GENDERING PROFESSIONS: AN ANALYSIS OF PEER EFFECTS

by

BRIAN A. RUBINEAU

Bachelor of Science in Mathematics, Massachusetts Institute of Technology, 1993
Bachelor of Science in Brain and Cognitive Sciences, Massachusetts Institute of Technology, 1993
Masters of Science in Population and International Health, Harvard School of Public Health, 2000

Submitted to the Alfred P. Sloan School of Management
In Partial Fulfillment of the Requirements for the Degree of

DOCTOR OF PHILOSOPHY

at the

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

June 2007

Author: _____

Brian Ari Rubineau
Sloan School of Management
April 30, 2007

Certified by: _____

Roberto M. Fernandez
William F. Pounds Professor of Management
Thesis Committee Chair

Accepted by: _____

Birger Wernerfelt
Professor of Management Science
Chair, Ph.D. program, MIT Sloan School of Management

Gendering Professions: An Analysis of Peer Effects

by

Brian A. Rubineau

Submitted to the Alfred P. Sloan School of Management on April 30, 2007 in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Management

Abstract

Professional identity is important both to professionals and to the professions of which they are members. In addition to being crucial for professional success at an individual level, and for the maintenance of professional boundaries and autonomy at the collective level, professional identity is an important contributor to the career decisions of professionals including persistence in the profession and specialization choices. When professional identities within a profession differ systematically by sex, these identity-dependent decisions contribute to the sex-segregation of professions or their specialties. Research often implicates professional identity as contributing to the segregation and related gender inequalities documented in numerous professions.

Efforts to address these gender inequalities must be informed by the gender dynamics of professional identity formation processes. Despite copious theory, the literature on professional identity formation suffers from being under-tested. In decades of research, there has been little conclusive evidence as to which socialization mechanisms contribute to professional identity formation or how these mechanisms may be gendered. This dissertation provides conclusive evidence for peer influence and gendered peer influence on professional identity formation in engineering.

After surveying the literature on identity formation theories, my first study investigates a host of professional identity indicators to establish which aspects of professional identity are associated with gendered persistence in the engineering profession. I identify a role-specific efficacy-related measure as a potential source of gendered persistence in the profession. My second study conducts a causal test of peer influence on the development of the efficacy-related measure identified in the previous study. Using the quasi-experiment of roommate assignment, I address the methodological and analytical hurdles that have stymied previous research in this area. I find evidence that men are influenced by their male peers, and find no such influence among women. This result is replicated in a similarly-structured third study from a different professional setting. I conclude that men's informal professional socialization via peers serves a resource for professional identity formation that is not available to women. These studies provide the first conclusive evidence for the role of peers in professional identity formation, and how this peer influence mechanism is gendered.

Thesis Supervisor: Roberto M. Fernandez
Title: William F. Pounds Professor of Management

THESIS COMMITTEE

Roberto M. Fernandez (Chair)
William F. Pounds Professor of Management
Sloan School of management
Massachusetts Institute of Technology

Lotte Bailyn
Professor of Management
Sloan School of management
Massachusetts Institute of Technology

Susan S. Silbey
Professor of Sociology and Anthropology
School of Humanities, Arts, and Social Sciences
Massachusetts Institute of Technology

Acknowledgements

In addition to teaching by his singular example, Roberto Fernandez teaches using his own library of stories and sayings. One of the many Roberto-isms I have come to appreciate is "it takes a village to raise a Ph.D." In my case, it has taken more than one.

The first village without a doubt has been my family. First and foremost, my besheret, AJ, for whom every hour I worked in the evenings at home was an hour she was solely responsible for our first just one, then two, then three children. In addition to providing me endless encouragement, perspective, love, and joy, my family has been a great motivator – if I weren't spending my time with my family, then I certainly needed to be productive with that time. And my family village is happily much larger than AJ and our children. My parents, Ken and Barbara Rubin (Ken & Barbie), my sister, Jennifer Larson and her family, and the whole Aarons clan have supported me and graciously indulged me as they shared me with my work on family holidays. AJ's father Paul and his wife Linda generously lent me the use of their house for a couple of weeks, when I needed to approach my dissertation with monastic intensity. AJ's unusual supply of sisters and their partners and families has helped far more than I could have hoped or would have expected. Childcare, rides, meals, laughs, distractions, even yard work at the 12-14 Blackstone Street family compound, and perhaps most importantly, acting at times as a surrogate partner for AJ when I was less available or helpful were all provided with love and without hesitation by Niki & Roland Plourde (and Wendy Plourde's excellent babysitting), Michele & Will McNeill, and Kate Babineau and Kevin Zanetti, and for that and more, I am eternally grateful. And for those few precious times when I wasn't working, all of our vacations were made possible by the Rubin Resort (either for us or a place to park the kids), the Babineau shack in Shediac, or wonderful cousins Brian & Lori Bianchin in Hawaii.

The second village raising this Ph.D. is the exemplary fifth floor at MIT Sloan and my committee. Every door is open there, and there is always time for help. Where else could I have such an amazing committee? At the feet of a master, I learned not only about excellent scholarship, but what an incredible difference a good mentor makes. To the best of my ability, Roberto, I will try to pass on what you have so richly bestowed. If it weren't for her kindness, generosity and patience, I would find Lotte Bailyn quite intimidating: expertly versed in seemingly all areas (and especially the ones I care the most about) with penetrating insight. Thank you, Lotte, for gently instructing me Jeopardy!-style, with comments coming in the form of a question, allowing me the illusion that I was coming up with the improvements myself. It is not that Susan Silbey was a perfect matched for me, but that she somehow impossibly seems to be a perfect match for anyone. Susan's ability to see beyond the surface of a topic into its underlying tensions and assumptions allows her target the essence of not just scholarship but everyday life with brilliance and acumen. Susan, thank you – I am lucky to have your voice added to my own internal chorus. I now think what you might ask or say not only when engaging with academic topics, but when choosing among supermarkets, contemplating jury duty, or reading a warning label. Beyond my committee is the wonderful village of the extended fifth floor: not only the Organization Studies Group and Economic Sociology Program both with which I'm honored to be associated, but many others. When I arrived, I was told just to knock on the doors of faculty to talk. I had been more of a go-it-alone person, but happily got over it. To Pierre Azoulay, Pablo Boczkowski, Diane Burton, Paul Carlile, John Carroll, Emilio Castilla, Jared Curhan, Kate Kellogg, Tom Kochan, Denise Lewin Lloyd, Mark Mortensen, Wanda Orlikowski, Nelson Repenning, John Sterman, Jesper Sørensen, Chris Wheat, JoAnne Yates,

Ezra Zuckerman, thank you for welcoming me in, listening and helping, engaging with my work at talks, and more, after little more than a knock. This dissertation is about peer influence, and I am well aware of the excellent benefits accruing from my amazing fellow students. Of particular help, comfort, and all things good (including the world's best flan and superlative hostessing) has been my compatriot and fellow traveler through OSG – Maria Alejandra Quijada – my havruta. Maria seemed to do everything a few weeks before me, from generals, to accepting a job, to defending, even to finally leaving MIT. Maria – thank you for breaking everything in for me. I'd like to note the support of a number of particular groups and their members. My Organization Studies Group: Michael O'Leary, Sachi Hatakenaka, Henrik Bresman, Kate Kellogg, João Vieira da Cunha, Heng "Alice" Xu, Melissa Mazmanian, Jason Greenberg, Joelle Evans, Jason Jay, Kate Parrot and Styliani "Stella" Kounelaki. The rest of my entering cohort: Kevin Boudreau, Nicola Lacetera, Karim Lakhani, Rafel Lucea, and Fei Qin. My officemates over the years: Kate, Michael, Sachi, Melissa, Sarah Kaplan, Matthew Bidwell, Steve Kahl, and Yanbo Wang. My job-market cohort: Maria, Rafel, Fei, Steve, and Ramana Nanda. My Fernandez siblings: Emilio, Jason, Lourdes Sosa, Isabel Fernandez-Mateo, Collette Friedrich, and Louise Mors. The fifth floor students remaining: J.P., Zev, Ryan, Ruthanne, Mara, Chuck, Rodrigo, Helen, Ethan, Adam, and the rest. But this fifth floor village would not function at all were it not for the efforts and countless favors of its excellent staff over the years: Carrie O'Brien, Cher Hugus, Loretta Caira, Michelle Fiorenza, Jamilah Allen, Megan Withers, and Keira Horowitz. I thank Pam Liu for all the forms, scheduling, and our community-enhancing lunches and such. Tammy Santora, Sharon Cayley and Hillary Ross: thank you for taking care of all the important things like bills and registration, so I could focus on my studies and completing this dissertation.

Although the fifth floor is a village unto itself, it resides within a larger village, which has also been very important to me during my studies – the rest of MIT. From the Anthropology department, were it not for the assistance of Ayn Cavicchi for data collection, administration and panel maintenance; and Amberly Steward and Rosie Hegg for things both quotidian and contractual, I would not have been able to have the data that is the basis of this dissertation. In addition to the scholarship, there is the business of maintaining and improving the MIT village. For these efforts, I'd like to thank the inspiring people serving on the Committee for Student Life, the Committee on Campus Race Relations, LBGT-Issues Group, the wonderful volunteers of the GSC Task Force on Diversity. I would especially like to thank Larry Benedict, Ike Colbert, Steve Lerman, Hazel Sive, Ceasar McDowell, Rochelle Weichman, Nicholas Pearce, Hector Hernandez, Lily Burns, Tom Robinson, James Collins, and Abigail Francis for working with love for the improvement of MIT, and Chuck Vest for his incomparable leadership during the majority of my years at the Institute. Amid all this excellence, one person, leading by example, typifies the things I like and admire most about MIT – Mary Rowe.

Two village "outposts" have also been fundamental to my development as a Ph.D., and to the work in this dissertation in particular. One is that village upriver, most notably in the persons of David Lazer and Robin Ely. The second is the entire distributed FuturePaths team, including Susan, Ayn, Carroll Seron, Gina-Louise Sciarra, and Erin Cech. Along with my thanks to the FuturePaths team, I note that this material is based upon work supported by the National Science Foundation under Grants No. 0240817 and 0503351. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation.

I dedicate this work to Elian Sutker Rubineau, Morielle Daisy Rubineau, Melina Kay Rubineau, and their mother, my bride, AJ Rubineau.

Table of Contents

ABSTRACT **2**

THESIS COMMITTEE **3**

ACKNOWLEDGEMENTS **4**

TABLE OF CONTENTS **6**

TABLE OF TABLES **8**

TABLE OF FIGURES **10**

CHAPTER 1. INTRODUCTION AND OVERVIEW **11**

1.1. **STATEMENT OF PROBLEM** 11
1.2. **ANSWERS AND QUESTIONS FROM RELATED SCHOLARSHIP** 13
1.3. **RESEARCH QUESTIONS / AIMS OF THE DISSERTATION** 15
1.4. **DISSERTATION OVERVIEW** 17

CHAPTER 2. PROFESSIONAL IDENTITY FORMATION: PREVIOUS RELATED RESEARCH **19**

2.1. **PROFESSIONS AND PROFESSIONAL CREDENTIALING** 19
2.2. **THEORIES RELEVANT TO PROFESSIONAL IDENTITY FORMATION** 20
2.2.1. *Foundational Theories: Functionalism & Symbolic Interactionism* *20*
2.2.2. *Current Sociological Theories of Identity Formation* *31*
2.2.3. *Current Psychological Theories of Identity Formation* *41*
2.3. **SYNTHESIS** 47
2.3.1. *Common Mechanisms* *47*

CHAPTER 3. CLARIFYING TERMS AND DEFINING CHALLENGES **54**

3.1. **CLARIFICATION OF TERMS** 54
3.1.1. *Profession* *54*
3.1.2. *Gendered Processes* *56*
3.2. **CHALLENGES IN IDENTIFYING PEER EFFECTS** 58
3.2.2. *Reflection Problem and Its Solution* *61*
3.2.3. *Exemplars and the Current Approach* *62*

CHAPTER 4. DISCRIMINATING PERSISTENCE: IDENTITY AND GENDERED ENGINEERING OUTCOMES **63**

4.1. **WHAT ASPECT OF PROFESSIONAL IDENTITY IS ASSOCIATED WITH GENDERED PERSISTENCE?** 63
4.2. **IDENTIFYING ASSOCIATIONS WITH GENDERED PERSISTENCE** 65
4.3. **DATA** 67
4.4. **VARIABLES** 68
4.4.1. *Independent Variables: Professional Identity Indicators* *69*
4.4.2. *Dependent Variables: Persistence in the Engineering Profession* *82*
4.5. **ANALYSIS: TESTING FOR ASSOCIATIONS WITH GENDERED PERSISTENCE.** 85
4.5.1. *Variable Summaries* *85*
4.5.2. *First order associations: Correlations* *87*
4.5.3. *Identifying associations with gendered persistence: Regression with interactions by sex* *90*
4.6. **DISCUSSION** 94

APPENDIX A. SURVEY ITEMS FOR CHAPTER 4 ..... **99**

CHAPTER 5. PEER INFLUENCE ON THE PROFESSIONAL IDENTITY OF ENGINEERS **101**

5.1. **OVERVIEW** 101
5.2. **INTRODUCTION** 101
5.3. **DATA** 103
5.3.1. *Data Sources* *103*

5.3.2. Dependent Variable: Engineering Self-Competence (ESC) *105*
5.3.3. Independent Variables: Students' background characteristics *106*
5.4. ANALYSIS 109
5.4.1. Non-random assignment & Inverse Probability of Treatment Weighting *109*
5.4.2. Roommate Correlations on the Background Variables *113*
5.4.3. First Causal Test of Peer Influence: Ignoring Gender *116*
5.4.4. Second Causal Test of Peer Influence: Gendered Dynamics *118*
5.5. CONCLUSION 122

APPENDIX B. ANALYTICAL SCENARIOS FOR STUDYING GENDERED PEER INFLUENCE 126

B.1. ANALYTICAL SCENARIO TAXONOMY 126
B.2. DESCRIPTIONS OF INDIVIDUAL ANALYTICAL SCENARIOS 127
B.2.1. Scenario A. Ignoring gender *128*
B.2.2. Scenario B. Sex differences in the experience of influence *128*
B.2.3. Scenario C. Sex differences in the exertion of influence. *129*
B.2.4. Scenario D. Sex differences in both exerting and experiencing peer influence. *130*

APPENDIX C. SURVEY ITEMS FOR THE ANALYSIS VARIABLES IN CHAPTER 5 131

C.1. ROOMMATE PREFERENCE SURVEY 131
C.2. ITEMS FROM THE FIRST YEAR SURVEY 131
C.2.1. DEPENDENT VARIABLE: ENGINEERING SELF-COMPETENCE *131*
C.2.2. INDEPENDENT VARIABLES *132*

APPENDIX D. GENDERED PEER EFFECTS IN ASSIGNED PROJECT TEAMS 133

D.1. INTRODUCTION 133
D.2. DATA 133
D.3. ANALYSIS 143
D.3.1. Gendered role of peers in professional identity *143*
D.3.2. Testing for Non-random Team Assignment *143*
D.3.3. Analysis of peer effects *150*
D.4. SUMMARY AND DISCUSSION 162

CHAPTER 6. SUMMARY, DISCUSSION AND CONCLUSION 164

6.1. SUMMARY 164
6.2. DISCUSSION 166
6.2.1. Discussion of Findings *166*
6.2.2. Limitations *177*
6.3. CONCLUSION 178
6.3.1. Lessons *178*
6.3.2. Future Research *179*

