HES are expanding notions of who an engineer is and *can be* simply by *showing* the faces of Latina engineers and describing something about them. While I will refrain from sharing a specific example here to preserve the anonymity of the organization and its members, the image above conveys some of the spirit of the movement: “HEStinas are Superheroes!” suggests an image of strong, powerful—not peripheral or silenced—women in engineering. An additional call to “Be bold and strong!” (also on HES’s Twitter feed, #HEStina) acts as necessary encouragement in the face of the challenges Latina engineers will likely face as they strive for success. Starting with the media image alone, HES provides an empowering alternative space for Latinas to access and use

various forms of capital that may facilitate their efforts along their career trajectories. Even the detail of the heels in the above picture conveys a possibility for the feminine (see the heels?) to be equated with strength.

Interestingly, none of my core participants mentioned the HES<sup>tina</sup> movement – it was only Marielena, a slightly younger (i.e. mid-twenties) HES member who recalled that it had started recently and featured highlights of some women in HES. This was perhaps because while it was a movement with a presence at the national conference, it was quieter at the regional/local level. As a younger member, Marielena was perhaps more aware of recent movements within HES compared to the participants who had been HES members for a decade or more. That being said, as an indicator of HES's discourse on Latinas in engineering, the HES<sup>tina</sup> movement shows that, at least in word, it strove to be an organization that supports its female members.

Insights from HES's leadership project a similar image. Pilar, who had served as Chair of HES's national board of directors, shared her thoughts regarding HES's (potential) role in the lives of its members: "I do think that HES, and of course, I've been involved with HES so I see a lot of the things that HES brings to the women and men who are Hispanic. And as it strengthens, our program continues to grow our professional membership, we can be a key player behind more Hispanics, including Hispanic women succeeding in STEM" (Pilar, Interview, 4/5/17). She explains also how HES's programming for women has strengthened over time and connects to both their gender and cultural identity: "what I have seen HES over the years they have really strengthened their women's programs so we have a Latina track at all the conferences...and...I think

that for me as a Hispanic woman, HES just connects to both because they have forums that will hit both” (Pilar, Interview, 4/5/17).

John, HES-NYC’s president (at the time of the study), shared his thoughts regarding the organization’s role in relation to Latino culture as well as “mainstream culture” and engineering school:

...the organization, as much as I guess historically...the Latino culture has been a machismo type of culture...what’s interesting is that within the organization...we’re pretty welcoming to women, to women leaders and for us there isn’t that disparity or ...there isn’t as many roadblocks, again from an organizational perspective...[W]e spend a lot of time uplifting our female members and ensuring that we treat them as equals and ensuring that they’re engaged at all levels. So just culturally within the organization specifically, I’ve never seen that barrier. Which is interesting, right? Because in engineering school it’s almost as if there are two cultures, right? There’s the mainstream culture which absolutely there’s a disparity but within the organization not so much. (John, 7/21/17)

Here, John highlights HES’s role as an organization that is “pretty welcoming to women, to women leaders,” one in which “there isn’t that disparity or...there isn’t as many roadblocks.” He also highlights influential cultural forces outside of HES: the “machismo type of culture” that typifies Latino culture and engineering school that has, as implied for HES members, “two cultures...the mainstream culture [with]...a disparity” as well as what one could call HES culture (e.g. HES *familia*, as discussed in Chapter 4). What follows then is a general overview of participants’ experience in HES as it pertains to their trajectories through engineering. Earliest accounts include participants’ experiences with HES in college while most recent accounts include volunteering and professional development experiences. Generally, HES stood out as both a source of capital for those who participated in/attended its events and as a network within which Latinas I spoke

with developed their own soft skills (i.e. networking, recruiting, interviewing etc.) and so became sources of capital themselves.

### *Interviewees in HES*

The language participants use regarding HES itself creates an image of an organization that actively provides capital – science (professional development, primarily in the form of “soft skills”), social (i.e. a network of potential employment contacts), and cultural (i.e. a network of individuals who identify with and support your cultural identity as an engineer, Hispanic/Latinx). As a culturally-rooted professional organization, HES is also poised to interact with other social structures that Latina members occupy and thus mediate the capital, and the impact thereof, that they may employ along their career trajectories. Each of the participants – both primary and secondary groups – were involved in HES on a regular basis starting in college (see Table 10: *Participants’ Roles in HES*) and so could speak about HES based on at least five years of experience with the organization. The key points in participants’ trajectories that HES appeared to have an impact were thus during college and during the early stages of participants’ careers.

### *HES in College: “If They’re Not Giving Up Then I Don’t Have A Reason To Give Up”*

Nearly every HESstina I interviewed recalled joining HES in college. Involvement consistently provided support that interviewees identified as meaningful, if not vital, to

Table 10

*Participants' Roles in HES*

<b>Name</b>	<b>Role in HES</b>
Mary	Current member; volunteer at conference (panelist)
Camila	Current member; former “Northeast Region” Graduate Student Representative; volunteer at conference (organized graduate student programming)
Victoria	Current member; VP HES Boston professional chapter; volunteer (mentor)
Ana	Current member; volunteer (mentor)
Isabel	Current member; volunteer (high school-oriented STEM events)
Pilar	Current member; former HES Board Chair, Treasurer, Regional VP; volunteer (mentor)
Rosa	Current member; former Regional VP; volunteer (conference workshop facilitator, speaker)
Alexandra	Current member; volunteer
Mónica	Current member; volunteer (mentor, conference workshop facilitator, speaker)
Nicolyn	Current member; Regional VP; volunteer (mentor)
Marielena	Current member; volunteer (high school- and middle school-oriented STEM events)
Esther	Current member; former chair of marketing (2008); volunteer (professional events)
John	Current member; President, HES-NYC

their successful completion of their studies. HES offered a network of culturally similar peers—those with a common language, social class, and/or familial background—who participants said helped them to push through challenges and persist toward attaining their degree. Additionally, HES membership provided access to a network and

professional development opportunities that poised Latinas I interviewed for future success. These general findings resonate with prior research on the role that peers play in fostering persistence (e.g. Solorzano et al., 2005) and illuminate specific ways in which HES provides capital to its members, including Latinas.

Nicolyn explains how HES was critical to her graduating from her Bachelor's program despite significant delays (due to financial constraints and family emergencies) because it provided her with a network of peers from similar backgrounds and with shared aspirations:

I started in '99 and I didn't finish until 2006 and during that time, most of my friends graduated in 2003, so that was a really hard time for me, the fact that all my peers graduated and I didn't...so, 2004 we founded a HES chapter at my school and that was the first time when I actually had friends that...were like me, that grew up, humble beginnings, grew up without cable...were struggling, were working multiple jobs to make ends meet. But had a goal, had a vision and were really...focusing on the engineering whereas before in my classes I really couldn't connect with anyone because it was a very affluent school and that was something, you know, I wasn't used to. So...that definitely, having that support system, people that understand social class issues, understand exactly what you're going through. Plus your personal life background, having that, made a world of difference. (Nicolyn, Interview, 8/2/17)

For Nicolyn, HES provided a network of "friends that...were like [her]" both in the sense of similar "humble beginnings" and as individuals who had "a goal...a vision and were...focusing on the engineering" in contrast to the dominant affluent culture of her school, including other engineering students. The combination of shared socioeconomic status (linked in the case of HES with culture) and shared aspirations that Nicolyn found in HES acted as a family that helped her achieve her goal: "So I was able to finish undergrad and would have never considered going to grad school if it wasn't for my HES family. There, just hearing stories, their encouragement really motivated me to go back to school and finish strong" (Nicolyn, Interview, 8/2/17). Alexandra described a similar

experience and noted how the friendship she found in her college's HES chapter overcame gender differences:

So I think what motivated me [to pursue and complete an engineering degree] was that I was part of the organization in HES. There I had met other Latinos who had the same thing, the same goals that I did. There were not really that many computer science females, they were mostly electrical engineers and civil engineers in [HES college chapter]. To me the fact that there were older students that wanted me to succeed...most of my friends were male in the computer science department too and taking classes and just we encouraged each other. And to me I never saw that difference between a woman and a man, so to me that didn't exist. To me it was just the same, we were dealing with the same issues, the same challenges and as a team we were going to succeed and make it happen. (Alexandra, Interview, 6/29/17)

Like Nicolyn, Alexandra highlights the "same goals" and the encouragement she received ("older students that wanted me to succeed") as key attributes of her HES involvement. Also, the point that, overcoming any potential gendered differences, "we were dealing with the same issues, the same challenges and as a team we were going to succeed and make it happen," demonstrates the significance of working as a team with a common goal of success. She explains this significance further:

...it was a very important time in my life, especially it was the help and the community that I needed when I continued college and throughout my years. They are very helpful in developing – in helping you develop your leadership skills...it's a family. And to me family is very important. We help each other, we're always striving to succeed, teamwork...they're always going to be there in the good and in the bad. So having a support line when you don't know what you're doing, when you don't know where you're going, when you don't know what's happening and you...you feel like "oh my god, what am I doing here?" And then you see all the people that have the same questions that you have, they have the same goals that you have and they are dealing with the same struggles. You're like, "you know what? I'm not alone. So, I need to continue. I cannot – if they're not giving up then I don't have a reason to give up." (Alexandra, Interview, 6/29/17)

Alexandra articulates in detail the capital HES offers: helping you develop your leadership skills (science capital), "it's a family" (social/cultural capital), "a support line"

(social capital), and “you see all the people that have the same questions...the same goals...the same struggles” (social) that all combine to remind an engineering student: “I’m not alone...I need to continue...if they’re not giving up then I don’t have a reason to give up” – contagious persistence. Alexandra recollects the long nights she and her HES mates would spend studying (also referenced in Chapter 7):

When I was in school I always remembered the nights that I spent programming (laughs) with my friends. Yeah, we were just like, we knew that once we had a project...or exam it was going to be an all-nighter so we just, we would go buy food and go to either [HES college chapter] and just study all night or go to my friends’ house and just make fun, we’d just cook and eat and have coffee, we’d talk. And we would know that at the end of the day we were going to make it. (Alexandra, Interview, 6/29/17)

It sounds almost festive, yes? While the details of “all-nighter” and “study all night” implies hard work that likely felt challenging at times, that they could “just make fun” and work with the knowledge that “at the end of the day we were going to make it” reveals the strength Alexandra and her peers drew from their HES network.

Esther, as a slightly younger HES member, also talks about having peers that could relate to her professional aspirations and cultural background—including parents that “just didn’t understand”:

So for me HES...they were very helpful in just making me feel that there were other people that looked like me that were studying the same thing that I was studying, that were facing the battles at home where like parents didn’t understand or, not that they weren’t supportive but they just didn’t understand what it was that you were studying, didn’t understand the value, didn’t understand any of that. (Esther, Interview, 4/9/17)

Here, HES peers were helpful as they too were navigating obstacles such as parents who “didn’t understand the value” of an engineering degree. She explains further that this peer support was valuable when her studies became challenging:



So when it became tough to continue to pursue the major, when you're hitting...the very tough classes like physics and calculus and linear algebra and all these other – and chemistry, organic chemistry, whatever it is – you were able to find somebody that you could relate to that would help you push through the tough parts of the curriculum. (Esther, Interview, 4/9/17)

The shared cultural background combined with support here acted as a boost to “push through” the challenging coursework.

### *HES in College and Beyond: Developing “Soft Skills”*

Esther's sense of having “somebody that you could relate to that would help you push through the tough parts...” highlights a hybrid form of socio-cultural capital that HES provides: culturally similar peers who motivate you to achieve academic success.

Esther explains that not only did HES help her get through classes but they also provided opportunities to develop her leadership skills, her soft skills:

...in addition to really providing that support to get through the classes, they also allowed me to become a leader...on campus. To really take on some of those projects and say “I want to lead this,” “I want to build a team,” “this is a new project I want to bring into the organization, this is how I'm going to do it” and really just, they allowed me to create sort of a reputation of somebody that could bring people together, put together a plan and carry it out. And they also introduced me to other people within the NYC non-profit space that focus on doing work with students around science and technology. So for me that was big – the network, the ability to take on projects and develop my own...soft skills that would be very important in the working world once I graduated. (Esther, Interview, 4/9/17)

Esther sums up the value-added nature of HES: “the network, the ability to take on projects and develop my own...soft skills that would be very important in the working world once I graduated.” Not only did HES help her successfully complete college but it prepared her for her next step where, as seen in her experience as well as the experience of her peers, she could continue to advance professionally and give back to the community in an effort to help others succeed.

References to HES after college tended to relate to participants' volunteer experiences and the space that HES provided for participants to mentor others, yet a couple of women noted how HES helped them advance professionally. For example, Pilar, like Esther, attributed her professional advancement to "soft skills" that she learned in HES's professional development workshops. She first joined HES as a young professional before she took on her first management position:

...prior to moving into management I'd become very involved with HES and that definitely has helped with my career, has helped me tremendously grow, uh, professionally, not as much on the technical side but really on the soft skills side and I do attribute my transition into management, and second line management to my involvement with HES. (Pilar, Interview, 4/5/17).

That she could say "I do attribute my transition into management, and second line management to my involvement with HES" is a testament to HES's mission of empowerment.

Pilar also juxtaposed the quality of HES's professional development with similar professional development she had done at work citing how sharing similar challenges as fellow workshop participants was an "empowering and eye opening" experience. She describes:

So in 2007 when I first attended a HES conference—I was just there as a recruiter so I wasn't familiar with HES so I went ahead and registered—I could attend a professional program so I registered as a member and I attended a professional program. What was incredible was that our company offered a lot of the same type of professional development in advanced communication and difficult conversations...but being able to take that training at the HES conference around people that had similar feelings or had gone through similar challenges as me was very, very empowering and eye opening because I know taking courses with a lot of white males at the company was very difficult to speak up or really pick up for specific situations but I knew they were not able to relate to and they will not be. And that has been very interesting to see how situations, obviously comments that are less than ideal or approaches that are less than ideal, are perceived completely different depending on your background...[S]o it was very, very powerful to me

to be able to attend professional development programs at HES. (Pilar, Interview, 4/5/17)

To hear this from a woman who occupies a second line management position, who has served on HES's National Board of Directors, and who has been recognized for her professional achievements (in 2010 she received an award from the Hispanic Association for Corporate Responsibility) is again another testimony to HES's success in providing science (social) capital to its Latina members. While Pilar's achievements are also the result of her own efforts, she didn't hesitate to give credit to an organization that accompanied her along her professional trajectory.

### *HEStina Capital*

Observations revealed that, overwhelmingly, HES members (and Latinas in particular as those were the individuals I focused on) were themselves sources of capital. A memo from my first observation expresses this hunch I had even from my first visits to the field:

In the case of, for example, the early career professionals volunteering at the mock career fair, while the college students may be receiving capital, the early career women themselves are acting as agents – sources, if you will – of capital – how cool is this?? Just as when you teach, you end up learning 90% of the instructed material (compared to 5% in the case of reading it or 15% in the case of hearing it etc.), perhaps capital works similarly – when you become a source/channel for social – perhaps even cultural in the context of engineering - and science capital....(Analytical Memo, 11/17/16)

As my nerdy excitement indicates, I could sense that the observable actions of individual Latinas themselves were critical to the question of how HES mediated their capital use; in fact, HES appeared to be a space in which they, as part of a vibrant network of similarly-identified, like-minded peers acted as channels for capital flow. Interviews corroborated this hunch: having benefitted from the support HES offered (as seen in the accounts

shared earlier in the chapter), HESinas are able to advance professionally and give back (as discussed in Chapter 7). Victoria used the term “outlet” to describe HES’s role in her career: “because I wanted to help Latinas, so I always...wanted people [to] change how they see you, so for me...HES is the perfect outlet for me to do that because I want people change different about us what they see us for first time” (Victoria, Interview, 3/3/17). Here, HES is not the source of capital; rather, Victoria is a source of human capital and describes HES as “the perfect outlet” for her to carry out her personal mission to help Latinas. Mónica describes her involvement in HES in a similar way – as a space where she could do something “to make some change” in the lives of youth. She explains that she really enjoys talking with youth and was happy to do this at the regional leadership development conference:

So that’s one of those really, really cool things, just to see that I’ve done something to *change*, you know? To make some change. And that’s what I did at the HES conference when I was there. I talked to the high school students again. And it was interesting you know because I could *see* they were asking these questions and I was just trying to fill up their minds with things [as she explained earlier in our conversation – visions of the money they could make, the success they could have]...So that’s really what I really enjoy. (Mónica, Interview, 7/31/17)

Mónica’s sustained involvement in HES—as also observed in photo documentation and online announcements in which she was featured as a speaker or facilitator—is thus motivated not by capital she *receives* per se but by having a space to be a *source* of capital for others.

All study participants were active members in HES (a prerequisite for participating in the study) and each was involved as a volunteer either as a mentor or as an active participant (i.e. facilitator, organizer, speaker) at HES’s regional leadership

development conference (see Table 10). Observations revealed informal and formal modes of acting as a channel for capital flow. Informal modes included observing Victoria talking with a group of high school students at RLDC: “[Victoria] was standing in the doorway talking with a group of young professionals—it appeared she was addressing them as a group” (Observation, field notes, 3/2-4/17). I observed Marielena, acting in a recruiting role for her company, “at [the company’s] table listening quietly to a student” (Observation, field notes, 3/2-4/17). I observed a moment of Ana’s project director role during our interview: “We started the interview and paused partway as another person came in to ask her to sign off on a document. She signed as we continued speaking. Multi-tasking at its best” (Observation, Ana’s Interview, 4/5/17). Rosa I observed facilitating a workshop at RLDC: confident in her tone, masterfully weaving in references to being short, brown, and female, the challenge her social identity presented and how she navigated those challenges (Observation, field notes, 3/3/17). I noted the consistent “put-together,” professional physical presence: most wearing make-up (Mary, Camila, Ana, Mónica, Victoria, Esther, and Marielena); some wearing heels: Ana, Mónica, and Victoria; some wearing blazers: Marielena, Pilar, and Isabel). Most – as well as other Latinas at events I attended – exuded charisma through smiles, eye contact and confident tones (e.g. Rosa at RLDC when facilitating a professionals’ workshop, Mónica’s direct conversation style during our interaction at RLDC).