REFERENCES 182

Table of Tables

Table 1: Factor Analysis Yielding "Demographic Category Importance" and "Career Category Importance" Professional Identity Indicators 70

Table 2: Factor Analysis Yielding "Value Problem Solving" and "Value Social Perspective" Professional Identity Indicators 73

Table 3: Factor analysis yielding the "Academic Self-Competence" professional identity indicator. 75

Table 4: Factor analysis yielding the "Engineering Self-Competence" professional identity indicator. 76

Table 5: Factor Analysis to Establish Independent Dimensions of the Major-role 80

Table 6: Factor Analysis to Establish Independent Dimensions of the Self-Role 80

Table 7: Factor Analysis Yielding "Engineering Commitment" Persistence Indicator 84

Table 8: Summary statistics of analysis variables and tests for significant differences by sex. 87

Table 9: Correlations Among Persistence and Professional Identity Indicators 89

Table 10: Associations between professional identity indicators and persistence with sex interactions. 93

Table 11: Point estimates and standard errors for associations among women, derived from Table 10. 94

Table 12: Summary statistics of variables 107

Table 13: Summary statistics for and correlations among the variables used in the analysis 108

Table 14: Initial and final predictive models for roommate assignment for men and women using p*. 112

Table 15: Correlations between roommates on analysis variables. 114

Table 16: Tests for model fit and associations in roommate assignments of men based on student background characteristics using p* giving estimated coefficients as log odds (and standard errors) 115

Table 17: Tests for model fit and associations in roommate assignments of women based on student background characteristics using p* giving estimated coefficients as log odds (and standard errors) 116

Table 18: Analysis of roommate influence on ESC ignoring gender, weighted using the IPTW method, and including the HC2 small sample adjustment. 118

Table 19: Test for peer effects regressing ESC on ego's and alter's background characteristics with sex interactions using IPTW weighting and HC2 small-sample correction. 121

Table 20: Four Analytical Scenarios to Test for Gendered Peer Influence Processes. 126
Table 21: Description of Assumptions and Parameterization of the Four Analytical Scenarios to Identify Gendered Peer Influence Processes. 127
Table 22: Roommate Preference Survey with Response Counts (N=75) 131
Table 23: Summary Statistics for Analysis Variables 140
Table 24: Correlation Matrix for Analysis Variables 141
Table 25: Tests for Demographic Sources of Non-random Team Assignment using p* ... 145
Table 26: Testing for Non-Random Team Assignment Among the Independent Variables used in the Analysis using p*. 149
Table 27: Testing for peer effects using analytical scenario A (ignoring gender) across four outcomes using ordered logit regression models, and clustering by team. . 151
Table 28: Testing peer influence using analytic scenario B (sex-interaction effects) across four outcomes using ordered logit regressions and clustering by team. .. 153
Table 29: Results sub-set: Point estimates and standard errors for peer effects on women in scenario B. 155
Table 30: Testing gendered pnfluence using analytic scenario C - peer effects of male and female peers across four outcomes using ordered logits and clustering by team. 156
Table 31: Testing for gendered peer effects in analytical Scenario D across four outcomes using ordered logit and clustering by team, part I. 158
Table 32: Testing for gendered peer effects in analytical Scenario D across four outcomes using ordered logit and clustering by team, part II. 159
Table 33: Results sub-set: Point estimates and standard errors for peer effects on women students separated by sex of peers. 161
Table 34: Regressing year 1 Engineering Self-Competence (ESC) on only the significant variable from Chapter 5, using IPTW and HC2 small sample correction. 173
Table 35: Tests of network variable interactions with roommate influence effects regressing year 1 Engineering Self-Competence (ESC) using IPTW and HC2 small sample correction. 175
Table 36: Text interpretations of the results from Table 35 176

Table of Figures

Figure 1: Histogram of the sex composition of the teams in the sample based on survey responses. 146

Figure 2: Histogram of the sex composition of the teams with full team-member data. ... 147

CHAPTER 1. INTRODUCTION AND OVERVIEW

1.1. Statement of Problem

Few women become engineers. Of all the main undergraduate majors, engineering is the most male-dominated (National Center for Education Statistics 2005b). Those women beginning their undergraduate career as engineers leave that major at rates higher than their male counterparts (Adelman 1998; National Science Foundation 1999). Women who go on to work as professional engineers have higher rates of exit from their jobs and the profession than comparable men. The engineering profession's job pipeline leaks women at every stage (Alper 1993; Seymour & Hewitt 1997; Sonnert 1999).

Other professions with more success in numerical integration still have persistent gender inequalities. Women and men have been admitted to law schools in approximately equal numbers for over a decade. Admitted women's LSAT scores are just as high as men's, and women actually tend to have somewhat *higher* undergraduate GPA's than their admitted male colleagues (Wightman 1996). By these indicators, women should do as well or possibly better than men in law school. However, by the end of the first semester at law school, women's grades tend to be significantly lower than men's grades, and this gap persists throughout the three years of law school (Guinier et. al. 1994; Wightman 1996). This gap is found even in schools that have eliminated participation grades and instituted name-blind grading (Working Group on Student Experiences 2004), and even schools eliminating the often deprecated pedagogical practice of the first year Socratic classroom (Fischer 1996). Because of this grade gap, recipients of law school honors such as law review membership and the Order of the Coif are disproportionately male. These honors directly affect which law students are considered for the most prestigious posts and firms.

Another numerical success story is medicine, which has not only achieved sex parity in admissions, but has had a number of newsworthy entering medical student classes dominated by women (). Medical schools have no gendered grade gaps detectable on a national scale as was the case among law schools. However, concurrent with this growth of women entering the medical profession, the medical specialties have grown *increasingly* segregated (Boulis, Jacobs & Veloski 2001). That is, women are increasingly selecting female-dominated specialties and avoiding male-dominated ones, and men are doing the complement. (There is very little movement across specialties once a specialty is determined in medical school because there is the high cost requirement to repeat residency training in the second specialty.)

What do these gender inequalities across professions have in common? For each of these phenomena, gender differences in professional identity have been implicated as important contributors. Forming an engineering identity has been shown to be directly associated with gendered persistence in that profession (Correll 2001; Lee 2002; Seymour & Hewitt 1997). Law schools are seen to be working to inculcate an implicitly masculine version of a lawyer identity within its students (Guinier et. al. 1994). When entering the enduringly hierarchical hospital setting, with a tradition of strong overlaps between occupational roles and sex (e.g., physicians and nurses), women's socialization experiences during training differ from those of men (Beagan 2001). And as the medical profession faces structural and institutional changes, the negotiations around identity tend to be resolved with a reification of masculinized themes in the male-dominated specialties (Kellogg 2005). Although there are certainly many other contributors to gender inequities in the professions, in this dissertation I focus on the processes gendering professional identity outcomes.

If these identity-based explanations for the gender inequalities in professions are even partially correct, then one ameliorative solution would be to work to eliminate gender differences in the professional identity formation process. There is a major problem: there is no conclusive evidence as to which processes contribute to gender inequalities in professional identity formation. Sociological studies of professional identity formation have focused on description and theory building, with a notable absence of theory-testing.

The study of professions has been a topic of enduring interest to sociologists and organization scholars. In the sociological study of professions, particular scrutiny has been directed toward professional education - notably, the institutions and processes associated with the socialization of new professionals. Given this history of intense and ongoing study, it is curious that much of the theory generated by this field has remained untested. That is, despite an abundance of attention, empirical data collection efforts, and more, across many professional socialization settings, there are surprisingly few studies where the hypotheses derived from this literature are empirically tested. Far from being an under-theorized topic, professional identity formation is however a grossly under-tested one.

This dissertation embraces the analytical sociology approach (Hedström 2005), that focuses on mechanism-oriented explanations of social phenomena. After reviewing and synthesizing the evidence and insights from previous research, I seek to "dissect" (Hedström 2005:3) one potential mechanism related to the gendering of professional identity formation – peer influence. Taking advantage of the quasi-experimental manipulation of peer ties in the form of roommate assignment, I test for the presence of peer influence in professional identity formation and for evidence that peers contribute to the gendering of those processes.

1.2. Answers and Questions from Related Scholarship

Professional identity formation has figured prominently both in literatures on the sociology of professions and identification in social groups. Between these two streams of scholarship, there is a good deal of agreement (or lack of disagreement) concerning the likely mechanisms of professional identity formation. First, professional identity formation is one key result (and indeed a primary purpose) of professional socialization processes. One reason for this prominence is the belief that the development of a professional identity entails a fundamental redefinition of an individual's self-concept (Hughes 1958). More than other role-identities, professional identity is commonly seen as remaining central and salient to the professional even beyond the professional setting (Abrahamson 1967). Further, fellow professionals become the primary reference-group for any social comparison (Salaman 1971). In this way, professional identity is an exemplar of Turner's concept of a person-role merger (Turner 1978).

Second, the training or credentialing phase of the process of becoming a professional is the locus of the most concentrated, intense, consequential and enduring socialization period in a professional's career. (Although there are some theories – Chicago School Symbolic Interactionism for one, that would be consistent with an alternative view – that the socialization during a professional's first job could be of comparable or greater import – this idea has not been voiced explicitly by that theory's proponents.)

Third, the informal aspects of socialization are likely to be as important if not more important than the formal aspects in terms of identity formation (Merton 1957: 41). Further, these informal socialization processes present the most promising opportunities for planned interventions (Sewell, Haller & Portes 1969). It is in specifying these informal socialization processes that the theories from these literatures begin to diverge.

There is a lack of agreement concerning the mechanisms of informal socialization that contribute to professional identity formation. One notable area of disagreement is the role of peers. Ethnographic and first-hand accounts of the identity formation experiences of professional entrants (e.g. Becker et. al 1961; Dornbusch 1955; Turow 1977; Van Maanen 1975) are replete with examples of peers figuring prominently in socialization. Professional entrants help each other to recognize, learn and enforce the norms and important aspects of the professional identities they are collectively pursuing. Yet, theories related to professional identity formation often play down a strong role for peers, or in some cases, neglect a possible role entirely. The few quantitative studies of peer influence on professional identity formation have not only produced ambivalent results, but have been plagued by problematic research designs that hamper the ability to draw conclusive inferences. This confusion is an empirical question I seek to begin to resolve with these studies.

A second area of disagreement relevant to my topic is how professional identity formation processes may be gendered. Some theories include gender as an aspect or form of identity interacting with aspects of professional identity along theory-consistent mechanisms. Other theories posit additional gendering mechanisms which intrude upon professional socialization processes. As previous empirical work on gendering in organizational contexts has shown, it is entirely possible for all of the theorized mechanisms to be contributing simultaneously to the gendered outcomes (Fernandez & Sosa 2005). Moving this debate forward requires testing these differing theories.

1.3. Research Questions / Aims of the Dissertation

There are two fundamental research questions driving my analyses in this dissertation:

1. During professional credentialing, do a novitiate's peers (fellow novitiates) have a significant impact on his or her professional identity outcomes?
2. If peers do have an impact, are these peer influence processes gendered?

For both of these questions, the answers suggested by the current literature are a likely "yes." Most theory supports the view that peers are likely to play some role in professional identity formation, and that it would be surprising if the role was not gendered in some way. This support, however, is only speculative. To date, there has been no rigorous demonstration of a causal role for peers in professional identity formation.

My contribution is to provide the first rigorous causal test of peer influence on professional identity formation and to test the gendered nature of that influence. The goal is not merely to demonstrate what has long been either directly or indirectly (in the case of gendered peer influence) hypothesized, but to assist in identifying opportunities to intervene in professional identity formation processes to promote more egalitarian outcomes in the professions. Although scholars may have hypothesized that the informal and social side of professional identity formation processes contain the most promise for planned interventions (Sewell, Haller & Portes 1969), this intuition has provided little guidance to policy makers regarding the actual design of such interventions. To better inform policies on this important matter, the cause-and-effect mechanisms of gendered professional identity formation must be demonstrated explicitly. In this dissertation, I perform this explication in the context of engineers.

The focus of this dissertation is squarely on the social processes producing professional identity, and NOT the professional identity outcomes themselves. Without question, differences in outcomes are an important topic that has motivated my research, but it is not the current

subject. A mechanism-based approach is based on the premise that to understand a phenomenon, one must understand the mechanisms that give rise to that phenomenon. Significant sex differences in professional identity outcomes prompt the question of "how did this come to be?" Answering this more process-oriented question with regard to one set of mechanisms – peer influence – is the goal of this dissertation. This dissertation tests whether peer influence is a mechanism that can contribute to gendered outcomes in professional identities.

1.4. Dissertation Overview

The remainder of this dissertation is organized as follows. Chapter 2 reviews and synthesizes the literature relevant to professional identity formation, drawing from social psychological theories of identity formation. For each theory, I provide the general mechanisms of identity formation suggested by the theory, how that theory explains gendered identity outcomes, and the suggested role of peer influence. Following this review, I synthesize the described mechanisms into a set of common mechanisms, and identify the aspects of professional identity that can serve as indicators for the identity formation process.
In addition to providing some much needed precision regarding terms at the core of this study – "profession" and "gendered social process," Chapter 3 describes the analytical challenges that have stymied work in this area, how I overcome them.

Chapter 4 presents a prerequisite analysis testing different theorized aspects of professional identity for associations with gendered persistence. Professional identity is a multi-faceted and multi-dimensional construct. Because the goal of my research is to explicate mechanisms to inform equity-promoting policies, it is important that the aspect of professional identity being explicated is consequential for gender equity in the profession. This analysis identifies two aspects of professional identity directly associated with intentions to persist in the

profession: problem-solving values, and engineering self-competence (ESC). Of these two, only ESC is associated with gendered persistence. Although increases in ESC are directly and positively associated with persistence among both men and women, women have significantly lower levels of ESC. Increasing women's ESC is one way to promote persistence among women engineers.

Revealing the role of peers in ESC formation is the subject of the analysis presented in Chapter 5. The analysis of peer effects when neglecting the possibility of gender differences in influence finds no strong peer influence. When conducting an analysis of gendered peer influence, the story changes dramatically. The results show that while men do significantly and directly influence men on the ESC outcome, there is no such evidence for women influencing women. Concluding this dissertation, Chapter 6 contextualizes the results in terms of related research and findings, offering some explanations for the finding of peer influence among men but not women, and presents suggestions for future research.

CHAPTER 2. PROFESSIONAL IDENTITY FORMATION: PREVIOUS RELATED RESEARCH

This topic brings together two considerable literatures: the sociology of professions, and identity, with a focus on gender at their intersection.

2.1. Professions and Professional Credentialing

The study of professions has been a topic of active research within sociology and organization studies. Society affords privileged status to those individuals who belong to the various cadres of professions. Professionals comprise a growing segment of the workforce, performing tasks society reserves for them. The degree to which certain segments of society are under-represented in the professions is one indicator of their status in society. In this way, the segregation of professions can be an indicator of social stratification more generally (Appold, Siengthai & Kasarda 1998).

Individuals wishing to join a profession must first gain entrance to that profession's credentialing program. Those who successfully complete a profession's credentialing program may join the ranks of practicing professionals (Collins 1979). One characteristic of professions is that they set their own membership criteria, and thus can define the structure, nature and content of their own credentialing processes (Goode 1957; Merton 1982). Therefore, it is in the credentialing process interface between the lay public and professional practitioners that professions have the most opportunity to determine the character and composition of their membership. An individual's experiences during the professional credentialing process determine whether or not she completes the process with a desire to continue in that profession. Given the importance of the credentialing process to the professions, it is no surprise that one of the most studied topics in the sociology of professions is the process of professional training (Elliott 1972). Credentialing institutions are commonly compelled by professional ethics, if not

explicit law, to ensure that the formal processes of credentialing are free from discriminatory bias. The informal processes do not receive such scrutiny, and one such process – socialization via peers – is the subject of this study.