Participants cited being a source of capital, exercising their agency to help a fellow Latina. One example was Ana’s account of assisting a younger Latina HES member in securing an internship (also shared in Chapter 6 as an example of aspirational capital):

I meet people at random places, conferences and somebody, some people come and say “oh you know if there’s an opportunity this summer,” someone that I mentored through HES asked me if she could get an internship and then we had the opportunity here and I talked, “I met this young lady, I was truly impressed, so you think we could bring her on board?” And they were like “absolutely!” you know, it just happened, it was pure luck, it was pure luck for her. It was pure luck that a position was available, it was pure luck that I remembered her.... (Ana, Interview, 4/5/17)

Ana then goes on to describe how her position as project director enabled her to have this power, this “reach,” yet it is interesting to note here how the HES network provided a space through which she connected with a fellow HESTina and was able to act as a source of social capital for her.

### Summary

The role that HES thus plays in Latinas’ use of various forms of capital is that of being a source of capital itself and a space, an “outlet,” for Latinas to develop professionally and be a source of capital to others. Given the other forces at play: engineering as “a [white] man’s world,” the fewness of other Latina engineers at the collegiate and professional level, the feeling of needing to prove oneself on account of the possible racist or sexist views of one’s peers or supervisors in the workplace, and the broader U.S. context in which women’s intelligence is questioned, HES plays a critical role as a space in which Latinas can access social and cultural capital and develop their own potential to become sources of capital to others. HES thus provides a culturally-rooted space in which Latinas can connect with others with similar socio-cultural backgrounds, who experience similar challenges and who share similar aspirations. As HESTinas, they are no longer “one of the few” and they do not have to “speak louder, fight harder.” Instead they can be “HEStina Superheroes!” They can “Be bold and

strong!” and derive strength through giving back to the generation of Latinas before them and paying it forward to the generations of Latina engineers yet to come.

## **CHAPTER 9**

### **CONCLUSIONS AND FUTURE RESEARCH**

I recently revisited HES-NYC's Facebook page and saw that their support of their Latina members continues: on March 1<sup>st</sup>, 2018, HES held a "Latinas in HES" event in NYC in honor of women's history month that included a panel of Latinas in HES speaking on the theme of "Movers and Shakers in STEM" (HES-NYC, Facebook Page, 2018). I saw that both Rosa and Mónica were part of the four-woman panel. My first reaction was disappointment at having missed the event as I am now no longer "in the field." Taking a step back, I was pleased to see that HES-NYC was hosting a significant event that featured Latinas and was in no way surprised that Rosa and Mónica were featured panelists – they are indeed "Movers and Shakers in STEM." Having the opportunity to hear their stories as well as the stories of their HESTina sisters was a bounty to me as a researcher; that each woman shared her experience so openly and honestly about at-times intimate topics (one's career aspirations often overlap with one's broader life goals and so swiftly enter the space of the personal) felt like I was being allowed to share a sacred space with them in which we reflected on the joys and pains involved in being brown and female in the U.S. To also be able to spend time at HES events where college students and professionals alike were engaged in their own professional development as well as the career development of those younger than themselves was energizing and revealed to me the importance of sustaining spaces that honor multiple aspects of one's identity.



What follows is a brief reflection on the study as a whole and a discussion of the findings in relation to my conceptual framework, as well as additional relevant literature that has been published during the course of my study or has otherwise come to my attention. The chapter closes with an exploration of implications of my findings for other researchers focused on the persistence of women of color within science, technology, engineering, and mathematics (STEM) and for future research on the topic. It is my hope that the findings may be useful for others seeking to encourage greater participation among underrepresented groups in STEM as well as those striving to transform STEM itself to be more welcoming of all who aspire to STEM careers.

### Summary

As described in Chapter 1, the underrepresentation of women of color in STEM is a national issue receiving policy and programmatic attention. Various structural factors have been identified, including inadequate academic preparation and lack of interest on the part of underrepresented students. The role of social identity has been researched to some extent but needs to be better understood as social identity is clearly a factor related to persistence. Given the pervasiveness of underrepresentation (with exceptions such as the life sciences which have near gender parity at least) and the reality that underrepresentation is worsening in fields such as computer science and among women in STEM generally (Huyer, 2016), it is vital to continue to explore possible factors related to persistence among underrepresented groups in STEM.

Given that gender disparity is most extreme in engineering, this is a critical area to explore. Latinas are particularly underrepresented engineering, and all STEM fields.

Given the growth of the Latinx undergraduate population, they are a group poised to meet national demands (i.e. they are estimated to comprise 30% of the workforce by 2050 (National Science Foundation, 2017)) and so require research focused on developing a deeper understanding of the needs and assets unique to them. For Latinas in particular, use of intersectional social identity theories (e.g. Carlone & Johnson, 2007; Crenshaw, 1989) reveals the nuances of being female and Latinx in historically white, male-dominated STEM spaces. In relation to other STEM disciplines, engineering professions more commonly overlap with industry at the corporate level; combined with a heavy emphasis on “technical” content perceived to be “masculine,” or “a man’s job,” engineering remains an especially male-dominated, “chilly” climate (Rincon & Yates, 2018; Walton, Logel, Peach, Spencer & Zanna, 2015). Latinas in engineering are a distinct group of women of color in STEM. Understanding the experience of this specific group bears implications for experiences of women and engineers of color more broadly as the “double bind” conundrum applies to all historically marginalized groups who identify with more than one minority label that is underrepresented in STEM.

Within engineering, two common patterns of underrepresentation are emerging: First, underrepresentation within engineering is uneven as it is most extreme in more technical subfields such as electrical engineering (11.5% Bachelor’s degrees earned by women) or computer engineering (10.9%) compared to environmental engineering (49.7%) or biomedical engineering (40.9%) (Meiksins et al., 2017); second, once in an engineering profession, many women are tracked toward management positions away from technical tracks (Cardador, 2017). While this is associated to some extent with career advancement and a salary increase, the nature of the work of a manager is far less

“technical,” and so thus less masculine and therefore perhaps less valued or esteemed (Cardador, 2017).

Keeping in mind prior research on science identity that has shed light on the significance of capital (*la facultad*, science etc.) as it relates to science identity, looking at Latinas in engineering adds value: it both builds upon prior research and expands current understanding of persistence among women of color in STEM through looking at a new, slightly larger group in a field where underrepresentation is extreme. Prior research reveals forms of capital women of color possess/access (framed in terms of assets, including personal ones, like human capital – altruism, desire to give back to one’s community, defining one’s identity and meaning of science on own terms, and transforming challenges into means of success). My study confirms prior research that identifies various assets and forms of capital that women of color in STEM have been found to have and expands upon it by looking at Latinas in engineering – a group that has not been researched to a significant extent – and their perceptions of what enables/motivates them to succeed.

My study links the notion of “double bind”/“double jeopardy” with science identity and capital to explore how Latinas, an understudied group of women of color, strive to succeed in engineering, a STEM field in which underrepresentation of Latinas is severe. Background research on the “double bind” and the relevance of this phenomenon for women of color in STEM in the 21<sup>st</sup> century acts as a foundation for exploring the role of gender and racial/ethnic identity in the experience of Latinas in engineering. Established female STEM professionals resounded the call decades ago for increased intersectional (i.e. gender *and* race/ethnicity) programming as well as cultural and

structural change at the departmental level since an emphasis on “fixing” the women was neither required nor effective (Malcom et al., 1976). Additionally, the “double jeopardy” described in more recent research is evidence of the persistence of the “double bind” (Williams et al., 2014). Among other forms of gender-related bias, “prove-it-again” (working twice as hard, to prove you are as smart as a man) and “tight-rope” (acting masculine enough to seem competent in science yet not *too* masculine so as not to appear unfeminine) biases plague women of color in STEM today.

Based on this reality, looking at identity as it relates to science is thus logical. Defined in terms of recognition, competence, and performance, science identity has been found to intersect with social identity and structures (Carlone & Johnson, 2007). Research using the model has expanded upon it (e.g. Rodriguez, Cunningham & Jordan, 2017) and directly applied it to the experiences of students of color in STEM (Chang et al., 2011). Science identity also relates to capital, including science capital (Archer et al., 2015) and an awareness of the implications of one’s social identity that translates into a motivation to work harder in the face of potential obstacles to one’s success (i.e. *la facultad*) (Carlone & Johnson, 2007).

Use of the science identity concept in my study was productive in that it confirmed prior research and expanded use of the model to a substantial group of Latinas in engineering (i.e. not solely in science). The model helped to shed light on the shape of participants’ trajectories through engineering. Additional research could reveal identification processes unique to engineering and thus possibilities for engineering identity (Godwin, 2016) that may be distinct from science identity.

My study corroborated prior science identity research as I found, generally, that participants' social and science identities were intertwined: who they are as Latinas has shaped who they are as engineers; in fact, as outlined in the findings, their culture itself is a motivating force for persistence. Additionally, all forms of capital that prior research has shown relates to the success of women of color in STEM was found in the data, including aspirational capital and invisible strategies (Herrera et al., 2012), cultural knowledge (i.e. currency – a form of cultural capital), and altruism (Yosso, 2005).