2.2. Theories Relevant to Professional Identity Formation

The first explicit studies of professional socialization during professional credentialing were conducted in the mid-twentieth century by two differing schools of sociological theory: functionalism and symbolic interactionism. The work of the former culminated in the publication *The Student Physician* (Merton, Reader & Kendall 1957), and the latter in *Boys in White* (Becker, Geer, Hughes & Strauss 1961). After reviewing the contributions to this topic since these two foundational works, Atkinson (1983) criticized the field for making little progress. Seven years later Atkinson and Delamont (1990) declared the topic "stagnant" and "sterile." Although their prescription is additional theory building, by integrating the sociology of professions with advances in the sociology of science, my perspective is that after a half century of theory building, serious attempts at theory-testing are in order.

After discussing what both of these theoretical perspectives suggest regarding professional identity formation, I describe the current social psychological theories of identity formation in general – both from the sociological and psychological sides of the disciplinary divide, focusing on select aspects of a set of theories that are relevant to professional identity formation, peer effects, and gender. The goal of this review is to identify the salient mechanisms and indicators to inform and facilitate efforts to empirically test these theories.

2.2.1. Foundational Theories: Functionalism & Symbolic Interactionism

2.2.1.1. Functionalism: The Student Physician

The Functionalist view of professional identity formation emphasizes professional socialization (Merton et. al. 1957: 288) during credentialing (Merton et. al. 1957:77) as the process of creating new professionals. As the introduction to *The Student Physician* stated, "it is plainly in the professional school that the outlook and values, as well as the skills and knowledge, of practitioners are first shaped *by the profession*" (Merton 1957: vii, emphasis added). This apparent agency given to the profession as a collective, but more or less absent among the entering professionals, later became a key critique of Functionalist Theory (Giddens, Duneier & Appelbaum 2003:19; Turner 1988).

The goal of professional socialization, and one definition of professional identity from Functionalism, is for aspirants to acquire "a definition of professional status,… attitudes toward that status,... a self-image, and a set of professional values" (Merton 1957: viii). These understandings and internalized conceptions and values are the *sine qua non* of Functionalism's professional identity. The socialization processes instilling professional values within entrants include both formal and informal processes, with an acknowledgement that the informal or "indirect learning" processes are likely more important for identity formation or "role acquisition" (Merton et. al. 1957: 41).

Mechanisms

Although Functionalism emphasized the role of socialization in professional identity formation, including both formal and informal processes, the particulars of the informal mechanisms were not fully described. Indeed the teleological focus on effects rather than mechanisms was another key criticism of Functionalism (Turner 1988). Two mechanisms hypothesized as important by a member of the research team were tested and shown to have associations with professional identity. These mechanisms correspond to reflected appraisals (an

individual's perceptions of others' evaluations of the individual) and building mastery or self-efficacy. Functionalists no doubt offered many more mechanisms, but they were neither clearly delineated nor tested in *The Student Physician.*

The series of empirical tests of the antecedents of professional identity conducted and presented by Mary Jean Huntington operationalized the role-acquisition of physicians as where medical students would place themselves on a continuum of thinking of themselves more as a student or more as a doctor. Huntington identified two dynamics with associations with physician role-acquisition by medical students at the end of their first year: (1) the degree to which others treated the students as doctors, or perhaps more to the point, the degree to which the students felt that others treated them as doctors (as the data came from self-reports); and (2) the degree to which the students felt like they handled clinical tasks without difficulty (Huntington 1957). These two concepts map well onto the familiar concepts of reflected appraisal and competence or self-efficacy. In addition, Huntington showed that over the four years of medical school, there was an increasing trend for medical students to report thinking of themselves more as doctors than students (Huntington 1957).

Gender interactions

Any role for gendered dynamics in professional socialization was essentially ignored. Women composed a small fraction of medical students at the time of the observation, and none of the teams made any particular note of any differences in experiences, interactions, or outcomes by sex. Mertonian's functionalism certainly allowed for the possibility of gendering dynamics in roles and occupations, including the dynamic of occupational sex-typing. Given male-dominated composition of both physicians and medical students, this profession meets Merton's definition of being "sex-typed" (cf. Epstein 1970: 966).

Role of peers

As mentioned above, the medical students themselves were afforded little agency under Functionalist Theory. Nonetheless, there are many examples of clear peer influence in the socialization process documented in *The Student Physician*. Several notable examples come from Rene Fox's chapter.

One source of evidence of the important role for peers in medical student socialization is the reasons for which students missed their peers when, in the third year, they entered the more individualized apprenticeships with clinicians in a hospital setting. One student reported considerable regret and increased uncertainty once "[s]eparated from some of the people on whom he depended for confirmation and support" (Fox 1957: 224).

Importantly, Fox provided evidence of a peer-contingent relationship between the technical mastery of a particular clinical skill and a student's self-efficacy as a physician. One student commented, "if it turns out that you're the only one who seems to be having so much trouble [with a particular diagnostic technique], you begin to look like a fool after a while if you do" (Fox 1957: 219). This quote suggests that failing to master a technique mastered by most of one's peers can result in the diminishment of one's physician self-efficacy; whereas failing to master a technique mastered by few or none of one's peers would be less likely to yield a similar decrement in self-efficacy. Turning this dynamic around, mastering a technique mastered by few of one's peers may result in an enhancement of self-efficacy beyond the enhancement associated with mastering a technique mastered by most of one's peers.

Finally, one student explicitly recognized the importance of the informal confirmation and enforcement of norms via peers when he stated, "As always, the biggest lift comes from talking to other students and finding that they have felt the same way. You may do this by a few

causal jokes, but you know there is more to it than that" (Fox 1957:220). After these and other observations, Fox summarizes, "[O]ut of the more than 'casual joking, asking around, and talking to others' that constantly go on among students, a set of standards for dealing with uncertainty [the chapter's focal dimension for student physician socialization] gradually emerges – standards that tend to coincide with those of the faculty" (Fox 1957: 220). In this statement, Fox not only acknowledges the important role of peers, she suggests that peer interactions are an important if not primary vehicle by which the norms of the profession (personified by the faculty) come to be realized by the students.

Despite this documented and recognized role of peers in professional socialization, Functionalist theory largely viewed professional identity formation as a process by which the profession – represented by established professionals – acted upon professional entrants via socialization during the credentialing process. Still, Merton and colleagues recognized that *all* the players contributed in some way to the socialization process. "Students not only learn from precept or deliberate example; they also learn – and it may often be, most enduringly learn – from sustained involvement in that society of medical staff, fellow students, and patients which makes up the medical school as a social organization" (1957:42). This difference is largely one of emphasis, and is captured by the functionalist concepts of manifest and latent functions. Professional identity formation may include both manifest functions of faculty and school-initiated socialization processes entailing latent functions of socialization via peer interactions. In Merton's functionalism, latent functions may be no less important than manifest functions in generating social outcomes.

2.2.1.2. Symbolic Interactionism: Boys in White

A team of researchers conducted extensive qualitative observations and interviews on a cohort of medical students for the duration of their four-year program. The synthesis of the team's interpretations is provided in the now-classic *Boys in White* (Becker et. al. 1961). Although the subject of study was very similar to that of the team in *The Student Physician*, the interpretations were quite different. Most relevant to the topic at hand, Becker's team did not see the medical school credentialing process as inculcating medical students with the identity of the profession. Quite the contrary, the socialization experiences of the students were towards realizing a *medical student culture*, with a clear preservation of the student role – often at the cost of the nascent physician role. For example, one of the norms collectively negotiated was in how to cope with the large volume of work expected of the students. There were two competing norms: one emphasized focusing on what would be helpful as a practicing physician, a second emphasized focusing on what was needed to satisfy the instructors. Although both norms were present early on, the former – which was argued as more consistent with shedding the student role in favor of embracing the physician role – lost out to the latter.

Socialization into the role of practicing physicians, according Becker's team, did not take place during medical school, but would take place once the students actually engaged in the work of practicing physicians. The medical student culture was described as having a "family resemblance" to the professional culture of physicians (1961: 192-193), providing the students with the "rudiments of the professional culture they will participate in after graduation" (1961: 193). Still, this perspective is quite distinct from that of the functionalists.

Another aspect of the medical school socialization experience viewed very differently by Becker's team as compared to Merton's team is the social construction of the socialization process. Whereas the functionalists saw the socialization process as generated by the profession

itself, Becker's team saw the students themselves exert agency in collectively developing the perspectives that comprise medical student culture. The student culture and the norms therein were not foisted upon the students, but rather collectively constructed by them.

Mechanisms

Symbolic Interactionism views social life as the shared and iterative creation of meaning through the sharing of social symbols (language, behavior, etc.), as well as the imbuing of meaning into new symbols. This meaning creation and meaning sharing happens not internally within individuals, but relationally via interactions. Shared meanings direct actions as well as generate new meanings.

During the course of medical school, the socialization process was one of generating meaning around the medical student role. In this process, the school, faculty and clinical settings introduce new symbols into the lives of the medical students whose meanings they must collectively negotiate. In addition, symbols and statuses from similar previous roles (e.g., fraternities in college) provide resources for this negotiation. The result is a culture that is decidedly more student than physician, but that includes many of the symbols that they will soon draw upon as they become practicing physicians.

In some earlier work by the lead author of *Boys in White*, Howard Becker, along with his colleague James Carper, described a set of mechanisms for professional identity formation (Becker & Carper 1956a). The set of five mechanisms included: the investment of time and personal resources; the development of interest and acquisition of specific skills; sponsorship by established professionals; the acquisition of ideology; and the internalization of motives associated with the profession. Of these mechanisms, Becker and Carper highlight the final two mechanisms as taking place via interactions with peers in addition to interactions with

established professionals. Although these mechanisms of professional identity formation are a product of the Chicago School of Symbolic Interactionism, they were neither used explicitly nor built upon in *Boys in White*. Given that the Becker and Carper study also investigated individuals during their professional credentialing, the theory expressed in *Boys in White* suggests that the identity formation taking place during that stage is distinct from professional identity, and could be more accurately described as the student culture associated with the profession. Even so, Becker and Carper note that particularly among engineers, most professional identity formation took place prior to the graduate training observed; that is, during undergraduate training or the work thereafter (Becker & Carper 1956a; 1956b).

Gender interactions

Becker's team tried to note when the few women in the cohort of medical students engaged in distinct activities, though no systematic analysis or theory-building was devoted to the possible impact of gender roles in the development and maintenance of student culture (with the possible exception of noting the distinctive behaviors and slightly lower integration of married students – which appeared to refer exclusively to male students). Notably, they observed that female medical students "are such a visible minority in the class that they evidently turn to each other for company" (1961: 148), but did not elaborate on the implications of this separation. In addition, they noted the absence of expected harassment of women in anatomy lab (1961: 103), and that "sex culture" of society did intrude on their interactions with patients (1961: 323-325). The theory is consistent with sex-differentiations in the negotiations of meaning given the salience of sex in society in general, and its documented intrusion into the practice of the medical students. However, they obliquely discount this possibility in that they believe "that the perspectives developed are much more apt to reflect the pressures of the immediate school

situation than of ideas associated with prior roles and experiences" (1961:47). One of the "latent identities" that was seen as having some expression in student culture was that of fraternity membership. Although I am not familiar with the fraternity cultures of mid-twentieth century, modern fraternities are settings where gender roles are extremely salient (Kalof & Cargill 1991). It would not be surprising if the fraternity identity included some particular norms regarding male-female interactions. Despite these observations and possibilities, the operation of gendered dynamics via the negotiation of student culture was a theme left unexplored in *Boys in White*.

Role of peers

In Symbolic Interactionism, every interaction is a source of negotiated meaning. The Becker team devoted much attention to the types, nature, frequency and content of student interactions. Dividing student ties with regular interactants into "companion" ties (ties between individuals sharing common living arrangements or choose to interact outside of class as in recreational activities) or "associate" ties (ties between individuals sharing only a class-based team), the team concluded "that companionship groups in the class affect the development of student perspectives at the beginning of the freshman year" (1961: 151-152). There are other examples of peer influence at this early stage of medical training, but the student culture at that point is focused on handling class work. I turn my attention to the peer influences documented in the last two years of medical school – the clinical years.

According to Becker's team's Symbolic Interactionism, students are not acquiring a professional identity in medical school, but only the rudiments thereof. Given my study focuses on professional identity formation, then the relevant aspects of medical school socialization included the processes by which these rudiments are acquired. Peers not only enforce the student culture of seeking clinical exposure and responsibility, as in one example of teasing a student for

not having a sufficient diversity of patients (1961: 247), but also serve as resources for clinical information and training. In fact, Becker's team documented the student perception that the closer a physician or resident was to being a peer, that is people "who are a little bit ahead of you" (1961: 246), the easier it was to talk with them about "practical information." This observation is not strictly peer influence, but indicative of shift in the types of interaction that range from the formal interactions with physician faculty to the less formal interactions with peers. And in some cases, where a student has more clinical or technical expertise than his colleagues, there will be explicit and impromptu peer-instruction (1961: 306). As documented in *Boys in White*, informal peer-comparisons on clinical tasks are common (e.g. Becker *et. al.* 1961: 249). As peers, students also engage in direct negotiations regarding clinical responsibilities and roles in the hospital in ways that are not possible to do with the physician staff and faculty (e.g. 1961: 301). *Boys in White* contains extensive documentation of the important role played by peers in acquiring the perspectives and symbolic meanings of not only the student culture, but also clinical and technical aspects of a physician's role – if only rudimentarily.

2.2.1.3. Relative Success of the Two Perspectives

Despite the decline in Functionalism as a leading theory within Sociology, and despite the fact that *Boys in White* has at this time more than twice the citation count of *The Student Physician* (although, to be fair, the latter is structured as chapters by distinct authors, while the former is a single team effort, which likely skews the counts from indexing databases), the functionalist perspective on professional identity formation has endured and arguably succeeded the symbolic interactionist perspective from *Boys in White*. I attribute this success to two primary reasons. First, Herbert Blumer, the father of Symbolic Interactionism from the Chicago School – the school of Becker and his team – explicitly eschewed quantitative evaluation of his theories

(Blumer 1956). The empirical verification of theories advocated by Blumer focused exclusively on qualitative observation. This stance challenges a strong norm even in the social sciences that the hypotheses entailed by a particular theory be subjected to hypothesis testing via traditional quantitative methods. To reflexively apply the theory of Symbolic Interactionism, the meaning of the conclusions from the qualitative observations negotiated within the proponents of the Chicago School Symbolic Interactionism did not achieve the same meaning when negotiated among the wider group of sociologists. Although Becker *et. al.* did include some quantitative analysis in *Boys in White*, in the form of count and frequency tables, the analysis was predominantly qualitative, and associated with Blumer's "Chicago School" perspective in name and perception if not in fact (Becker 1999).

Second, despite the appealing ideas of student agency and idiosyncratically negotiated cultures, in terms of professional socialization, the outcomes tend towards uniformity. Goffman described an extreme version of socialization in institutions where the entrant had little or no agency, and the socialization outcomes were uniform as socialization in a "total institution" (Goffman 1961a). Although professional schools are not at that extreme, they tend to be closer to it and the highly "custodial" socialization processes that yield more uniform outcomes (Van Maanen & Schein 1979), than institutions with more "innovative" socialization practices. One law student did make the claim that specifically Harvard Law School shared many characteristics with Goffman's "total institution" (Anonymous 1998). In the case were individuals who participate in the socialization processes within a particular institution tend to emerge with regular and consistent socialization outcomes, it is not surprising that the theory emphasizing the processes of uniformity finds greater traction than the one emphasizing idiosyncrasy. As described below, current theories of identity formation relevant to professional identity formation

continue to embrace quantitative analyses of the processes, and continue to emphasize the credentialing phase as a period of intense socialization where a professional identity is primarily developed.

2.2.2. Current Sociological Theories of Identity Formation

2.2.2.1. Structural Symbolic Interactionism (Iowa School),

As a defined theory, the Structural Symbolic Interactionist theory descendant from the Iowa School is arguably the dominant sociological theory of identity. Initially, the Iowa school of Symbolic Interactionism distinguished itself from Blumer's Chicago School in part through its embracing of quantitative approaches to studying interaction and meaning. In terms of identity, Manford Kuhn and Thomas McPartland's "Twenty Statements Test" (Kuhn & McPartland 1954) has been a widely-used innovation (Grace & Cramer 2003). Sheldon Stryker, Peter Burke and their colleagues have formulated the principles of Iowa School Symbolic Interactionism as applied to identity dynamics into the explicitly named "Identity Theory" (Burke & Reitzes 1981; Stryker & Burke 2000), and more recently, "Identity Control Theory" (Burke 1997; 2004; 2006).

Identity Theory sought to explicate Mead's assertion that "society" shapes the "self" (Stryker & Burke 2000:285). Notably, Identity Theory tried to identify what aspects of "society," interpreted as the social environment and structures encountered by an individual, does the shaping and how. In this search for mechanism-based explanations of identity development, Identity Theory was recast as Identity Control Theory (ICT). Because of this progressive elaboration, and in fact integration of views that began as more distinct (cf. Stryker 1980, where Burke's work is explicitly labeled as a variant of Stryker's interpretation of symbolic Interactionism), I focus on the most recent expressions of Identity Theory and Identity Control Theory (ICT).

Mechanisms

Identities are role-specific. The process of cultivating an identity with a particular role involves a control-feedback process beginning with an initial understanding of the role, and an understanding of the self. The individual locates others who are likely to provide useful role-relevant evaluations, and engages in role-performance. Based on reactions and additional observations of these alters, the individual alters her own definition of the role, as well as her understanding of her degree of match or mismatch between her role-enactments and her understanding of the role. This match is considered a multi-dimensional match between distinct role profiles. An example of a method for assessing profiles is provided by Burke and Tully (1977). ICT would operationalize professional identity as a particular type of role-definition, and thus definable by a role profile such as described in Burke and Tully (1977). Fundamental to this social aspect of role-identity formation or adoption is that the role is a socially-defined symbol with meaning to more than just the individual. Professions are such roles, but membership or acceptance in the role is not assigned but enacted. As stated by Burke, "[role identity] verification comes by what one does, not who one is" (2004: 9).

The process of acting and evaluating the role-match continues iteratively until the individual receives feedback that the match has been made successfully, or the person abandons the attempt to adopt that particular role in favor of some other role. It is conceptually possible that a person continues to endeavor to adopt a role despite enduring feedback of unacceptable mismatch, and simply remains in role-conflict, but the theory would posit that this would eventually resolve in either adoption or abandonment of the role.

The mechanisms of feedback about the focal individual's actions take the form of either direct observation (as in grades, task completion results, etc.) or reflected appraisals (the

individual's perceptions of alters' views of her degree of match). When the individual acts in role-appropriate ways such that her sense of mismatch is small or decreasing, positive emotions of satisfaction result and provide reinforcing motivation to continue to act in role-appropriate ways. If the mismatch is large or increasing, negative emotions provide the impetus to change. These interactions of external and internal feedback, matching, and altering both behaviors and role-understandings, driven by emotional motivations constitute the core mechanisms of Identity Control Theory.

Gender interactions

ICT has explored the dynamics of multiple-role identity processes, finding that individuals with existing higher status identities (tested using ascribed gender and race/ethnicity identities) were better able to verify other types of identities (work-based or academic-based) than individuals with lower status ascriptive group identities (Stets & Harrod 2004). This improved ability to verify includes the higher status person (ego) being able to influence a lower status alter's views of the higher status person; in addition to having the higher status ego influencing the lower-status alter's self views (Cast, Stets & Burke 1999). Applying these findings to the topic of the paper, if there are gender-status associations within co-educational undergraduate engineering degree programs such that men have higher status than women, then such associations may better enable men to self-verify their identities as engineers than women. Men's views of the appropriate role-profile for engineers would be more likely to be accepted by women than vice-versa. Also, women would be more likely to accept men's enactments as matching engineer-appropriate behaviors than the reverse.

Role of peers

ICT embraces the idea that not all alters have equal input for all roles. Part of the process of engaging in role-verifying acts is the selection of those alters with whom ego engages in such interactions. ICT suggests that those already in the role are particularly likely alters, which would emphasize role models over peers. However, peers may be more likely to provide the desired verifying feedback, or at least more predictable feedback, and thus also be attractive alters for verification.

2.2.2.2. Role Theory & Dramaturgical Theory

Rather than a distinctly articulated theory, Role Theory is more of a widely embraced metaphor. This metaphor is perhaps most fully explored in Dramaturgical Theory (Goffman 1959), where not only roles, but staging and other theatrical metaphors provide a useful lens through which to examine the social world. The Role Theory metaphor has suffused the social science literature involving identity – there is functionalist role theory (Merton 1957c; Parsons 1951), interactionist role theory (Stryker 1980), structural role theory (Winship & Mandel 1983-1984), and cognitive role theory (reviewed in Biddle 1986) – and has been wholly embraced by organization scholars as a key organizing principle (Katz & Kahn 1966: Chapter 7). Despite the lack of agreement on a defined Role Theory, an important and useful contribution of Role Theory is the language used to discuss social acts and identities. Below I present some of this language and discuss its relevance to professional identity formation, peer effects, and gender.

Role: Despite being the titular component of Role Theory, there is little agreement as to whether a role is a social position, a set of expectations, or modes of behavior (Biddle 1986).

Role-performance: In every social act, an actor adopts one or more roles that both guide the act, and assist the audience in correctly interpreting the meaning of the act. An act while in a particular role or set of roles is a role-performance.

Repertoire: The set of roles an individual may perform.

Role-taking: When engaging in a role-performance, an actor first engages in some sort of "role-taking," referring to cognitively assuming the role of the audience or alter that will observe or participate in ego's role-performance. The goal of role-taking is to anticipate reactions and responses, allowing some manner of adjustment before the actual role-performance takes place. In an extensive test of 15 hypotheses (with 10 tests each for most of the hypotheses) regarding role-taking inferred from Mead's writings based on surveys of married children and their parents and in-laws, Stryker found consistent support for only two of the hypotheses, but these two were strongly supported (10 out of 10 tests showed support). These were: that role-taking is more accurate among people who share the same occupation; and the accuracy of role-taking is independent of the amount of sympathy the person has with the views of the other whose role is taken. It is striking that similarity in occupation allowed greater accuracy in role-taking when similar similarities in sex, age, religion, blood ties, level of education, or even based on frequency of contact, produced less if any consistently accurate role-taking. Stryker did not comment on this particular finding, but I interpret this finding as support for the idea that occupational identities become primary among the many roles included in an individual's repertoire, and that within occupations, role-understanding of these identities are quite similar. It is worth noting that less accurate role-taking does not correspond to either less practiced or less important.

Alter-casting: Alter-casting is a form of influence where a role is assigned, rather than performed (Biddle et. al. 1985; Weinstein & Deutschberger 1963). When interacting, one can behave as if an alter is in a particular role regardless of whether that alter is actually attempting

to perform that role. Alter-casting is a form of role imputation and figures prominently in discussions of anticipatory socialization.

Role-conflict: When an actor's performance of a role is rejected by her audience, the actor experiences role-conflict. There are many possible reasons for role-conflict. Role-ambiguity could refer to the role performance not having a clearly identified role, or that the actor and audience disagree on the nature of the role being performed. Role-malintegration refers to an actor, who also inhabits other roles, performs a role that is inconsistent or contradictory with some of these other roles. A subordinate attempting to take on a role exerting authority over a superior might be one example of role-malintegration resulting in role-conflict. Further, the actor may simply lack the skills in producing the actions signifying a successful role performance. An unprepared lecturer might run into this aspect of role-conflict.

Role-merger: When a person cannot or does not shed a particular role, they have merged with that role (Turner 1978). In this case, the person internalizes the attitudes, values and behaviors associated with the particular role, and enacts the role even in situations where it may not be appropriate. Professional identity is a role commonly seen to be merged with the individual. Once a person becomes a doctor or lawyer or engineer, they remain in that role to some extent, even when engaging in other performances with other audiences when that role is unnecessary.

Role-modeling: Role performances serve as information to others seeking to enact similar roles. Successful role-performers are considered role-models for those aspiring to enact that role, or enact that role less successfully than the model.

Mechanisms

The primary mechanisms of identity formation in Role Theory involve the choices in enacting a role, the perceived reception or results of the role, and reactions or adjustments towards future performances of the role. The audience or alter participating in or observing a role-performance is a fundamental component of that performance. Understandably, Role Theory emphasizes the importance of selecting an audience (Mortimer & Simmons 1978:429). This audience selection mechanism relates role theory to reference group theory, which will be discussed in more detail below. Assessing the reception of a particular role performance may be via the familiar reflected appraisal mechanism or observation of less subjective role performance outcomes (e.g., grades). Adjustments to the role can result from the assessment mechanisms or through observations of role-models.

Gender interactions

The idea that some roles may affect the performance of other roles was articulated in Alvin Gouldner's description of "latent social roles" (Gouldner 1957; 1958). Latent roles are those other role enactments included in an individual's role performance that are considered illegitimate for evaluating the particular performance. Despite this illegitimacy, these latent roles often do affect the reception of a role performance. Sex-roles are a prime example of consequential latent roles. In her study of women's advancement in science, Barbara Reskin noted that the interactions of simultaneous roles "create a hybrid of gender and collegial roles that systematically introduces sex-role differentiation into the scientific community" (Reskin 1978: 10). Gendered role enactments in collegial interactions may conflict with meritocratic assumptions of the professional role. In our society, this conflict usually negatively affects women. Women may either act collegially – assuming equal status with male classmates – a violation of common societal gender-role norms, or they observe gender-role norms which also

signal lower professional status. The former is likely to provoke social sanction, while the latter undermines professional recognition. (Although status equality between women and men has progressed, research continues to demonstrate that the same behaviors that yield success for men can yield penalties for women [Carli 1999; 2001; Wagner & Berger 1997].) Also, in situations where there is role ambiguity regarding directing the actions of a profession's members, societal gender norms may serve as the resource to resolve that ambiguity, differentially engaging behavioral norms among professionals in gendered ways (Smith & Rogers 2000).

Role of peers

Although role models are commonly viewed as individuals more established in a particular role, and therefore unlikely to be considered a peer, peers can also serve as role models, in addition to providing information via reflected appraisals. In a study comparing the influence of the observed behaviors (modeling) and perceived attitudes (normative appraisals) of both peers and parents on students' self-concepts in terms of being a "smoker" or "drinker," Biddle *et. al.* (1985) found consistent evidence that peer behaviors influenced self-concepts, perceived peer attitudes sometimes influenced, and parental behaviors and perceived attitudes never influenced students' self-concepts for both types of identities. The study by Biddle *et. al.* provides an example where the major mechanism of identity formation was the role modeling from peers.

2.2.2.3. Reference Group theory and Networks

As with Role Theory, neither Reference Group Theory (Litwak 1960) nor Network Theory are fully articulated theories of identity formation; however, these related perspectives are increasingly invoked in scholarship on identity dynamics. Reference group theory, also tracing its lineage back to Cooley and Mead, emphasizes that the reflected appraisals from alters

are not all valued equally. Whether self-selected or structurally imposed, the identity formation process is more informed by a subset of one's alters. In some cases these consequential alters are members of an identifiable group (as in current professionals or professional school faculty for professional school students) seen as a *reference group*. In other cases, the important alters are more individually idiosyncratic, and may be considered *significant others*. The behaviors of and feedback from these consequential alters have a greater impact on an individual's formation of a particular identity than her other alters. Network methods have been suggested as a means to operationalize and analyze these particularly consequential subsets of possible alters and their effects on identity formation (Deaux & Martin 2003; Ibarra Kilduff & Tsai 2005; Kilduff & Tsai 2003). In one recent articulation, reference groups are explicitly defined through individual-specific network connections (Lawrence 2006).

Mechanisms

Reference group theory and network theory posit differences in the effects of alters or potential alters on identity formation by virtue of their relationships to the individual (ego), and their relationships to the identity in question. The mechanisms of this influence are not articulated within these theories. Studies testing reference group theory or network theory will test for differences in associations with identity outcomes between reference group / significant other / tied alters and other alters (e.g., Denzin 1966; McFarland & Pals 2005; Morrison 2002; Smith-Lovin & McPherson 1993; Wallace 1966).

Gender interactions

Because of strong social norms of associating by sex (McPherson, Smith-Lovin & Cook 2001), studies based on reference group theory, significant other theory, and network theory are likely to identify gendered dynamics. Denzin's (1966) study of college students looked at sex

differences in the frequencies with which students listed (among others) friends and other students (peers) as significant others (whose evaluations mattered to the subjects the most) either in their role as student (role-specific) or in their general role as a person. Women were more likely to list peers as role-specific significant others than men. There was no such difference in listing significant others for their general role. The sex of the significant other was not recorded in this study, but other studies have suggested that same-sex peers are more likely to be significant others than opposite sex peers (e.g., Wallace 1966:52). Notably, a study seeking to explain how women could be content workers in the presence of large wage disparities by sex found that women tended to compare themselves to other women and not to men in this regard (Major 1994). Network studies have demonstrated the effects of sex differences in the structure of instrumental and social support networks on professional advancement (Ibarra 1992; 1993), but have not looked explicitly at the role of identity in these processes

Role of peers

Early versions of Reference Group Theory emphasized a distinction between the reference group and the group to which ego belongs (Hyman & Singer 1968). In this sense, peers cannot be members of a reference group by definition. Current conceptualizations of reference group are less rigid (Lawrence 2006). Further, some scholars have suggested the more specific "significant other" conceptualization of the influential subset is also more accurate and useful than "reference group" (Sewell, Haller & Portes 1969). Peers are a source of important network ties, reference group members, and significant others. There is also evidence that social similarity, along a multitude of dimensions, makes social interactions and thus relational ties more likely (McPherson, Smith-Lovin & Cook 2001). So unless defined as irrelevant (as in the

case of early reference group theory, where peers cannot also be in a reference group), these theories support the importance of peers in identity formation.

Regarding gender and peers, these topics frequently overlap in reference group theory and significant other theory. In an analysis integrating questions of gendered dynamics of significant other influence, and distinctions between peer and parental influence, Hoelter (1984) found that perceived appraisals from peers had the biggest effect on women's self-evaluations, while perceived appraisals from parents had the biggest effect among men. It is also worth noting that Cooley emphasized both that "ascendant" individuals are likely to have greater influence – that is, role models influence the self more than peers – and that girls are simultaneously more impressionable in and more reflective and intentional about self-construction than boys. (1922:384-385).