This study generates findings within a topically-relevant (i.e. science capital) and culturally-relevant (i.e. *la facultad*) conceptual framework and with an awareness of the “double bind” women of color in STEM historically and presently face (e.g. Malcom & Malcom, 2011). The study is rooted in an understanding that an inquiry of the “double bind,” particularly analyzed through the lens of *la facultad*, bears implications for new conceptions of being a scientist that may transcend cultural boundaries and leave space for multiple epistemologies such that females of color in particular can readily identify as scientists and scientists can readily identify as whichever social identity they choose.

Employing ethnographic methods shaped by a critical theoretical framework, I gathered data from 10 professional Latina engineers as well as three of their peers in engineering. I also engaged in approximately 41 hours of observations of the professional network to which they all belong – the Hispanic Engineers' Society (HES). I also analyzed documents pertaining to HES National and HES-NYC, the New York City regional professional chapter whose events I observed. These interview, observation, and document data, together with periodic memos, constituted my primary data sources and

triangulated each other to portray a nuanced portrait of Latinas' experiences in engineering.

### Key Findings

As a reminder, key findings included:

- HES is a cultural and professional organization that supports the sociocultural and science identities of its membership:
  - HES is a “*familia*”-like organization inclusive of a variety of races/ethnicities with a programmatic focus on fostering the success of Latinx/Hispanics in STEM broadly and Latinx/Hispanics in engineering specifically
  - HES fosters the science identity of its female members through programming that highlights the accomplishments of its female members and supporting Latina initiatives (i.e. HESTinas) as well as through general programming focused on professional networking and career development
- Women interviewed consistently conveyed a strong science identity as evidenced through recognition they received at work (e.g. being assigned team leadership roles) or in their community (e.g. one participant received an Hispanic career achievement award), through competence evidenced through steady career advancement, and through performance as measured by specific successes they achieved at work (e.g. difficult projects). Their strong science identity was manifest in their workplaces even as it was fostered through forms of capital sourced elsewhere (i.e. mentors both in and out of work, family support, HES, or themselves in the form of *la facultad*-related mindsets)

- Generally, women characterized their trajectories according to notions of “struggle” or “challenge” rooted in the complexity of engineering as a subject and in their experience as being female and Hispanic/Latina in white, male-dominated space. Participants expressed an understanding that “struggle” was an innate aspect of their trajectories that they drew inspiration from; additionally, their own “struggle”/“challenge” and the “struggle”/“challenge” of other Latina engineers was understood to be capital in that it had value in fostering their own persistence and inspired them to give back to younger Latinas in STEM. The main themes are outline below:

- Liking a challenge:
  - Engineering itself is challenging;
  - Being a woman in engineering is rare – wanting to be that rare person.
- “We are fighters”:
  - They possessed the cultural currency as Latinas with a heritage of facing and overcoming challenges;
  - Keep on going—a belief in the need to keep on in spite of challenges;
  - Woman up—the understanding that you need to face challenges head on if you want to succeed.
- “I’m Going to Show You”:
  - Obstacles (including others’ prejudiced views) as fuel to try even harder to succeed.
- Underrepresentation as an American Problem:
  - “Latina” is an American construct;

- Gendered notions of intelligence (in which men are presumed to be better at STEM than women) prevalent in the U.S. perhaps to a greater extent than in other countries;
- Representation of Latinas in STEM not a “problem” in non-U.S. contexts.
- Persistence as Resistance:
  - For many women interviewed, they were motivated to persist as a means to address underrepresentation and improve the field for next generation of Latinas and other women in STEM;
- “Bro” or male-dominated culture identified as a social force that shaped participants’ experience in engineering.
- The primary forms of HES capital that mediated HES members’ and participants’ experiences included:
  - HES<sub>tina</sub> movement (observed; for Latina HES members broadly);
  - HES in College: “If They’re Not Giving Up Then I Don’t Have A Reason To Give Up” (peer support);
  - HES in College and Beyond: Developing “Soft Skills” (e.g. professional networking, mock interviews, resume review);
  - HES<sub>tina</sub> Capital (In HES, they be Latina *and* engineers – they can be HES<sub>tinas</sub>).

#### Limitations of Study

While this study produced robust data that illuminate the relationship between identity and persistence, the scope of the topic was necessarily narrow. Looking at the relationship between science identity, capital use and experiences in engineering related to many other aspects of my participants’ identities that related to their persistence (e.g.



cultural identity, family roles, faith etc.). These will need to be addressed more fully in subsequent research as this study focused on forms of capital participants used along their career trajectories.

My sample population was limited in that I focused on a specific demographic of STEM professionals and so perhaps didn't capture the perspective that comes with a more diverse group of participants or a comparison group. Comparative research on the topic of science identity and persistence (e.g. Espinosa, 2011; Hurtado et al., 2008) is growing; my study seeks to fill the gap in research focused exclusively on science identity development among women of color as a distinct group of potential STEM professionals in the U.S.' workforce heretofore understudied and historically excluded from both education and career opportunities in STEM. The dearth of research on identity as it relates women of color from a variety of ethnic backgrounds in STEM warrants focused research on sub-groups within the "women of color" category. It is hoped that that this study aids in the process of generating knowledge useful in understanding the dynamic between identity and STEM participation as well as possibilities for creating school and work environments conducive to the success of all who aspire to careers in STEM.

Key limitations of my methodology included a need for more rigorous triangulating techniques to strengthen the credibility of my analysis. Collaborative artifacts such as online group chats could have provided a space to explore commonalities and distinctions between participants experiences and views. While my study met the minimum requirements of being ethnographic (i.e. I did have prolonged engagement in the field, persistent observations, and an instance of a negative case

analysis), future research can focus on a wider variety of data collection from the focus group, including more rigorous member checks, to create an even more comprehensive understanding of the variety of their experience.

## Discussion

While key findings have already been discussed, I will note here the striking professional diversity of the Latina HES members I interviewed (see Appendix G for Interviewee Demographic Data). Given the aforementioned trends of underrepresentation within engineering, it was beneficial to talk with women from a variety of engineering subfields as well as a combination of women serving in management and technical roles. While patterns in underrepresentation in different engineering subfields was part of the background of the research question, it did not feature prominently in interviews. Yet as I was analyzing the data and reviewing the backgrounds of my interviewees as a group, I observed that four of the women I interviewed were trained as computer engineers/scientists and one was trained as an electrical engineer. Further research with a larger participant pool could explore patterns in experiences of Latinas with backgrounds in various engineering subfields such as computer engineering, where Latinas are especially underrepresented, as well as environmental engineering, where they participate to a greater extent, to see if there are variations in science identity, capital use or the experience of the “double bind” associated with being in a given subfield.

The variety of managerial and technical roles that participants occupied was also striking. Here interviews did reveal—as alluded to in Chapter 7—that women sensed that, as they transitioned into management roles, they were moving further away from the

technical aspects of engineering, from what they originally enjoyed doing. Implications of the perceived management/technical split within engineering include the need to acknowledge the intrinsic enjoyment of the content of engineering itself that motivated women to become engineers in the first place and the fraught nature of what appears to be career advancement. The women I interviewed didn't view their transition to management as discriminatory in any way; in fact, they described their surprise as effectively being a "boss" or leader in their departments, often despite their relatively junior status in the company, and were salaried accordingly. Yet participants' awareness that they are no longer doing exactly what they love to do says something and provides an emic understanding of what it feels like to be "promoted" in some sense even while not advancing in the way they may have planned or wanted. This emerging theme warrants further research to look not only at statistical demographic trends among Latinas in engineering – do a disproportionately large portion end up in management roles? – but the experience of Latina managers themselves to ask how they experience their management roles and how their roles fit in their career trajectories.

My findings confirmed prior research on science capital and related constructs and expanded on current understanding of the forms of capital Latinas in engineering utilize along their career trajectories. Keeping in mind the interrelated nature of capital, habitus, and field, I found that participants' use of science capital and other forms of cultural and social capital was shaped by their habitus; that is, the extent to which they embodied requisite behaviors and beliefs associated with being recognized in varying engineering spaces (i.e. fields) shaped their trajectories. In their critique of Archer et al.'s work, sociologists Eric Jensen and David Wright argue that Archer and her colleagues

...undertheorize the role of the field in relation to capital in Bourdieu's model. Capital is not simply accrued. Its value is also *struggled* over by social agents and institutions with various, often competing, interests in maintaining the shape of the field and their positions in it. Although in their summary of Bourdieu's approach they acknowledge the significance of the field in understanding the role of capital in all its forms, it is unclear in Archer et al.'s exposition of how the field affects the struggle over science capital, or how the field is shaped by the dispersion of such capital. (Jensen & Wright, p. 1145)

Jensen and Wright highlight here the critical relationship between capital and field. In the case of Latinas in engineering, what constitutes valuable capital is defined by the field of engineering itself (both literally and figuratively in Bourdieu's use of the term).

Depending on the norms and criteria for success defined by various institutions in engineering, various forms of science capital may be more or less valuable. Additionally, given the varying social position of Latinas in different engineering-related spaces (i.e. HES vs. workplaces), their "struggle over science capital" involves tensions between structure and agency that Bourdieu explains typify all social relations and relates to directly to the role of power in shaping individuals' access to capital, which itself is unevenly distributed (Bourdieu, 1990). Here, Bourdieu's conception of habitus is critical to note as this is the embodied set of dispositions (i.e. embodied cultural capital) that is simultaneously a product and producer of forces of power (articulated through institutions) in a given field (Bourdieu, 1990).