2.2.3. Current Psychological Theories of Identity Formation

The above sociological theories of identity formation have emphasized actions, interactions, and reactions in a social context. The psychological theories of identity formation stress personality and cognitive mechanisms. The two major psychological theories related to identity – Social Identity Theory (SIT) and Social Learning Theory (SLT) – for the most part are not concerned with the process of identity formation, but rather the consequences thereof. However, both have derivative theories that do focus some attention on this topic. In addition, there is one psychological theory that focuses squarely on identity formation processes: Self-Verification Theory (SVT). I summarize each below.

2.2.3.1. Social Identity Theory / Self-Categorization Theory (SIT/SCT)

Despite being arguably the dominant theory of identity in the social sciences, Social Identity Theory (SIT – Tajfel & Turner 1986) has largely been mute about how the professional

identity formation process (as a type of social identification process) unfolds (Ashforth & Mael 1989:27; Whetten & Godfrey 1998). The fundamental component of SIT is a social group boundary. Being a member of a social group defines both an in-group and an out-group. Much of SIT focuses on the distinctive dynamics comparing in-group behavior and out-group behavior as well as the interactions across the group boundary. For SIT, joining a particular social group is also not-joining the corresponding out-group – the two groups cannot be considered in isolation.

The identity formation process – that is how an individual comes to see herself as belonging on one side or other of a particular social group boundary – is not a central topic of SIT. Many of the group boundaries studied are ascriptive groups that are socially defined since birth (e.g. sex, race, nationality), or groups constructed within a laboratory setting, as in the minimal group paradigm studies (Tajfel 1970). In both of these cases, the process of locating the self relative to the social group boundary is only incidental. Unlike such ascribed or assigned identity groups, there is more choice, negotiation, and latency in the process of forming a professional identity, and it is this process that is the topic under study. A theory derivative of SIT that does concern itself with the process of identity formation is Self-Categorization Theory (SCT – Hogg & Terry 2000; Turner 1987).

Mechanisms

A key concept in SCT is that of a group prototype. The prototype is a "cognitive representation of features that describe and prescribe attributes of the group" (Hogg & Terry 2000: 123). There are prototypes for people on both sides of a social-group boundary. SCT posits that people will be more likely to join the group with the prototype that best matches their own self-concept. As the individual engages in the process of joining the group, they de-personalize their own self-concept in favor of adopting more of the features of the group's prototype. In

addition, the individual considers out-group members less as individuals but instead embodiments of the out-group's prototype (Banaji & Prentice 1994; Hogg & Terry 2000).

Pre-dating SIT/SCT is the concept that the "groupy-ness" (termed *entitativity*) of a particular social group can be assessed by the degree to which group members feel they share a "common fate" with other group members (Campbell 1958). This concept was embraced by SIT/SCT and a "common fate" measure (e.g., Castano *et. al.* 2002; Gurin & Townsend 1986) has been developed to measure the degree of identification a person has with a particular group.

Gender interactions

The division of the sexes is a fundamental social boundary in SIT (Banaji & Prentice 1994). In addition, the features and characteristics defining a group's prototype are likely to have gendered associations in some way (Kreuger et. al. 2003). As such, the ability to join and adapt one's self-concept toward the prototype can be gendered in consequential ways (e.g., Payne, Connor & Colletti 1987).

Role of peers

Because ego's peers are, by definition, members of ego's in-group along a set of social boundaries, ego's behaviors, values and beliefs can be expected to be similar to those of ego's peers. If ego faces a choice of joining a group that places many of ego's peers as out-group members along that new group's boundary, then this presents a conflict that ego will need to resolve. This association is hardly one of direct influence, but SIT/SCT is primarily cognitive in its operation.

2.2.3.2. Social Learning Theory / Social Cognitive Career Theory (SLT/SCCT)

Social Learning Theory (SLT – Bandura 1977) was developed as an explanation of learned human behavior, and was in part a reaction against Skinnerian Behaviorism. Bandura's

critique of behaviorism was that people could learn from observation, that is, vicariously, in addition to direct reinforcement (Bandura 1969). The ability to learn from the experience of others turns learning into an ongoing social enterprise. In elaborating his theory, Bandura renamed his theory "Social Cognitive Theory." (Bandura 1986; 1989; I keep the SLT abbreviation to avoid confusion with Self-Categorization Theory.)

An abbreviated representation of the ideas underlying SLT is Bandura's "triadic reciprocal determinism" (1989:1) between the person, behavior, and environment. Each of the three components can be thought of as a function of the other two, thus each component is both cause and consequence. The three elements serving as the basis of Bandura's theory actually map quite well and directly onto Mead's I, me, and society (Mead 1934). Thus, the self (Bandura's "person" and Mead's "I") is constructed through the cognitive incorporation of interactions between behavior and environment, which have in turn been shaped by the self.

A key mediating concept in self-construction under SLT is self-efficacy. Individuals pursue roles, activities and behaviors where they have a sense of self-efficacy, and avoid pursuits where self-efficacy is low. Self efficacy is completely task or role-specific. That is, it can be high for one role but low for another, and Bandura would reject the concept of a "global" self-efficacy. This specificity is because self-efficacy is learned in the context of a particular role or task. An individual's previous achievement in a role or task, coupled with external feedback and any relevant sources of observational learning (as well as the individual's physiological state), cognitively combine to form that person's self-efficacy for that role or task. SLT has been tested extensively, but most commonly with children as subjects, as has been the custom of behavioral learning theories. A group of scholars applied SLT to the career pursuits of adults, and developed "Social Cognitive Career Theory" (SCCT – Lent, Brown & Hackett 1994).

Mechanisms

In SCCT, individuals develop interests in occupations over the course of their youth. In iterative and parallel processes, individuals observe adults in occupational positions and engaging in occupation-related tasks, try performing some related tasks, and receive feedback on their actions. By engaging in many such trials, the young person develops interests in vocational areas depending on: their self-efficacy in related tasks, the perceived rewards of the vocational path, and personal goals. Vocational interests are thought to remain fluid through adolescence and solidify during early adulthood, requiring major disruptive events to prompt adults to reconsider their vocational paths.

Gender interactions

Given that vocational interests in early adulthood are refinements of exposures and experiences from childhood, early gendered exposures and feedback on activities can have dramatically cumulative effects over the life course. Interestingly, conditioned on reaching adulthood with similar vocational interests, SLT/SCCT would predict gender differentiation from that point on resulting less from self-efficacy differences and more from differences in goals and expected rewards.

Role of peers

Although SLT/SCCT is a primarily cognitive theory, the learning is definitely social. Bandura wrote explicitly, “Peers are sources of much social learning” (1989). Observational learning influences self-efficacy and expectations of success. In this way, individual self-efficacy can be anchored to the observed experiences of peers. If a person sees her peers doing poorly at a task, she is likely to have lower self-efficacy than she would have absent that information. A similar positive effect could happen in the reverse.

2.2.3.3. Self-Verification Theory

"Self-Verification Theory" (SVT – Swann 1983) presents a psychological perspective on the "looking-glass self" theory of Cooley (1922) and of symbolic interactionism in general (e.g., Blumer 1969; Mead 1934; Stryker 1980). SVT may be seen as a psychological analogue of Identity Control Theory (ICT). Both theories emphasize the importance of identity formation via interactions with, and processing identity appraisals from, alters. Both theories also allow for the possibility that the influence of ego's alters result from ego's own choices and may not be causally attributable to the actions of ego's alters. From this theoretical perspective, a causal role for peers in identity formation is ambiguous.

Mechanisms

Self-Verification Theory (SVT) sees identity-verifying feedback from ego's alters as fundamental to identity formation (Swann 1983). Despite this central role for alters, SVT does not entail a causal role for peers. SVT posits three main mechanisms in identity formation: seeking, signaling, and selecting. The seeking mechanism has ego differentially seeking out alters who are more likely to verify her identity. Signaling are ego's actions (e.g., dress, language, and other behaviors) intended to signal membership in a particular group and to elicit identity-verifying responses from her alters. The selecting mechanism is how ego deals with variation in the received "verifications." It is a form of confirmation bias where supporting verifications are remembered while contrary feedback is disregarded.

In all three of SVT's mechanisms, agency rests squarely upon ego. Although the individual depends upon the verifying feedback of alters to construct her identity, she selects not only the set of alters from whom she seeks verification, but also selectively attends to the verification responses offered. Importantly, self-verification theory requires that the individual

have a prior preference regarding her identity, which serves as the identity sought to be verified. SVT does not address how or from where this prior identity preference arises. In this way, although SVT offers a set of empirically-supported mechanisms involved in identity formation, it also is silent on an important element (and potential role for alters) of identity formation – how an initial preference for identity forms.

Gender interactions

One natural question regarding SVT is whether there are situations where an alter's contrary feedback is *not* disregarded? A study of this question determined that when ego is uncertain of their role, and alter is very certain in her appraisal, ego may adopt alter's perspective (Swann & Ely 1984). Some of the other theories reviewed in this chapter provide suggestions as to why women may be less certain of a given role – particularly a role as a professional in a male-dominated field, such as engineering. In this case, the normal psychological buffering against negative appraisals would be disproportionately unavailable to women.

Role of peers

As stated above, SVT really has no distinct role for peers, other than as a potential source for verifications.

2.3. Synthesis

2.3.1. Common Mechanisms

Despite the varied disciplinary and theoretical underpinnings of these identity formation theories, there are a number of striking similarities allowing a rather simple synthesis. First of all, the mechanisms of all these theories are remarkably similar. There may be differences in emphasis, and some theories may neglect a mechanism completely, but the fundamentally similar structure has three elements.

1. An agentic individual enters a social setting and may enact a role.
2. The individual collects information concerning her enactment
3. The individual reacts to the information collected.

Below, I discuss each of these three processual components in turn.

1. An agentic individual enters a social setting and may enact a role.

Entering a social setting is a social act in and of itself. Individuals usually have some choices and when, how and whether to enter a social setting, as well as which setting to enter. These choices help to determine the audience, or set of alters with whom the individual may engage in a role performance. As I indicated, entrance alone is a type of performance. Although more active role performances are certainly possible, observation of the social setting is a likely early action.

2. The individual collects information concerning her enactment

Whether observing role models (be they peers or not), collecting appraisals – both overt (e.g., persuasion or sanctions) and subtle, or attending to less subjective consequences of enactments (e.g., grades), the social setting is rich with cues and other feedback that can inform future role performances.

3. The individual reacts to the information collected.

The reactions an individual can make are varied. One important set of reactions is whether and how to incorporate the feedback available within the social setting. ICT and SVT emphasize confirmation biases allowing contrary verifications to be discarded. Reference group theory, significant other theory, and network theory would suggest the feedback from the alters in the social setting may be differentially weighted at a group or individual level.

Another important reaction is the choice of whether to continue to pursue the particular role or not. If continuing, an individual can change her understanding of the role, or change how

she plans to enact it. All of the theories discussed conceive roles as ongoing accomplishments. So while only small changes may be possible for someone well-established in her role, making absolutely no changes is highly unlikely. Although an obvious change is in how the individual plans to enact the role on the next occasion (e.g., conformity), changing one's conceptualization of the role itself is also an option.

One of the areas of greater variation across the theories was in an individual's conception of a role. In most of the sociological theories, the role was an internal conception of an ideal type – allowing for an internal sense of mismatch between one's self-concept and role-concept. But the role-self distinction is not necessary. In role theory, the individual enacts the role as she understands it, and any mismatch is purely in between the experience of the performance and the expectations and reactions of the audience or alters. In some of the psychological theories, the idealized role-concept is to some extent external to the individual. SIT/SCT's group prototypes are perceptions of group-level characteristics, with the implication that within a highly entitative group, there would be little variation across the prototype perceptions of its members – for both the in-group prototype and out-group prototype. The common thread is that the individual has a conception of the role. One reaction is to alter that conception. Such changes are normal to the point of being predictable. In the literature on professions, a common observation is that upon entering a profession's credentialing process, entrants usually go through a disillusionment phase where they are disabused of their previous understandings of the profession, and a new one is created through the socialization processes (Abrahamson 1967; Becker & Geer 1958; Granfield & Koenig 1992; Hughes 1958; Turner 1978).

Given one's identification with a group, or in this case, a profession is also a largely internal conception, researchers seeking to study identity formation must look towards overt

manifestations of identity. The behaviors and changes occasioned by many iterations through the three mechanisms of identity formation provide these needed observables. The different theories emphasize different outcomes and observables as professional identity indicators, which I present and summarize in the next sub-section.

2.3.1. Indicators of Professional Identity Formation

The mechanisms of identity formation across the theories may have followed a very similar structure, and the indicators for identity formation are only slightly more varied. The distinct disciplinary backgrounds and theoretical bases served to emphasize different aspects of identity as consequential, but with several common overarching themes. In this section, I assemble a list of five key identity formation indicators from the theories above relevant to professional identity formation.

1. Values

In Merton's Functionalism, the internalization of a profession's "attitudes, values, and behavior patterns" (Merton 1957: 41), was considered a defining aspect of professional identity formation. Although adopting the attitudes and values of the profession is also indicated in role theory specifically with regard to role-merger, it is much less central. In the Chicago School Symbolic Interactionism of Becker and Carper's work (1956a; 1956b), the ideology associated with a profession was identified as one of four key elements of professional identity. For SIT/SCT, attitudes and values are a subset of the features and characteristics of the role prototype members come to resemble.

2. Self-Esteem

Self-esteem is one of the most commonly-studied constructs in association with identity. Rosenberg and colleagues have described self-esteem as having "global" and "specific"

components (Rosenberg 1979; Rosenberg *et. al.* 1995). In addition, Gecas and colleagues describe self-esteem as having "competence" and "worth" components (Gecas 1982; Gecas & Schwalbe 1983). Together, these two dimensions present a possible 2x2 matrix defining four types of self-esteem. Not all four of these are directly implicated as being indicators of professional identity formation. ICT (and by extension, SVT) suggests that the more one successfully verifies a particular role-identity, the greater one's specific worth-based and efficacy-based self-esteem (Cast & Burke 2002). Although self-esteem also figures prominently in SIT/SCT, it is as a motivational force towards group membership, and not an outcome (cf. Abrams & Hogg 1988).

One of these four aspects of self-esteem, role-specific self-efficacy, is a key indicator of another of the theories, and merits some additional attention. As discussed in the previous section, self-efficacy is a central topic in SLT/SCCT. The referent type of self-efficacy is specific self-efficacy, and Bandura would argue against the relevance or even existence of a global self-efficacy in the Rosenbergian sense. Role-specific self-efficacy is both a motivation for and outcome from persistence in a given role. This self-efficacy is a sense of ability and capability, and not necessarily certainty of outcome. In addition, Mertonian Functionalism, in the chapter by Huntington discussed earlier, also documented that a sense of mastery in role-specific tasks was significantly associated with professional identity.

3. Role-matching

In Role Theory, ICT, and SIT/SCT the actor is trying to match her performance to a target role that minimizes role conflict. The target role may be defined relationally between the actor and audience (Role Theory), internally within the actor (ICT), or result from the collective and salient characteristics of the group (SIT/SCT). However defined, the degree of match is an

indicator of successful role embracement (Goffman 1961b), and the degree of mismatch, of unsuccessful performance of the role.

4. Common Fate

As discussed earlier, the sense of common fate indicator was adapted by SIT/SCT from a concept developed within the groups literature. As an indicator of group identification, or more specifically, professional identity formation, it is unique to that theoretical perspective.