More fully integrating Bourdieu's conceptual framework illuminates the distinctions between HESTinas' experiences in HES compared to college or workplaces: each field has varying, if overlapping, norms that define what it means to be a legitimate, successful engineer. In the case of most participants, their sense of legitimacy in HES resulted from an alignment between their habitus and the norms of HES (in this case

manifest in cultural capital). HES also acted as a space at the “crossroads,” as it were, between HESTina’s community/family cultural backgrounds and the norms associated with dominant engineering culture; as a result, HES was a field in which, even as the value of capital was *struggled* over, with even the struggle itself constituting a form of capital, HESTinas were ultimately enabled and *empowered* to acquire capital that they could then successfully apply in less welcoming spaces. As agents, the HESTinas who participated in my study, were generally successful in acquiring capital in the context of HES that enabled them to disrupt power relations in the other fields they occupied, if only at the individual, micro level.

It is important to note here too the early-mid career status of participants and how this may have intersected with their capital use. Participants held various occupational roles in diverse industries, ranging from project managers in construction in both private industry and government settings as well as IT specialists to graduate studies in engineering education and independent IT consulting work. Five participants held visible career distinctions: Two participants held patents; one held a doctorate in professional studies in computing; one had a PE (Professional Engineer’s license granted to those with a B.S. in engineering, who have worked at least four years’ under a PE, and who have passed state licensing exams) and a PMP (Project Management Professional credential earned through testing); and one had an EIT (Engineer in Training licensure). That many of these women currently hold management positions belies their technical expertise even as it signals recognition of and reward for demonstrated talent (as evidenced through the aforementioned credentials). While the focus of this study required limiting analysis of the relationship between participants’ specific work backgrounds as early-mid career

engineering professionals and the forms of capital they utilized, future research can apply Bourdieu's conceptual framework more fully to develop a nuanced understanding of the relationship between capital, habitus, and field in the variety of engineering roles early-mid career professional Latinas occupy.

Of the various forms of capital that featured prominently in the data, altruism or participants' sense of "giving back" and "struggle as capital" warrant further discussion here. Given that altruism featured as a motivating factor in participants' persistence and that participants were deeply involved in an organization that placed value on giving back to one's community (i.e. in the form of volunteering through outreach, charity, and mentoring), it is important to ask whether this form of capital was born of individuals' altruistic beliefs and behaviors or was it organizationally driven. Altruism is a character trait that has been identified in research on persistence among underrepresented students in STEM as a variable that inspires students to pursue and complete STEM degrees (Tran, 2011). Several participants (e.g. Victoria, Rosa, and Mónica) explicitly referenced their desire to give back as something that drew them to HES. For them, HES was a space in which they could articulate their desire to give back to others. In other words, they may have expressed these altruistic tendencies in other spaces had the opportunity arisen. For other participants such as Nicolyn and Alexandra, both of whom were particularly involved with HES during college, and both of whom were about 10 years younger than the aforementioned women, it appears that their involvement in HES provided them invaluable support that got them through college and likely inspired their desire to give back to other Hispanic women and men who came from similar backgrounds. In their case, it is possible that the sense of "giving back" may have been

directly driven by their involvement in HES. While future research is required to generate data that reveal the role of organizations such as HES in either directly fostering a strong sense of the need to give back to one's community or in simply providing a space for those who are already altruistically-oriented to enact their identities, findings from this study illustrate the distinction between altruism as a form of capital that Latinas in engineering may possess and the role of HES as a source of capital in the form of "giving back."

The other form of capital that requires further discussion is the finding that, for many participants, a sense of "struggle" acted as a form of capital that motivated their persistence. While the notion of "struggle as capital," conveys the ways in which individual Latina engineers in this study make meaning of the struggle they have experienced such that the struggle itself becomes a form of capital that can propel their career advancement, this in no way excludes the need for broader, systemic transformation that promotes the advancement of all individuals desiring careers in engineering or other STEM fields. Broadening participation in STEM among underrepresented groups requires institutional change rooted in an understanding that STEM has been an historically exclusionary space for all groups who do not conform to the predominantly white, male norms of STEM culture (Camacho & Lord, 2013a). In fact, that the women in my study attributed their success in part to a sense of past struggle signals to institutions a need to proactively *reduce* struggle for students. The women I spoke with articulated this need as well, calling for training at the middle management level and for change at the level of institutional policy that prioritizes recruitment and matriculation of underrepresented groups. Future research on Latina engineers' and other

STEM professionals' insights into necessary systemic change can highlight possible paths institutions could pursue in their efforts to broaden participation of underrepresented groups in STEM.

In addition to the forms of capital that can be expanded upon in future research, there are two aspects of the findings related to identity that require future attention as well: the role of race/ethnicity in Latina engineers' experience as well as the role of HES in providing as space for identity development. I came into the project with the aim of analyzing participants' experiences primarily based on an understanding of Latinas in engineering as a sub-group of women of color in STEM. That is, while I was aware that I would need to account for cultural particularities and discipline-specific factors to keep my own biases in check and to honor participants' individual experiences, I assumed that the "women of color in STEM" category would generally suffice as an analytic. As Chapter 6 outlined, this category was productive in that participants' experience of the "double bind" shaped their trajectories in ways similar to other groups of women of color in STEM. Specific findings such as "I'm going to show you..." clearly reflected the recent research on women of color in STEM (e.g. "prove-it-again" bias found in Williams et al.'s 2016 report) and the notion of drawing strength from one's cultural heritage echoed research on STEM students' of color persistence (e.g. Yosso, 2005). It should also be noted that race/ethnicity didn't feature prominently in participants' descriptions of challenges they faced. As the majority of participants appeared as "white Hispanic" – and demographic data collection didn't account for specific racial/ethnic identification, future research is required to adequately account for the role of race/ethnicity in Latina engineers' experience.



HES's explicit emphasis on Latinas' identity – seen most clearly in the HESTina movement – resonates with research on persistence among women of color in STEM that argues the importance of “counterspaces” – spaces that honor the racial/ethnic *and* gender identities of women of color in STEM (Ong, Smith & Ko, 2017). This research shows that intersectionality is important with respect to individuals *and* organizations and highlights the utility of spaces on the “periphery” of STEM that foster the well-being of STEM professionals from non-dominant sociocultural backgrounds. While the STEM climate itself may be “chilly” for those from underrepresented groups, these “counterspaces” legitimate multiple aspects of their identity. Thinking of HES as a “counterspace” is conceptually useful in that it frames its vision and corresponding programming as critical to fostering the science identity development of Latina engineers who find themselves in professional workspaces that don't consistently or uniformly conduce to their positive science identity development.

Before exploring emerging themes, it is necessary to highlight additional scholarship that became increasingly important to my analysis. Specifically, research on Latinas in engineering helped frame participants' experiences as I reviewed the data and saw participants' unique experiences rooted in their cultural heritage (which is itself very diverse) and the distinctiveness of engineering in relation to other STEM fields. In particular, seminal work by Professor of Sociology Michelle Madsen Camacho and Professor of Electrical Engineering Susan Lord on Latinas in engineering at the undergraduate level provided a comparable analysis that I could bring into conversation with my findings. Camacho and Lord's (2013) study provided a comprehensive analysis of Latinas in engineering in terms of specific challenges Latinas face due to culture and

gender, and with respect to the climate of engineering. While they did not draw upon capital theory, they did provide an overview of the range of structural and personal supports Latina engineering students draw upon and my findings reflected theirs. Distinctions between U.S.- and foreign-born Latinas also arose in their work. Future research on larger groups of U.S.-born and foreign-born Latinas in STEM could help researchers better understand within-group and between-group differences. Also, their work brought into focus the important role that HES can play, as a “counterspace” that provides a “warm” climate where Latinas can thrive; so that even if their professional spaces are chilly, Latinas can have a space that fosters their science identity development.

### Emerging Themes

Despite the overall thematic trends in my findings, there were several emerging themes that warrant further research attention. Two merit brief exploration here: First, the impact of being a source of capital had on participants and, second, the dynamic between overcoming obstacles and thereby advancing in one’s career. Regarding the former, even during my initial observations I became aware of the benefit derived from being a source of social capital to others: watching HES members interact with high school and college students, the joy that they appeared to feel (evidenced through smiles and encouraging tones) was at times palpable. While research on the psychological effects of altruism and the positive impact of giving back to others (e.g. Sinek, 2011) has not been directly linked to persistence in STEM among women of color, it does directly overlap with research that shows that altruistic desires are a common motivating factor for women of color – and underrepresented groups generally – to study STEM. My participants’ repeated references to how giving back to others, whether through mentorship,

facilitating workshops or volunteering in some other way gave meaning to their work, their lives indicated how being a source of capital was a motivating factor to persist in engineering and something they enjoyed. Although lengthy, the field note memo from a high school STEM night at a science museum in Queens outlines the trend that I had observed:

This aspect of capital-sharing that HES members do whether mentoring in volunteer roles or networking as fellow students/professionals, definitely counts as science capital because, particularly in the volunteer situations, ...information is shared about internships, sometimes actual science capital, yet always related to advancing along a trajectory through a career in engineering specifically or STEM more broadly (other examples: resume assistance, mock interviews). Knowing what it takes to succeed in the sciences and sharing that information based on one's experience (e.g. Juana's sharing about the DDC...internship), sharing information about critical PD experiences one needs...to be a viable, successful job candidate. Counts as science capital. Watching Alex [pseudonym], Juana and Marielena recount their experience talking with these 5 kids...they had felt a real connection and were so excited because they felt that they were really helping these kids out. So it's interesting...(this is the third time I've seen this – what were other instances? And I'll see if I can corroborate this in interviews) that, in sharing science capital, I feel like what happens is that the recipient gets a lot out of it because hopefully their horizons are expanded, their social mobility is supported, or their mobility along their desired trajectory is supported – a boost, encouragement, or actual results are achieved (e.g. if Al.(name of student) goes to conference and scores interview that leads to internship that leads to job, that counts as actual capital, tangible result from an initial conversation about linking up with HES). But then also for Marielena, Juana, and Alex – I could see this the most between the extra handshakes and the deep eye contact – that it has such meaning for them. And that meaning is what brings them out to volunteer at these events. What they're receiving from being channels for this capital flow is as or more valuable than the capital that the youth may be receiving. It resonates strongly with Simon Sinek's "dopamine effect" that one gets from serving/helping others. It may not be an initial motivation to do it, but it's definitely a sweet reward and has a motivating effect in the line of decision-making around whether to volunteer your time, or not volunteer your time, between being a member of HES or not being a member of HES, mentoring or not mentoring. That role of the mentor – is often looked at in terms of what the mentee receives but what the mentor receives is really significant. To look at how all of us were *feeling* after our encounter with the youth, I think we were all inspired and humbled by their experiences because they were all first-generation, to think of the paths that they trod to get where they were now and their strong, honed focus on a career in STEM as freshmen, sophomores, juniors, that's humbling and inspiring as it

likely resonates with the drive that these three HES volunteers had to some extent or wish they had more, so it was something to aspire to. But it was also the sense that “wow” we just had a really strong connection, meaningful interaction. You could just see it in all of the HES members’ eyes that they had just done something important, that had made the whole evening worth it. So I think there’s aspect of capital that could be explored more. Perhaps it’s too “psychological” and that’s why it’s not central to analyses of capital (or maybe I just need to read about it more). Now that I’ve see it several times in the taking up, use of, and receipt of capital, there’s something else there that’s helping, not necessarily out of self-interest, it’s like knowing the good feeling that you’re going to get from doing a thing, for being this conduit of capital, and it’s not even self-congratulatory. It’s almost euphoric. I don’t know if it’s an endorphin effect, euphoria, dopamine, or oxytocin?, I’ll have to look into it...but you could see that happening. People’s eyes looked brighter as they talked, their countenances rosier. I’ll need to look into this, document this further perhaps at the conference. Get permission from John. I also observed it at the Halloween weekend STEM night between Marielena and those two girls (see notes) who were really driven. It’s the thing that fosters altruism. Altruism **feels** good is the point. (Memo, field notes, 11/19/16)

The psychological effect of being a source of science capital was in no way a focus of this study nor did participants describe emotions per se associated with their altruistic desire to persist in engineering – it was simply something almost physical that I observed – so I did not include speculations in my findings; however, there were multiple instances where I observed increased energy and joy among HES members as they interacted with those younger than them, sharing tips such as college course selection suggestions and internship recommendations. Given the demanding nature of many HES members’ work (i.e. 12-14 hour work days at times), it was not that they had ample free time to fill. Instead, several HES members I spoke with described taking a Friday off to be at a school event or leaving at 7AM on a Saturday morning to attend a college fair. The volunteering involved a sacrifice of time and energy. To sustain such effort required motivation and, seeing the feeling that such volunteerism seemed to generate, made me wonder if the feeling itself was central enough to the volunteering experience to be a factor in HES members’ sustained volunteerism. Given the salience of altruism in

fostering persistence among Latinas in STEM, this potential aspect of giving back is worthy of further exploration.

Regarding a deeper exploration of the role of obstacles in career advancement, I suggest that this can also be understood in terms of capital – perhaps human capital (Bourdieu, 1986). Looking back over participants’ experiences, it appears that many of them wouldn’t have advanced in their career *without* some of the obstacles they faced. Keeping the “I’m going to show you” theme in mind, clearly obstacles were critical to shaping participants’ trajectories and fostering their persistence. Over time, such as in Rosa’s experience, each new obstacle presented an opportunity to draw strength from their own prior experience, and apply that wisdom and (a fighting) strength to the situation. Framing this “wisdom” and “strength” in terms of human capital could be conceptually productive because, like capital, it can accrue over time with each new obstacle that women face. Looking at the dynamic between the struggle that participants face, the role of specific obstacles therein and their awareness of the multi-faceted nature of the struggle (cultural context, the value and even benefit of a challenge) and the role of giving back in the success of generations of Latina engineers reveals an interconnected web in which challenges and related mindsets become capital that participants can draw upon as they strive for success.

### Implications

Can one be fully Latina and be an engineer? Redefining both what it means to be female and what it means to be an engineer is a necessary step toward fostering the success of Latinas aspiring towards engineering careers. Examining women’s capital use

in relation to HES illuminates some specific ways a given social support structure can mediate how women access and apply various forms of capital as they strive to succeed in their careers. Participants' insights in this study reveal how engineering remains "a man's world" yet possibilities for change exist.

Although findings revealed that the climate for Latinas in engineering is as "chilly" for Latinas (and, as participants suggested, for women generally) as it has ever been, implications from the finds reveal possibility for change. One participant cited the central role of "problem-solving" in engineering as an attribute that attracted her to the field when she was considering her career options starting in high school. Together with the obvious ability Latinas have to perceive the nature of and solutions for the underrepresentation problem, it is tempting to suggest that they alone are poised to bring about the structural and cultural changes required to make engineering and other STEM fields welcoming to a diverse talent pool. Looking for example at the latent possibilities in having women disproportionately represented in management roles – perhaps they are in a position to shift culture? In fact, when coding for women as a source of capital, I found 151 instances! Future research can explore the dynamics of having female managers in predominantly male spaces and implications for structural change relating to their professional roles.

Given the "struggle" participants were clearly engaged in, one is compelled to ask, *why* is it still so hard? As recent social movements related to women's rights suggest, many industries continue to be plagued with gender inequality and discrimination. While engineering is not Hollywood, it too is shaped by related social forces that perpetuate stereotypes regarding women's intelligence and their ability to succeed "in a man's

world.” Adding a layer of color/culture/immigrant status to this reality complicates matters further. The capital that Latinas have taken up, applied and been a source of is vital to their success; however, greater systemic change is needed. To echo the call of the women in science who gathered over four decades ago, what is needed is *cultural* and *structural* change. The women in this study are certainly crucial agents of change; however, the persistent underrepresentation of women of color in STEM indicates that underrepresentation is occurring at multiple levels – where are those from the dominant culture in the fight? Until those in the dominant majority realize their vested interest in diversifying the STEM workforce, substantial change—cultural or structural—is unlikely to occur.

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APPENDIX A  
RESEARCH TIMELINE

**May 2016**—Dissertation proposal defense

**October 2016**—IRB Approval

**October-April 2016-17**—Observation Data Collection; Wave 1 Data Analysis (i.e. Field note transcription, analytical memos re: observations)

**March-August 2017**— Interview Data Collection; Wave 2 Data Analysis (i.e. Analytical memos re: Interviews)

**September 2017 – January 2018**—Wave 2 Data Analysis (i.e. Interview Data Transcription); Wave 3 Data Analysis (i.e. Observation and Interview Data Open Coding); Wave 4 Data Analysis (i.e. Axial Coding)

**January-February 2017**—Chapter 4-8 Drafts; submitted draft to advisor for review

**March 2018**—Chapter revisions

**April 2018**—Dissertation defense

# APPENDIX B

## DATA TABLE

Research Question	Research Method	Specific Items of Inquiry	Ethnographic Method	Findings
Q1: What forms of capital do women of color utilize (e.g. science, social, or cultural forms, including <i>la facultad</i> etc.) as they strive to succeed?	Interviews (I); observations (O), Document analysis (DA)	I – Primary: Q1, Q3; Q4, Q5; Q7, Q8, Q9; secondary: Q1, Q3a  O – HES events	Emic perspective; contextual understanding	Science identity – competence (having a “knack” for it; successful completion of challenging projects); Family support (e.g. Chapter 6, p.180); Family science backgrounds (e.g. Chapter 6, p.184); “I Like Being Challenged...” (Chapter 7, p.197); “We Are Fighters...” (Chapter 7, p.199); “I’m Going to Show You...” (Chapter 7, p.201); “Persistence as Resistance” (Chapter 7, p. 211);
Q1a: What currently existing structures facilitate/inhibit capital production and use?	I	I – Primary: Q1, Q3, Q5b, Q7		HES (e.g. Chapter 6, p.183); “HES <i>familia</i> ” (Chapter 4, p.109); mentors (e.g. Chapter 6, p.184)
	O	Observations of participants in networking & volunteering events	Emic perspective; <i>how</i> obstacles have been approached (also, social and cultural capital)	HES programming (Chapter 4)
	DA	HES Documents (Twitter feeds)		HES <i>tina</i> movement (Chapter 8, p.230)
Q1b: What other forces play a role?	I	I – Primary: Q10; secondary: Q3, Q5		SEE RESEARCH QUESTION 2
	O	Observations of HES activities	Dialogical construction of knowledge	Chapter 5, p.127
	DA	HES Documents		Need for outreach (Chapter 4/Chapter 5)