5. Category Salience

Categories are important to many of the theories. The group category provides the in-group/out-group boundary fundamental to SIT/SCT. In Role Theory, agreement in the role category of a role performance is necessary to avoid role conflict. But these two examples are not examples of identity outcomes. The particular case of professional identity – precisely because it is characterized as being an identity that has merged with the person – entails that the professional category should be salient even in situations where it may not be indicated. The more one fully identifies with a profession, the more that professional category remains salient even in other contexts.

These five indicators emphasize the behavioral and observable outcomes of professional identity formation processes as suggested by the theories reviewed. The theories themselves suggest additional and more detailed indicators of different processes within their models of identity formation. I have attempted to provide a broad and encompassing overview. Notably absent from this listing are the informational inputs actors use in the identity formation process: appraisals, modeling, and the less subjective results from role-performances. These are inputs to the identity formation process, not outcomes. Because of the different processing schemes, weightings and biases that influence how these inputs are integrated into identity outcomes, there

is not necessarily a direct relationship between these inputs and identity outcomes. Given this overview of the theories relevant to professional identity formation, the remainder of the dissertation engages with the research questions identified in the previous chapter.

CHAPTER 3. CLARIFYING TERMS AND DEFINING CHALLENGES

3.1. Clarification of terms

3.1.1. Profession

Attempts to define the term "profession" were a staple of early works in the sociology of the professions (e.g., Palmer 1914; Flexner 1910; Carr-Sanders & Wilson 1933). Such efforts often concluded that definitions to clearly and unambiguously categorize occupations, vocations, and the like either as professions or not are not possible (e.g., Carr-Sanders & Wilson 1933; Cogan 1955; Klegon 1978). Indeed professions themselves organically interact and evolve, continuously redefining their roles and boundaries (Abbott 1988).

Here, I provide not a definition of profession, but the criteria I use to bound the range of professions and occupations that are in the realm of my study. Van Maanen and Barley (1984) suggested that professions are at one extreme on a continuum of occupational communities, but this continuum need not be uni-dimensional. My bounding of the term "profession" makes use of two criteria. First, I include those occupational communities that have a (either *de facto* or *de jure*) requirement that members complete a professional credentialing process at an educational institution resulting in a degree or certification from the profession's accreditation agency or professional association. In addition, professions must be associated with some privileged social status or above-average socio-economic class. Indeed the notion that professions are importantly "superior" relative to other occupations was the key commonality noted in Merton and Gieryn's (1982: 113) review of previous attempts to define professions. This definition includes not only the traditional professions of medicine, law, and the clergy, but also nurses, engineers, accountants, police and military officers and more. Managers, when constrained to those jobs requiring an MBA, would also qualify as professionals under my definition.

Examples of occupational communities that may be considered by some as professions but are nonetheless excluded from my definition are professional athletes, movie stars, loan officers and stock-traders which may have higher class or status, but lack a recognized formal credentialing process; as well as flight attendants, massage therapists and truck drivers which have established credentialing requirements (FAA-certification, national exam and state licensure, and commercial driver's license, respectively), but do not have a privileged status or association with a higher socio-economic class.

Many other occupational communities such as bartenders, wait-staff, janitors, line-workers, coal miners and the like simply reside towards the far quadrant of my two dimensional occupational communities spectrum. Some classical definitional aspects of professions I do not use include: autonomy, motivation or behavioral orientation, and a specialized knowledge or skill set. Autonomy refers to the monopolistic control taken by and afforded to the profession itself in defining its mode of functioning, requirements for entry, and recognizing who is and who is not a member of the profession (e.g., Broadbent, Dietrich & Roberts 1997; MacIver 1922, 1955, 1966; Freidson 1970). Motivation and behavioral orientation refers to the view that professions may be distinguished from other occupations because individuals feel a "calling" to work as that particular kind of professional, and as a professional, observe a strict code of conduct emphasizing ethics and integrity to an extent not seen in other occupational settings (e.g. Goode 1957; Palmer 1914; Merton & Gieryn 1982; Leicht & Fennell 2001). Specialized knowledge or skill set definitional aspects of professions suggest that professions are unique in part because of the large body of knowledge and uncommon skills that practitioners must have mastered to perform as a professional (e.g., Goode 1957; Hughes 1960). Also, although I have placed formal credentialing as one of my two dimensions, that criterion is not universally

accepted. For example, in defining salient characteristics identifying professions, Freidson has "explicitly denied the importance of training and licensing" (1970:77).

One main purpose of my bounding on the types of professions under consideration is to specify the set of occupations having professional credentialing processes characterized by a sizeable cohort of professional entrants simultaneously and collectively undergoing a common training regime. This cohort of entrants within a single institutional setting provides the needed quasi-laboratory setting allowing for the needed quasi-experimental design to conduct tests of causal hypotheses. My definition of profession provides a necessary boundary condition to allow my analysis to proceed. Testing for peer effects during the credentialing phase of a profession or occupation that trains via master-apprentice relationships is nonsensical. My focus on professions with formalized school-based credentialing programs is thus akin to James Coleman's focus on high schools: they provide a useful laboratory to scrutinize and elucidate particular social processes (Marsden 2005) – in my case, the gendering of occupational identities.

3.1.2. Gendered Processes

Gender is enacted (Fenstermaker & West 2002). As described above, gender roles are among the earliest roles learned. In addition to the gendering of individual selves, social processes too may be gendered, but this merits some explanation. For the purposes of this study, I consider two modes by which social processes may be said to be gendered: in outcome or operation. Gendered outcomes are commonly used as indicators of gender inequality within or across professions. The sex composition or segregation of professions or their sub-specialties, wage gaps by sex within professions, or sex differences in turnover rates within professions are examples of such outcomes. Processes or mechanisms contributing to these gendered outcomes

are then gendered or gendering processes. Social processes that operate differently for men and women are gendered in their operation. Social processes that are gendered in their operation are less commonly discussed or documented, but from a mechanism-oriented perspective, are of critical importance. Processes that are gendered in their operation may or may not be gendered in their outcomes, and vice versa. For example, a uniform height requirement for a job is not gendered in its operation, but would likely be gendered in its outcome. On the other had, sex-specific height requirements are certainly gendered in their operation, but may or may not be gendered in their outcome. Below, I provide more detailed illustrations of both types of gendered social processes.

Processes that are gendered in their operation treat men and women differently, though the net result may not necessarily be unequal. An extreme hypothetical example of this could be a school that segregates classes by sex, presenting the same curricular content via sex-distinct pedagogical approaches, but with men and women performing equally well in a common unbiased evaluation, and placing equally well in jobs or other degree programs after graduation. The instruction at this hypothetical school is unquestionably gendered regardless of the equity of the results. In my investigation of peer influence on professional identity formation, I test whether peer influence operates differently by sex. Given these are peers, differences by sex could mean experiencing peer influence differently by sex or exerting influence differently by sex. In a subsequent section, I describe how I can test and differentiate between these two examples of the gendered operation of social processes.

A second hypothetical example illustrates an extreme version of processes that are gendered in their outcomes, but not operation. Consider a military boot-camp before and after the integration of women as soldiers. Prior to integration, the drill sergeant was likely to have

attempted to motivate his charges towards success and humiliate them in failure by referring to them, among other things, as women and pejoratively female terms and body parts. A fundamental metaphor used in this training ties being a successful soldier to being a "real man" and anything less to being less male and hence, more female. After the integration of women to this boot camp, if women are given exactly the same form of interactions and training, using the same language and metaphors as before, one would hardly expect the outcomes to be equal between men and women. Certainly the gendered meanings in the operation of the training process give rise to gendered outcomes, but this process on its face exposes men and women to essentially identical stimuli. The effects of this exposure would not be identical.

The underlying gendered meanings of social processes are rarely so blatant as in the above boot-camp example. Sex inequalities in outcomes can be an indicator of more subtle gendered meanings in apparently equal and unbiased processes. Investigating the gendered outcomes of social processes is the traditional sex-differences in outcomes approach (e.g., Blau & Kahn 2000; Williams 1989), and is well-documented in the literature with many exemplars. Fewer studies test for the gendered operation of social processes. A notable exception is Herminia Ibarra's work on how the network processes of instrumental and social support operate differently for men and women in a way that can negatively affect women's professional advancement (1992). In this study, I test for sex differences in professional identity outcomes, identify the peer-mediated processes contributing to those outcomes, and test for sex differences in the operation of those processes.

3.2. Challenges in Identifying Peer Effects

The 1960's produced a number of scholarly efforts to identify a role for peers in occupational aspirations, persistence, and identity formation (Duncan, Haller & Portes 1968;

Quarantelli & Cooper 1966; Sewell, Haller & Portes 1969; Wallace 1966; see also Sewell, Haller & Ohlendorf 1970: 1015 for a listing of studies finding significant other influence on occupational aspirations). Despite the strong and consistent evidence of associations between peer influence and these outcomes, there is a fundamental problem in interpreting these findings as a demonstration of peer influence. The problem is that influence implies a directed causal association, and none of these studies demonstrate such a causal association.

Causal inference requires some experimentally controlled or random manipulation (Holland 1986), and neither form of manipulation is present in most field data on peers. This weakness was recognized and discussed in Duncan, Haller and Portes' (1968: 135). They identified that the fact that individuals are able to select among their peers the subset of peers with whom they associate, and that this choice may be based in part upon similar identities or occupational aspirations, renders moot any causal inferences of peer influence essentially. With this acknowledgement, the remainder of their discussion assumes this problem is not consequential. In fact, all of these studies, and all subsequent studies on the topic to date (e.g., Bank, Slavings & Biddle 1990; Thomas 2000) assume either that the association reflects a causal association, or that the bias from this endogenous selection of peer associates does not affect the reported results. These assumptions are overly optimistic and unwarranted.

Looking afield, the scholarship documenting attempts at professions' self-study fares no better. The conclusions from one recent study (Carless & Prodan 2003) that a particular form of instructional interaction - practicum training - enhances the professional identity outcomes of students training to be psychologists (enhancing vocational preference, but having no effect on career commitment, self-efficacy or job attainment confidence) suffers from a selection bias critique. The two groups – those with practicum training and those without – were not an

experimental manipulation generated by random assignment, but rather were identified from biodata. Clearly, factors that compelled some but not others to pursue this particular training experience could also have generated the identified association.

Another recent study concluded that interdisciplinary communication enhanced role understanding among medical and social work students (Fineberg, Wenger & Forrow 2004). In this study, there was an experimental manipulation: some students were assigned to the intervention group, experiencing four training sessions promoting interdisciplinary communication, and others to a control group, receiving written materials containing comparable curricular content. The problem with these findings is the attribution of causation to the interdisciplinary communication. Beyond basic "Hawthorne effect" concerns, additional training sessions means additional interactions with instructors (potential role models). That additional exposures and interactions with instructors would enhance role understanding is entirely consistent with the predictions of role theory, discussed above, even absent any interdisciplinary communication. To better test the interdisciplinary communication hypothesis, the same instructors could provide the same training sessions to three sets of students: two of the sets receive the sessions while separated by discipline, and the third set includes students from both disciplines (and not also from the first two sets).

A recent review published in the highly-regarded *British Medical Journal* (Littlewood *et. al.* 2005) concluded that conclusive "[e]xperimental evidence on [the benefits of early professional experiences on professional identity outcomes] is unlikely to be forthcoming" (Littlewood *et. al.* 2005: 387).

I have not been able to find any study of professional identity using an experimental approach to test for a causal role for peers in identity formation. Thus, I have found no

conclusive evidence that peers do play a causal role in professional identity formation. The two primary problems stymieing causal inferences of peer effects and their solutions are described in more detail below.

3.2.1. Selection Problem and Its Solution

Existing field studies investigating the influence of alters on identity formation have been hampered from inferring causality by several analytical challenges. The first is well-recognized as a selection problem in social networks (Winship & Mare 1992). Social network analysis is particularly suited for studies of interactions among people. In real-world settings, individuals tend to be able to select their own alters. This self-selection of ties to alters introduces a bias where apparent social influence could actually arise from ego's choice of alters. Indeed, this biasing behavior is precisely what is entailed by the seeking out "opportunity structures" for the identify verification processes of both Self-Verification Theory (SVT) and Identity Control Theory (ICT) discussed above. Taken to a logical extreme, alters play no causal role in identity formation; rather, an individual simply "shops around" for alters who will verify her identity, and disregards contrary views. With few exceptions, any study testing for social influence from alters where ego has a role in selecting her alters cannot support inferences of a causal role for alters.[1] The solution to this selection problem is to use assigned ties, rather than selected ties, when testing for social influence. My study uses roommate assignment and project team assignment as instances of assigned social ties.

3.2.2. Reflection Problem and Its Solution

A second important analytical challenge to inferring a causal role for alters in identity formation using data from the field is what has been called the "reflection problem" (Manski 1993). The basic finding of the reflection problem is that evidence that an ego and her alters

[1] One possible but unlikely exception is cases where the tie selection mechanism can be modeled perfectly.

come to reflect each other on a particular outcome (often called "convergence") cannot be interpreted as causal evidence of social influence. The problem is that by looking solely at outcomes that are simultaneously determined by influence processes working in both directions (from ego to alters as well as from alters to ego), alternative explanations cannot be ruled out. The solution to this reflection problem comes from using variables that are not subject to social influence – either static variables or pre-exposure variables – to test alters' influence on ego's outcomes. My study makes use of a set of pre-exposure variables to test for peer influence to solve the reflection problem.

3.2.3. Exemplars and the Current Approach

Recent innovations in research design and analysis have allowed causal testing of peer effects from field data (Mouw 2006; Soetevant 2005). A key innovation is the use of assigned social ties, rather than selected ties, for testing peer effects. Recent studies have used assigned ties, particularly the assignment of undergraduate roommates, as quasi-experiments to estimate peer effects. This approach has allowed the estimation of peer effects on college grades (Sacerdote 2001, Zimmerman 2003) and risk-taking behaviors (Duncan *et. al.* 2005). It is not the intimacy of the roommate relationship that is the critical feature here, but the assignment of the relationship. In this way, other assignment schemes can also be useful as quasi-experimental manipulations. In the setting currently under study, I use roommate assignments (and in Appendix D, project team assignments).

CHAPTER 4. DISCRIMINATING PERSISTENCE: IDENTITY AND GENDERED ENGINEERING OUTCOMES.

4.1. What aspect of professional identity is associated with gendered persistence?

As discussed in Chapter 2, professional identity is a multi-dimensional, multi-faceted construct. A clear analysis requires clear definitions and justifications for the analysis variables. The focal outcome of my dissertation is professional identity, but what aspect of professional identity? The answer to this question is evident from this chapter's subtitle – I am interested in those aspect(s) of professional identity associated with sex differences in engineering persistence outcomes. This answer begs the main research question of this chapter: Which aspect(s) of professional identity are associated with sex differences in engineering persistence outcomes (hereafter, simply "gendered persistence")? Using data from a multi-site longitudinal study of engineer and non-engineer undergraduates that provides a host of professional identity indicators, I test each of these indicators for contributing to gendered persistence in engineering. Once identified, this identity indicator becomes the outcome variable in the next chapter, testing for peer effects on professional identity formation.