Research Question	Research Method	Specific Items of Inquiry	Ethnographic Method	Findings
Q2: What role does the organization play in women's access to various forms of capital and how they use capital?	I	I – Primary: Q3, Q4, Q5b, Q9a	Emic perspective;	HESrina Movement (Chapter 8, p.230);  In college, peer group (Chapter 8, p. 233); “soft skills” (Chapter 8, p.238); HESrina capital (Chapter 8, p.240); “HES <i>familia</i> ” (Chapter 4, p.109)
	I	I – Primary: Q9a	Emic perspective; contextual understanding; dialogical Construction of knowledge	
Q2a: What other forces play a role?	I	I – Primary: Q6, Q10; secondary: Q5, Q6, Q7  Society documents, documents from other significant social spaces, twitter feeds	Emic perspective; contextual understanding; dialogical Construction of knowledge	In The Field: “It’s a [White] Man’s World” (Chapter 8, p.221; “In The U.S.” (Chapter 8, p.228)

## APPENDIX C

### CODEBOOK

Code Name	Code Definition
Capital: Cultural	Cultural capital
Capital: Direct counsel	Forms of capital participants suggested in the form of advice to Latinas interested in pursuing STEM degrees/careers
Capital: HES	Capital related to HES
Capital: <i>la facultad</i>	<i>la facultad</i>
Capital: my observations	Observations I made of participants using or being a form of capital that I couldn't easily categorize
Capital: Other	Forms of support participants mentioned that I couldn't easily categorize
Capital: Science	Science capital
Capital: Social	Social capital
Capital: Source	Instances when participants were acting as a source of capital for themselves or others
Engineering Companies	References to engineering companies
Engineering: Culture	References to the culture of engineering
Engineering & Business	Observations of or references to engineering-business partnerships
Latinx: Racial Diversity	Observations of and references to racial diversity within the Latinx population
HES Demographics: Career Opportunities	Observations of career opportunities highlighted at HES events
HES Demographics: Female Leadership	Observations of and references to female leadership within HES
HES Demographics: Membership Diversity	Observations of and references to non-Engineer members of HES



<b>Code Name</b>	<b>Code Definition</b>
HES Demographics: Professional Diversity	Observations of and references to different engineering jobs held by HES members
HES Demographics: Women in HES	Observations of and references to women in HES
HES: Media	Observed media use in HES
HES: Social Context	Observations of and references to any element of the social/political/ economic context surrounding HES
HES Demographics: Female Engin. Major	Observations of and references to HES members' Engin. (i.e. Engineering) majors
HES Demographics: Member backgrounds	Observations of and references to professional and school backgrounds of HES members
HES Demographics: Middle school	Observations of and references to HES's middle school programming
HES Demographics: Racial/Ethnic Diversity	Observations of and references to racial/ethnic diversity within HES
HES: Culture/Atmosphere	Observations of and references to HES's culture/atmosphere
HES: Organization	Observations of and references to structural/program-related organization within HES
Interviewee: Agency	Interviewees' references to how they overcame barriers
Interviewee: Barriers	Interviewees' references to (potential) barriers to their success
Interviewee: Capital	Interviewees' references to forms of capital
Interviewee: College	Interviewees' references to college
Interviewee Dem.s	Interviewees' demographic information
Interviewee: Elementary School	Interviewees' references to elementary school
Interviewee: Engin. Interest	Interviewees' references to initial or current interest in engin. (i.e. engineering)

Code Name	Code Definition
Interviewee: Family	Interviewees' references to family
Interviewee: Framing the Issue	Interviewees' description of the causes of underrepresentation of Latinas in engineering/STEM
Interviewee: Framing the Solution	Interviewees' description of the solutions to address underrepresentation of Latinas in engineering/STEM
Interviewee: High School	Interviewees' references to high school
Interviewee: Job	Interviewees' references to their job (past or present)
Interviewee: Language	Interviewees' references to role of language in their experience (e.g. learning English, speaking Spanish)
Interviewee: Middle School	Interviewees' references to middle school
Interviewee: Motivation	Interviewees' references to sources of motivation to study/pursue engineering
Interviewee: Social Context	Interviewees' references to aspects of their social context
Interviewee: Social Identity	Interviewees' references to any aspect of their social identity (race/ethnicity, gender etc.)
STEM and Gender	References to the role of gender in STEM (collective not individual)
Women: Alternative Engin. Spaces	References to non-HES engin. (i.e. engineering) spaces women occupied
Women: Dress	Observations of how women dressed
Women: Language Use	Observations of types of language women used
Women: Presentation of Self	Observations of and references to how women speak or act

# APPENDIX D

## PARTICIPANT DEMOGRAPHICS

### Part 1

Name	Job	Engineering background	Educational background	Role in HES	~Age	[Parents'] country of origin
Mary	Management-level position in procurement (Bacardi Martini)	Chemical Engineering	Stevens Institute of Technology (B.S. in Chemical Engineering - 2001)	Member in college, current member and volunteer	Late 30's	Colombia (immigrated to U.S. with mom at age 3)
Camila	PhD student, Virginia Polytechnic Institute and State University (Virginia Tech.)	Civil Engineering; Environmental Engineering; Engineering Education	Utah State University (B.S. in Civil Engineering – 2012; Master's in Environmental Engineering); PhD program in Engineering Education (Virginia Tech. - present)	Former Northeast Region Graduate Student Representative, current member and volunteer	Late 20's	Dominican Republic (she moved to U.S. for university)
Victoria	Independent IT consultant	Computer Engineering	Instituto Tecnológico Autónomo de México (ITAM) (B.S. Computer Engineering - 1994; Master's in IT and Administration – 1997)	VP HES Boston professional chapter	40's	Mexico (immigrated to U.S. after Master's degree)

Name	Job	Engineering background	Educational background	Role in HES	~Age	[Parents'] country of origin
Ana	Project Manager – Tishman Construction	Electrical Engineering	City University of New York City College (B.S. Electrical Engineering - 2005)	Current member periodic involvement	30's	Ecuador (came to U.S. for college)
Isabel	Deputy-Director (NYC Mayor's Office of Housing Recovery)	Chemical Engineering	University of Pennsylvania (B.S. Chemical Engineering – 2004; Columbia University (M.P.A. – 2015); PE; PMP	Current member and volunteer	30's	Born in U.S., parents origin unconfirmed
Patricia	WW Manager (Lexmark International, INC.)	Industrial Engineering/ Chemical Engineering	ITECH Lyon (Diplome d'Ingenieur); University of Florida (M.S. Chemical Engineering); University of Kentucky (M.B.A. – 2015)	Former HES Board Chair, Treasurer, Regional VP, current member and volunteer	40's	Venezuela (came to U.S. for grad. school)

Name	Job	Engineering background	Educational background	Role in HES	~Age	[Parents'] country of origin
Rosa	IT Project Manager (Credit Suisse)	Computer Information Systems/Mechanical Engineering	Stony Brook University (B.S. Applied Math & Statistics/Computer Information Systems; Mechanical Engineering – 3 yrs coursework); M.S., MIS; Teachers' College (M.Ed. Instructional Technology – 2000)	Current member and volunteer, former Regional VP	40's	Born in U.S., parents from Dominican Republic
Alexandra	Gov't contracted IT specialist	Computer Science	City University of New York City College (B.S. Computer Science – 2005); Florida Institute of Technology (M.I.S.)	Current member periodic involvement	30's	Dominican Republic, came to U.S. for college in 1999
Mónica	IT Training & Strategic Project Specialist (Mercedes-Benz USA)	Computer Science	Hunter College (B.A. Computer Science – 1994); Pace University (M.I.S. – 1998; Doctor of Professional Studies – 2009)	Current member and volunteer	40's	Dominican Republic, came to U.S. at age 16
Nicolyn	Project Engineer (Northrop Grumman Corporation) ; currently starting own company	Industrial Engineering	Southern Methodist University (B.S. Engineering – 2006; M.S. Systems Engineering – 2013); PMP	Current Regional VP	30's	Born in U.S., Mexican background

Name	Job	Engineering background	Educational background	Role in HES	~Age	[Parents'] country of origin
Mari-elena	Industrial Engineer (UPS)	Chemical Engineering	Columbia University (B.S. Chemical Engineering - 2015)	Current member and volunteer	20's	Born in U.S., parents from Ecuador
Esther	Project Manager (Samsung)	Mechanical Engineering	City College of New York (B.E. Mechanical Engineering)	Current member and volunteer; former chair of marketing (2008)	Late 20's	Mexico, came to U.S. at age 7
John	Product Manager (NY DoE)	Computer Science	City College of New York (B.S. Computer Science)	President, HES-NYC	30's	Unknown

## Part 2

Name	Family status	Relative Educational Attainment	Our connection	Interview format	Interview date and time	Interview length
Mary	Married	First Generation College Student	Observed her on panel and conversing with others at conference	In person, at RLDC	3/3/17 @5:05P M	43:26:00
Camila	Single	Family of Engineers	Met at RLDC: HES member directed her toward me as he felt like we were doing similar research	In person, at RLDC	3/4/17 @2:30P M	51:12:00