I am interested in those aspects of professional identity contributing to gendered persistence not because I think those identity indicators should be particularly susceptible to peer influence, but rather because I am interested in the phenomenon of gender inequality in professions and their generative mechanisms. Because identity is theorized as being socially constructed (as described in detail in Chapter 2) and known to be associated with persistence (cf. Correll 2001; Lee 2002; Seymour & Hewitt 1997 specifically for the case of engineers), I am investigating for evidence that those aspects of professional identity directly associated with gendered persistence are shaped by peer interactions. The purpose of this chapter is to establish

which aspects of professional identity are associated with gendered persistence. In the next chapter, I test for peer influence on those identity aspects.

The previous research on identity and role-persistence, whether professional, engineering, or otherwise, provides some hypotheses for which aspects of professional identity should be associated with persistence. Identity Theory, and its psychological cousin, Self-Verification Theory, emphasize the importance of validating feedback from others to allow persistence in a role (Burke 1997, 2004, 2007; Swann 1983). This social validation bolsters one's role-specific self-concept.

There is a considerable literature, from a variety of theoretical viewpoints, documenting the importance of self-efficacy in role-persistence in occupations and careers. Drawing upon Social Learning Theory (cited as Self-Efficacy Theory), a study of accountants adjusting to a new firm showed that post-training self-efficacy – measured in a 47-item survey of self confidence in performing a host of accounting-related tasks – was significantly related to professional persistence both in terms of professional commitment and intent to remain in the profession (Saks 1995). Saks included these profession-specific measures along with a set of organization-related measures of commitment, intention to quit, etc. Shelley Correll (2001) investigated the effects of self-assessed mathematics competence (a role-specific self-efficacy analog) on STEM-related (STEM refers to Science Technology Engineering & Mathematics) career persistence behaviors (enrolling in calculus classes in high school and declaring a quantitative major in college) among men and women. Her study found significant associations between self-assessed mathematics competence on these persistence behaviors for both men and women while controlling for measured mathematical ability. In addition to these examples, the relationship between role-specific self-efficacy and role-persistence has been consistently

demonstrated in the literature (Betz & Hackett 1983; Gist 1987; Torres & Solderberg 2001). Indeed, this relationship was a main motivating factor for the development of Social Cognitive Career Theory (Lent, Brown & Hackett 1994).

In addition to self-efficacy, the salience of membership in socially-defined groups or categories – the basis for Social Identity Theory – has been shown to be associated with persistence in those groups. A recent experimental study by Van Vugt and Hart (2004) testing the associations between one such category identity (identification with one's university in a multi-school study) and group loyalty. Group loyalty was assessed by presenting subjects with a social dilemma problem where they could abandon their group (others from the same school as the subject) for greater monetary rewards, or remain in their group for a reduced award. Over three experiments, the authors showed that category identification was directly associated with remaining in the group and could not be explained on the basis of prior investment in the group (an escalation of commitment) or social norms favoring loyalty and disfavoring abandonment. As discussed in Chapter 2, these category identities in the form of professional or occupational identity are not amenable to laboratory-based manipulations, and I could find no quantitative research testing a relationship between category identity in a professional or occupational role and persistence.

The theories reviewed in Chapter 2 do not clearly differentiate aspects of professional identity that should or should not be associated with gendered persistence. The purpose of this chapter is to operationalize and test an array of professional identity indicators for associations with gendered persistence.

4.2. Identifying associations with gendered persistence

Here, I establish the criteria I use to identify whether or not a particular professional identity indicator is associated with gendered persistence. Let β_i^{male} indicate the measure of association between professional identity indicator *i*, and the persistence dependent variable for men. Let β_i^{female} indicate that association for women. Let $\overline{X}_i^{male}$ indicate the mean level of professional identity indicator *i* among men, and $\overline{X}_i^{female}$ the mean among women. Professional identity indicator *i* can be said to contribute to gendered persistence if either of the following two sets of conditions are satisfied:

1. $| \beta_i^{male} - \beta_i^{female} | >> 0$, where ">>" means "is significantly greater than;" or,
2. $| \beta_i^{male} | >> 0$, and $| \beta_i^{female} | >> 0$, and $| \beta_i^{male} - \beta_i^{female} | \approx 0$, and $| \overline{X}_i^{male} - \overline{X}_i^{female} | >> 0$.

In the first condition, β_i^{male} and β_i^{female} are significantly different from each other. If so, then either $\beta_i^{male} >> \beta_i^{female}$, or $\beta_i^{female} >> \beta_i^{male}$. If $\beta_i^{male} >> \beta_i^{female}$, then a unit increase in professional identity indicator *i* promotes persistence among men far more than the effect a similar increase would have among women. That is, that type of professional identity benefits men more than women. If $\beta_i^{female} >> \beta_i^{male}$, then the reverse would apply. If one of these association patterns is identified, then efforts to reduce inequalities in persistence need to discern why identity is more beneficial to one group than the other. Although this may sound implausible, consider the evidence from negotiations and persuasive arguments, where aggressiveness is a benefit to men, but a detriment to women (Carli 1999, 2001; Wagner & Berger 1997). In such situations, efforts focusing on enhancing the particular aspect of professional identity among the lower-persisting group would be misplaced at best and harmful at worst (when the association is negative).

In the second set of conditions, it is not the professional identity indicator itself, but its unequal distribution that contributes to gendered persistence. The second set of conditions

requires that both β_i^{male} and β_i^{female} are significantly different from zero, but not significantly different from each other. They may both be positive or negative. What differs significantly are the mean levels of the professional identity indicator among men as compared to women. Professional indicator *i* has a similar significant association with persistence for men as for women, but the significant disparity in the levels of the indicator by sex yield significant disparities in persistence. In this dynamic, any enhancement of the particular aspect of professional identity among the group with the lower levels of that identity should yield greater persistence by that group.

These two sets of conditions defining associations with gendered persistence help to direct the analyses in this chapter. In the next section, I describe the data used in this analysis. In the following section, I describe the variables serving as indicators for professional identity and persistence. Then, I test for significant differences within those variables by sex. Next, I estimate the associations between the identity indicators and persistence. Finally, I review my findings to highlight those aspects of professional identity evincing associations with gendered persistence.

4.3. Data

The data for this study come from a set of surveys administered to a cohort of undergraduate students during the spring semester of their sophomore year at four different undergraduate programs. (Included in Appendix A are the items from the surveys used for the analyses in this paper.) These surveys are part of an ongoing longitudinal study following a panel of students from the time they enter college to their first year after graduation. Although future analyses of data from this study will explore temporal dynamics, this study has a cross-sectional research design.

I use the second year survey results in this analysis rather than the first year data (which is the data source for the analysis in the next chapter) for a number of reasons. First and foremost, I wish to focus my analyses on engineering students, and declaring a major is not usually required of students until their sophomore year. The structure of the surveys over the course of the study was also sensitive to this fact. As a result, the first year survey consisted largely of questions about students' background, high school experiences, and process of selecting a college. The second year survey included an array of identity and other scales thought to be associated with college success and persistence in engineering. Thus, for the purpose of comparing associations between identity indicators and persistence among engineers, the second year survey provides the richest data.

The panel of students at the four colleges totals 775 students, including engineering students and non-engineering students. These pseudonymous colleges include: O'Brien Institute, a new private college focusing on educating engineers; Sargent Technical Institute, an established private university with a focus on science and technology; Jackson College, a private liberal-arts women's college; and State University, a large land-grant public university. The survey for this study was sent only to the students in the panel of the longitudinal study, not the entire cohort of students at those schools. The panel populations at the four schools, and their response rate for their sophomore-year survey are as follows: O'Brien: 61 panelists, 82% responded; Sargent: 314 panelists, 64% responded; Jackson: 220 panelists, 65% responded; and State University has 144 panelists, and 51% responded. Of the 465 total responses (60% overall response rate), 183 identified themselves as engineering majors. The analysis in this chapter is based upon the responses of these 183 engineering sophomores.

4.4. Variables

4.4.1. Independent Variables: Professional Identity Indicators

The discussion in Chapter 2 illustrates the broad range of constructs associated with "identity." Below, I list the aspects of professional identity (or identity more broadly) referenced or emphasized in the identity theories reviewed in Chapter 2. In the synthesis from Chapter 2, I identified 5 primary aspects of identity relevant to professional identity based on the theories reviewed: categories, values and beliefs, self-esteem, role-matching, and common fate.
I provide indicators for four of these five categories, and in most cases, multiple indicators for each. I do not have a reliable indicator for the "common fate" aspect of professional identity. Each aspect of identity and their corresponding indicators are detailed below.

4.4.1.1. Categories

Fundamental to the SIT and SCT theories is the delineation of a group by some identifier. For professional identity, such signifiers could include the name of one's professional role or title. Engineers still in the credentialing process lack official titles beyond their year in school and major. Given that this analysis fixes both of these categories, I take another approach towards assessing individuals' category-based identity.

The survey asked students to rate sixteen identity categories in response to the question, "How important are the following group memberships to you in defining who you are?" Responses were limited to a 5-point Likert-type scale with "Very Unimportant" anchored to -2, "Neither important nor unimportant" anchored to 0, and "Very Important" anchored to 2. A principal factors analysis (unless otherwise indicated, all factor analyses herein use the principal factors method and use a threshold of 0.5 to determine associations with a particular factor) revealed two factors, one containing four items ("My nationality," "My sexual orientation," "My native language," and "My race/ethnicity"), and the other containing two items ("My chosen

career," and "My college major"). I labeled the first factor "Demographic Category Importance," which has a Cronbach's alpha = 0.84. The second factor, "Career Category Importance," has a Cronbach's alpha = 0.70. The factor analysis results, also presented below in Table 1, suggest that among the engineers surveyed, respondents tended to place those categories within the same factor at similar levels of importance or unimportance.

Table 1: Factor Analysis Yielding "Demographic Category Importance" and "Career Category Importance" Professional Identity Indicators

Identity Group Category	Varimax-rotated Factor Loadings		Uniqueness
	1	2	
Factor 1 items: Demographic Category Importance			
My gender	**0.75**	0.15	0.41
My nationality	**0.72**	0.04	0.48
My native language	**0.57**	0.04	0.68
My physical appearance or stature	**0.53**	0.32	0.62
My race/ethnicity	**0.71**	-0.07	0.49
My religion	**0.59**	-0.04	0.65
My sexual orientation	**0.68**	0.15	0.51
Factor 2 items: Career Category Importance			
My chosen career	0.10	**0.63**	0.59
My college	0.06	**0.62**	0.61
My college major	0.07	**0.65**	0.57
Items not associated with a factor			
My age	0.24	0.20	0.90
My college living group	-0.03	0.44	0.80
My family's economic status	0.29	0.34	0.80
My favorite sports, activities or hobbies	0.08	0.25	0.93
My geographic region	0.36	0.20	0.83
My political or ideological affiliation	0.34	0.01	0.88
Eigenvalue	3.71	1.53	
Cronbach's alpha	0.84	0.70	

Given that all the students in this analysis are engineers, I make the uncontroversial assumption that the major and career identity groups being rated so similarly by the students are both engineering-related. Based on this assumption, paired with the factor analysis results, there are two ways to use these factor scores as indicators for professional identity among engineers. One way is simply to use the Career Category Importance alone as an indicator for professional

identity. A second approach takes advantage of the other competing factor, and uses the difference in the levels between these two factors as an indicator of professional identity. This difference indicator treats individuals with Career Category Importance scores higher than their Demographic Category Importance scores as having stronger engineering identities than individuals for whom the differences are smaller or reversed. Rather than create an additional difference variable, I can test whether this potential difference relationship holds by including both component scores in my analyses (Edwards 1994).

4.4.1.2. Values

Most descriptions of identity from both the Symbolic Interactionist and Functionalist perspectives include "values", or a related concept, as an important learned aspect of identity. Becker and Carper emphasized professions' ideologies as a key element of professional identification (1956a; 1956b). Merton strikes an interactionist trope when writing, "in the course of their social interaction with others in the school, of exchanging experiences and ideas with peers, and of observing and evaluating the behavior of their instructors …, students acquire the values which will be basic to their professional way of life" (Merton 1957b: 42). Recent work has amplified the association between identity and values (e.g., Hitlin 2003; Hitlin & Piliavin 2004). Previous empirical work has shown that students' own values also play important roles in their educational outcomes (Astin 1998; Whitt *et. al.* 2001). Students valuing particular aspects of their education more are more likely to succeed and persist in those areas.

To assess the values aspect of professional identity for engineers, the survey asked students "What, in your opinion, makes a successful engineer?" Students rated a set of twenty-two aspects of engineering education on how important each aspect was in making a successful engineer. Responses were on a 5-point Likert-type scale from "Very Unimportant"=-2 to "Very

Important"=2. Factor analyzing the results among the engineers yielded three factors. The first factor, composed of eleven of the twenty-two items (e.g., "math skills," "problem solving skills," and "strong background in science") has a Cronbach's alpha=0.91, focused on items related to problem solving (referred to as "Value Problem Solving"). The second factor, composed of four items ("social skills," "leadership," "understanding the consequences of technology," and "effective writing and speaking skills") has a Cronbach's alpha=0.78. I refer to this second factor as "Value Social Perspective." The third factor was composed of three items ("being at the right place at the right time," "being good with hands" and "entrepreneurial ability") had a Cronbach's alpha = 0.55. As 0.70 is commonly cited as a minimum for scale reliability (Nunnally 1970; 1978), I do not use this third factor. The results of the factor analysis are provided below in Table 2. As with the two identity group category factors described above, I include both values factors in my analysis, and also attend to whether their difference is a consequential predictor.

Table 2: Factor Analysis Yielding "Value Problem Solving" and "Value Social Perspective" Professional Identity Indicators

Items rated for importance in being a successful engineer	Varimax-rotated Factor Loadings			Uniqueness
	1	2	3	
Factor 1 items: Value Problem Solving				
Intuition	**0.60**	0.23	0.22	0.54
Understanding machines	**0.60**	0.08	0.26	0.57
Ability to work in teams	**0.69**	0.48	-0.07	0.28
Problem-solving skills	**0.80**	0.25	-0.06	0.29
Maintaining updated skills and expertise	**0.71**	0.16	0.15	0.44
Innovative thinking	**0.68**	0.22	0.19	0.46
Math skills	**0.65**	0.01	0.04	0.58
Strong background in science	**0.63**	0.12	-0.02	0.58
Persistence	**0.79**	0.13	0.04	0.36
Understanding how people use machines	**0.53**	0.16	0.38	0.55
Attention to detail	**0.78**	0.08	0.16	0.36
Factor 2 items: Value Social Perspective				
Social skills	0.09	**0.73**	0.00	0.45
Leadership	0.20	**0.68**	0.14	0.49
Understanding the consequences of technology	0.33	**0.63**	0.12	0.48
Effective writing and speaking skills	0.35	**0.56**	0.17	0.53
Factor 3 items: Not Used				
Being in the right place at the right time	0.06	0.12	**0.52**	0.71
Being good with their hands	0.15	0.03	**0.71**	0.48
Entrepreneurial ability	-0.04	0.23	**0.58**	0.61
Items not associated with a factor				
Risk taking	0.19	0.26	0.32	0.80
Being well-read	0.16	0.49	0.12	0.72
Effective management skills	0.25	0.46	0.33	0.62
Professional and ethical responsibility	0.42	0.47	0.11	0.59
Eigenvalue	7.55	1.76	1.21	
Cronbach's alpha	0.91	0.78	0.55	

4.4.1.3. Self-Esteem

Self-esteem is perhaps the single-most common indicator for identity. Identity scholars have divided the self-esteem construct into two component elements: self-esteem based on a subjective sense of competence or self-efficacy; and self-esteem based on a subject sense of self-worth (Cast & Burke 2002; Gecas 1982). In addition to these two components of self-esteem, identity scholars also commonly distinguish between self-esteem in a "global" sense – referring to a relatively stable core sense of an individual's overall self-esteem, and "local" or role-specific

self-esteem, which varies more widely depending upon the individual's role at the time (Gecas 1982; Rosenberg *et. al.* 1995). These two dimensions of self-esteem: its components, and the aspect of self to which it refers, together define four self-esteem constructs: Global self-efficacy, role-specific self-efficacy, global self-worth, and role-specific self-worth. To the extent possible from the survey data, I present indicators for three of these four aspects of identity.