Victoria	Single	First Generation College Student	Met her at a professional networking night at RLDC and then talked with her and others over lunch also at RLDC	In person, at RLDC	3/4/17 @ 3:45PM	1:04:32
Ana	Single	Both parents doctors	One of my key informants connected me to her – responded to Facebook interview invitation	In person, in her office	4/5/17 @ 10:52AM	30:52:00
Isabel	Single	Unknown	Met at several HES events	Over the phone	4/5/17 @ 7:37PM	60:38:00
Patricia	Married, school age daughter	Both parents STEM backgrounds, college or higher	Met at RLDC over lunch	Over the phone	4/6/17 @ 10:11AM	45:09:00
Rosa	Single	Unknown	Saw facilitating panel at RLDC	Over the phone	6/19/2017 @ 10:10AM	1:04:19
Alexandra	Married	Father and siblings in engineering	Never met - One of my key informants connected me to her – responded to Facebook interview invitation	Over the phone	6/29/17 @ 7:07PM	40:27:00
Mónica	Married, has 3 children	First generation college student (FGCS); neither parent completed elementary school	Met her at a professional networking night at RLDC and then talked with her and others over lunch also at RLDC	Over the phone	7/31/2017 @ 8:41PM	49:20:00
Nicolyn	Single	First Generation College Student	Responded to interview invitation shared by another interviewee	Over the phone	8/2/2017 @ 9:10PM	32:55:00
Marielea	Single	First Generation College Student	Met in the field, interacted with and observed during several HES events	Over the phone	3/5/2017 @ 8:20PM	1:10:53

Esther	Single	First Generation College Student; neither parent completed elementary school	Met in the field, interacted with and observed during several HES events	Over the phone	4/9/2017 @ 3:09PM	1:26
John	Single	First Generation College Student	Met in the field, interacted with and observed during several HES events	Over the phone	7/21/17 @5:17P M	1:13:03



## APPENDIX E

### INTERVIEW PROTOCOL: PRIMARY PARTICIPANTS

**Name:**

**Date:**

**Profession:  
end time:**

**Int. start time:      Int**

#### I. Background

1. Can you tell me about your trajectory through the sciences?
  1. Given where you are now, how did it all begin?
  2. How would you describe where you are in your career/schooling now?
  3. Where do you plan to go from here (in terms of further schooling, career advancement etc.)
2. Did you always know you wanted to pursue a career in the sciences? (If not already answered)
3. What motivated you to pursue and complete a degree in engineering? A career (if applicable)?
  1. Role of peers
  2. Role of family
  3. Role of community
  4. Role of professional network
4. What motivates you to continue working/schooling in an engineering-related field?

*How would you describe your career goals/aspirations?*  
*How would you describe where you are now in terms of achieving your career goals?*  
*What are next steps you plan to take in your career?*

#### II. Capital

5. Can you tell me about any particularly memorable experiences you have had during the course of your trajectory?
  1. How have you approached any notable challenges or success?
  2. Did you receive any particular forms of support from specific individuals or institutions during these times?

6. How does your trajectory compare to the pathways of your peers throughout the sciences? In other fields?
  1. Why do you think there may have been similarities or differences between your experiences and those of your peers?
7. If you could go back and give your younger self any advice, what would you share?

### III. Individual – Collective Connections

8. If you could share advice with young Hispanic/Latina women considering pursuing degrees and/or careers in engineering or other STEM fields, what would you share?
  1. What do you think would help them succeed?
9. Given the underrepresentation of women of color in STEM – and Hispanic/Latina women in engineering in particular – what do you think are some of the primary causes of such underrepresentation?
  1. What do you think helps women of color persist?
10. While the numbers of Hispanic/Latina women receiving degrees in engineering are growing, they are still grossly underrepresented in most engineering fields; what do you think are some of the factors involved in moving from individual success in attaining an engineering degree to more collective success – how do you perceive the possibilities for pursuit and attainment of engineering degrees among Hispanic/Latina women on a much broader scale than heretofore realized?

## **APPENDIX F**

### **INTERVIEW PROTOCOL: SECONDARY PARTICIPANTS**

#### **I. Background**

1. Can you please describe to me your educational background and present work/school?
2. What is your relationship to Hispanic/Latina women in engineering? (i.e. are you an Hispanic/Latina engineer? Are you a friend? A mentor? An employer?)

#### **II. Capital**

3. What role do you think your organization plays in your career/life?
  1. The careers/lives of other members?
4. In what ways does your organization support its female members?

#### **III. Perceptions of status of Hispanic/Latina women in engineering**

5. Given the underrepresentation of women of color in STEM – and Hispanic/Latina women in engineering in particular – what do you think are some of the primary causes of such underrepresentation?
  1. What do you think helps women of color persist?
6. What do you think are some of the common challenges Hispanic/Latina women in engineering face?
  1. What are some ways that you have observed Hispanic/Latina women navigate such challenges?
  2. What are support systems you are currently aware Hispanic/Latina women may have access to?
  3. What additional supports may be helpful in helping Hispanic/Latina women who desire degrees and careers in engineering achieve their goals?
7. How do the experiences of Hispanic/Latina women in engineering compare to women in other STEM fields?
  1. To men in engineering?
  2. To men and women in non-STEM fields?
  3. To your experience in STEM (if applicable)
8. While the numbers of Hispanic/Latina women receiving degrees in engineering are growing, they are still grossly underrepresented in most engineering fields; what do you think are some of the factors involved in moving from individual success in attaining an engineering degree to more collective success?
  1. How do you perceive the possibilities for pursuit and attainment of engineering degrees among Hispanic/Latina women on a much broader scale than heretofore realized?

9. If you could share advice with young Hispanic/Latina women considering pursuing degrees and/or careers in engineering or other STEM fields, what would you share?

## APPENDIX G

### PARTICIPANT CONSENT FORM

***Title of research:*** Glimmers of Hope: Learning from the experiences of women of color striving to succeed in STEM

***Investigator and Department:*** PI: James Earl Davis, Department of Policy, Organizational, & Leadership Studies; Co-PI: Emily Tancredi-Brice Agbenyega, Urban Education

***Why am I being invited to take part in this research?***

We invite you to take part in a research study because you completed a Bachelor of Science degree in an engineering field at least five years ago and are currently working in an engineering-related position or are pursuing a post-baccalaureate degree in an engineering field.

***What should I know about this research and why is it being done?***

Underrepresentation of women of color remains an issue in STEM broadly and in engineering specifically. To learn more about the factors involved in women of color choosing to pursue a STEM degree and career, we are interested in finding out more about the experiences of Hispanic women in Engineering. We would like to learn about your experiences with science and Engineering growing up, during college/university, and as you've started your career. We will be observing HES events and carrying out interviews with select HES members. Your participation in the research is completely voluntary and you may choose to withdraw at any time without any negative consequences. You are welcome to ask any questions prior to participating and throughout the period of the research project.

***Who can I talk to about this research?***

If you have questions, concerns, or complaints, or think the research has harmed you in any way, you may contact the research team at:

Emily Tancredi-Brice Agbenyega, 16 Westminster Ct., New Rochelle, NY 10801, [emilytba@temple.edu](mailto:emilytba@temple.edu), or 484-433-9895.

This research has been reviewed and approved by an Institutional Review Board. You may talk to them at (215) 707-3390 or e-mail them at: [irb@temple.edu](mailto:irb@temple.edu) for any of the following:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research subject.
- You want to get information or provide input about this research.

***What happens if I agree to be in this research?***

The research project will last approximately 10 months including both observations and interviews. Interview invitations will be sent out and participants will be invited to participate in initial interviews lasting approximately 60 minutes at a time and location on a date of their choosing over a 2-3 month period. Following initial analysis of interview findings, approximately 2-3 months later, the investigator will invite the participants for follow-up interviews lasting approximately 30-45 minutes, also to be scheduled at a time and location on a date of the participant's choosing. The investigator may also, with the participant's permission, email a participant with questions to verify that the investigator's interpretation of the participant's responses matches the participant's intended meaning.

Interviews may be held in person, via telephone or Skype, depending on the participant's preference. All interviews will be recorded and transcribed.

***What happens to the information collected for this research?***

To the extent allowed by law, we limit the viewing of your personal information to people who have to review it. We cannot promise complete secrecy. The IRB, Temple University, and other representatives of these organizations may inspect and copy your information.

Each interview will be digitally recorded and recordings will be stored on the investigator's encrypted, secure personal computer until up to 5 years after the conclusion of the study. All files will be identified according to participant pseudonyms and will be transcribed by the investigator and a qualified transcription service. Each transcript will be reviewed by the investigator and interviewee to ensure accuracy and corrected accordingly. Each reviewed transcript will be stored on the investigator's encrypted, secure personal computer until up to 5 years after the conclusion of the study.

Generalized findings from the study may be shared with HES after all identifying information has been removed.

Your signature documents your permission to take part in this research.

_____ Signature of subject	_____ Date
_____ Printed name of subject	
_____ Signature of person obtaining consent	_____ Date
_____ Printed name of person obtaining consent	