4.4.1.3.1. Self-Efficacy

My measures of self efficacy are based on students' self-rated evaluations of their own performance or abilities. All students were asked to rank themselves relative to other students their age on a set of twenty traits, including academic performance and capabilities. In addition, engineers were asked to estimate their relative rank in their engineering endeavors relative to other engineers on eight dimensions. I am not concerned that students are unlikely to give accurate representations of where they fall in the distribution of traits and abilities. Indeed research suggests that it would be surprising if they actually did so (self-enhancement bias – see the review in Kruger & Dunning [1999: 1122]). The self-report provides the students' own sense of their relative position, which is precisely the type of self-perception relevant for self-efficacy measures. As before, these multiple-item questions were condensed into a scale based upon the results of a factor analysis. The former yielded four items (self ratings on: "Drive to achieve," "Mathematical ability," "Self-confidence (intellectual)," and "Academic ability") forming the primary factor, with a Cronbach's alpha of 0.73 for the scale. I call this scale "Academic self-competence," and use this variable as an indicator of an aspect of self-efficacy in the general student role. The results of this analysis are presented below in Table 3.

Table 3: Factor analysis yielding the "Academic Self-Competence" professional identity indicator.

Variable	Varimax-rotated Factor loadings 1	2	Uniqueness
Factor 1 items: Academic self-competence			
Drive to achieve	**0.62**	0.01	0.56
Mathematical ability	**0.73**	-0.12	0.45
Self-confidence (intellectual)	**0.64**	-0.07	0.45
Academic ability	**0.80**	-0.14	0.34
Factor 2 items: Not Used			
Religiousness/religiosity	-0.11	**0.79**	0.36
Spirituality	-0.12	**0.79**	0.35
Items not associated with a factor			
Cooperativeness	0.08	0.16	0.79
Creativity	0.35	-0.03	0.64
Leadership ability	0.38	0.08	0.61
Public speaking ability	0.38	0.03	0.69
Popularity	0.03	-0.02	0.40
Social responsibility	0.25	0.25	0.71
Self-confidence (social)	0.10	0.06	0.40
Self-understanding	0.22	0.11	0.72
Understanding of others	-0.01	0.26	0.71
Writing ability	0.42	0.03	0.68
Physical health	0.22	0.19	0.84
Emotional health	0.12	0.23	0.65
Artistic ability	-0.02	0.02	0.69
Competitiveness	0.26	-0.05	0.92
Eigenvalue	4.13	2.09	
Cronbach's alpha	0.73	0.64	

The self-rankings relative to students' fellow engineers yielded a three-item factor (agreement with: "I am generally more confident about my abilities," "I understand engineering concepts better," and "I am better at solving engineering problems"), with an alpha of 0.81. I call this scale "Engineering self-competence," and use this variable as an indicator of an aspect of self-efficacy more specifically regarding the role of engineer. The results of this analysis are presented below in Table 4.

Table 4: Factor analysis yielding the "Engineering Self-Competence" professional identity indicator.

Statements with which students rated their agreement based on comparing themselves to their classmates.	Varimax-rotated factor loadings	Uniqueness
Factor items: Engineering Self-Competence		
I am generally more confident about my abilities	**0.75**	0.44
I understand engineering concepts better.	**0.73**	0.46
I am better at solving engineering problems.	**0.71**	0.50
Items not associated with a factor		
I am less committed to engineering.	-0.16	0.97
I work better with other people.	0.25	0.94
I am more comfortable working with people of my own race/ethnicity	0.13	0.98
I need to spend more time and effort on my class work	-0.08	0.99
Eigenvalue	1.72	
Cronbach's alpha	0.81	

4.4.1.3.2. Self-Worth

Between the paired self-esteem components of self-efficacy and self-worth, self-worth is the less studied. Worth-based self-esteem is seen to arise from feelings of acceptance, inclusion, and being valued by others (Brown & Lohr 1987; Burke & Stets 1999; Cast & Burke 2002). Role-specific self-worth is that sense of acceptance and being valued by the members or occupants of the particular role. Global self-worth is the theoretical baseline level of self-worth an individual holds that is not based on a particular group or role (or, perhaps viewed as simply a larger, more inclusive group or role).

At the time of survey design, self-worth measures were not intentionally included. There were a number of items expressly to assess students' embeddedness in social and academic networks. One of these questions asks, "How many TIMES in the past two weeks did a fellow student ask you a question outside of class about a class assignment?" (This question was paired with "How many TIMES in the past two weeks did you ask a fellow student a question outside of class about a class assignment?" but the latter question has less relevance for the topic of worth-based self-esteem.)

Considering this student quote from McIlwee and Robinson: “I get more of a pat on the back from having someone say, ‘Boy, you explained that better than the teacher did,’ than I get from getting the homework right” (1992:49-50), this count of questions from peers could provide a useful indicator of peers’ expressions of role-specific acceptance and value for a student. Again, this self-report does not capture the actual number of questions asked to a particular student by her peers, but rather the student’s perception of the number of such queries, which is desired when assessing self-worth.

Because the number of students available for such interactions is dependent in part on school-specific factors, and because a student who gets asked for help four times is not necessarily twice as valued as a student who gets asked two times, the self-reported count must be recoded before its inclusion in the analysis. I converted the responses into school-specific percentile scores. The student who was asked for help the most within her school received a score of 1, and the student who was asked for help the fewest number of times within her school received a score of 0. Students who responded with identical numbers within the same school received identical percentile scores. I use the recoded variable, “Sought by Peers” as an indicator of role-specific self-worth. I neither have, nor am able to construct a reasonable indicator for global self-worth.

4.4.1.4. Role-Matching

Identity theory, Self-Verification Theory, Symbolic Interactionism of the Iowa School, Self-Categorization Theory, and Social Cognitive Career Theory all posit that individual identity work involves directing behavior toward comporting with (and receiving confirmations regarding) an idealized role definition. In IT, SVT and SI-Iowa, this role definition may be an individual’s own internal understanding of a role based on her social observations and

interactions. In the other theories, the role definition is based on a collectively defined ideal or prototype. It is this conceptualization of identity that has been recently imported to and operationalized within economics through the work of George Akerlof and Rachel Kranton (2000; 2002).

My operationalization of this role-matching identity measure is based on the role-identity work established by Burke and Tully (1977), and an appropriation of the formalization of similar idiographic metrics more recently articulated in the organizations and economics literatures (Akerlof & Kranton 2000; Kristof 1996). Burke and Tully proposed assessing role-identities by presenting subjects with prompts "Usually <people of a given identity group, e.g., boys> are…," followed by a series of opposing adjectives pairs rated on a Likert-type scale. After a couple of such "roles" are presented to subjects, they are asked to respond to a same or similar set of items under a "Usually I Am," prompt. Burke and Tully (1977) provide a suggested method for analyzing such data, which I adapted to align with more recent approaches. In the survey, students were asked to rate at set of eleven adjective pairs after the prompt "For each of the following qualities, please rate how you view OTHER STUDENTS IN YOUR SAME MAJOR. Usually, other students in my MAJOR are…" This item was followed much later in the survey with the identical set of eleven adjective pairs after the prompt, "For each of the following qualities, please rate how you see YOURSELF. Usually I AM…"

Following Burke and Tully's guidance (1977: 884), I conducted a factor analysis on the eleven adjective pairs to identify unique and independent factors. Burke and Tully (1977: 884) referred to the tendency of the adjective pairs to load onto one of three factors. In my analysis of the undergraduates' responses, six of the adjective pairs loaded onto one of two factors (one roughly corresponding to being "personable" and the other to being "linear"). One adjective pair

(Honest / Dishonest) loaded onto the "personable" factor when the subject was other students in the same major (as shown in Table 5), but did not load onto that factor when the subject was the student herself (as shown in Table 6). Because of this ambiguity I discard this item from the analysis. The remaining four adjective pairs showed a high degree of uniqueness, and are treated as orthogonal.[2] The resulting role identity profiles comprised six distinct dimensions. Burke and Tully recommend selecting the few characteristics with the greatest differences to distinguish role identities (1977:884-5, 889). Rather than following this approach, I conceptualize the role-identity distinctiveness Burke and Tully target as a kind of "person-role fit," and adopt the measurement conventions common in the measurement of person-organization and person-environment literature (Kristof 1996:15) – the Euclidean distance[3] between the profile of the self and the profile of the role along all six dimensions. This conceptualization is consistent with other efforts to formalize identity metrics.

[2] Another adjective pair (Immoral/Moral) was similarly ambiguous, but was not excluded.
[3] Aggregated distance, difference, or similarity measures all have known weaknesses (Edwards 1993). In particular, the Euclidean distance has no directionality associated with the measure and weights equally all the constituent dimensions. I do not include individual variables for all 8 constitutive dimensions I am not working from theory distinguishing their effects (Edwards 1994; Tisak & Smith 1994). The construct of interest for my study is the magnitude of the distance between one role-identity profile and another.

Table 5: Factor Analysis to Establish Independent Dimensions of the Major-role

Adjective Pairs Referring to the Major-role	Varimax-rotated Factor Loadings 1	2[a]	Uniqueness
Factor 1 items: Personable			
Happy/Unhappy	**0.50**	-0.01	0.75
Honest/Dishonest	**0.57**	-0.21	0.63
Want to work with people / Want to work with things	**0.57**	0.25	0.61
Social/Asocial	**0.81**	0.13	0.33
Friendly/Unfriendly	**0.73**	-0.06	0.47
Factor 2 items: Linear			
Illogical/Logical	0.05	**0.60**	0.64
Unsystematic/Systematic	0.08	**0.57**	0.67
Items not associated with a factor			
Individualistic/Cooperative	-0.28	0.04	0.92
Immoral/Moral	0.44	-0.30	0.72
Emotional/Unemotional	0.35	0.22	0.83
Seek practical answers/Seek general truths	-0.05	-0.20	0.96
Eigenvalue	2.50	0.97	
Cronbach's alpha	0.77	0.58	

[a] This factor was retained to comport with the analogous factor identified via the factor analysis of the self-role, shown below. The goal of these two factor analyses is not to identify factors per se, but to identify interdependence among the adjective pairs. The Euclidean distance measure assumes orthogonality, and thus requires reducing any interdependent dimensions into a single dimension.

Table 6: Factor Analysis to Establish Independent Dimensions of the Self-Role

Adjective Pairs Referring to the Self-role	Varimax-rotated Factor Loadings 1	2	Uniqueness
Factor 1 items: Personable			
Happy/Unhappy	**0.54**	0.23	0.66
Want to work with people/Want to work with things	**0.59**	0.24	0.60
Social/Asocial	**0.73**	0.22	0.42
Immoral/Moral[a]	**0.58**	0.03	0.66
Friendly/Unfriendly	**0.78**	0.12	0.38
Factor 2 items: Linear			
Illogical/Logical	0.14	**0.84**	0.28
Unsystematic/Systematic	0.17	**0.73**	0.44
Items not associated with a factor			
Individualistic/Cooperative	-0.05	0.40	0.84
Honest/Dishonest[a]	0.42	-0.02	0.82
Emotional/Unemotional	0.33	0.41	0.72
Seek practical answers/Seek general truths	0.21	0.27	0.88
Eigenvalue	3.16	1.15	
Cronbach's alpha	0.78	0.84	

[a] These items do not load onto the two factors as they did in Table 5. To resolve this inconsistency, both items should be excluded from the Euclidean distance calculations. The "Honest/Dishonest" item was excluded; the "Immoral/Moral" item was treated as a distinct dimension.

Economists George Akerlof and Rachel Kranton have been working on formalizing a theory of identity specifically based in educational institutions (cf., Akerlof & Kranton, 2000; 2002). Their theory defines each identity group as having an ideal profile or set of characteristics. Individuals then fit in (or fail to fit in) with others in a particular identity group in proportion to their own profiles' fit with the profile of the identity group's ideal type. The role-identity data collected per the recommendations of Burke and Tully (1977) provide exactly an individual's perception of that ideal-type profile and their own profile along the same dimensions. Taking the responses to the set of opposing adjectives as a multi-dimensional representation of a profile (either of an ideal type or of one's self), then the geometric (Euclidean) distances between these profiles gives the level of fit (or lack of fit) between those identities.

The "self – own major" distance measure (abbreviated as "self-major") resulting from this process provides an indicator of how poorly individuals see themselves as fitting in with their own stereotypes of their own major. This self-major distance serves as my indicator of the distance between an individual's own sense of self and her understanding of the engineering role: the larger the distance, the poorer the match.

4.4.1.5. Common Fate

The sense of having a common fate with others in a particular group (Campbell 1958) is one definition of identity embraced and popularized by Social Identity Theory / Self-Categorization Theory approaches to organizational identity (e.g., Hogg & Terry 2000; Mael & Ashforth 1992). The groups literature has also made wide use of this construct, and has developed a number of psychometric instruments to measure this sense of common fate (e.g., Lickel *et. al.* 2000). At the time of the development of the sophomore year survey, the research

team did not explicitly seek to include a scale to assess engineering students' sense of common fate with other engineers. Several items in the survey obliquely address this concept.
I tested the scale reliability of three such items: (1) agreement with the statement "There is a sense of community among the engineering students;" (2) confidence that "Engineering is the right profession for me;" and (3) agreement that relative to other students in the respondent's engineering courses "I am less committed to engineering" (reverse-coded). These three items had a scale reliability score (Cronbach's alpha) of 0.47 – nowhere near the minimal threshold for a reliable scale. As a result, my analysis does not include a measure of a sense of common fate with other engineers.

4.4.2. Dependent Variables: Persistence in the Engineering Profession

For this study, persistence is based on survey response data, not observed events such as leaving school or changing majors. Thus, my four measures of persistence use expressed individual intent or commitment to engineering as a major and as a career. As I introduce each of the four dependent variables, I describe the analytical approaches used to test for associations with those outcomes.

All students (engineers and non-engineers) taking the survey received the question, "How likely are you to change to another major before graduating?" Responses had the form of a 5-point Likert-type scale, with "0" anchored to "Unlikely," and 5 anchored to "Likely." The question provides the first dependent variable, "Major Persistence." Part of the survey had more detailed questions only for engineering majors, including the question, "At this moment, how likely it is that you will be an engineer five years from now?" Responses to this question (coded on a 4-point Likert-type scale from 0="Not likely at all" to 4="Very likely") provide the second indicator of persistence, "Career Persistence." Both this outcome measure, and the "Major

Persistence" variable described in the previous paragraph, consist of an ordinal scale. So although these variables may take on values such as 1, 2, or 4, they can only take integer values, with the distances between integers being undefined. Because the distances are not defined, I cannot infer, for example, that a respondent who answered with a "4" is precisely twice as likely to persist as one who answered with a "2." The simple rank-ordering enforced by the survey, and the lack of scale to define distances among the values means that the usual linear regression approach is not appropriate. Rather, when testing for associations with either the "Major Persistence" or "Career Persistence" variables, I use ordered logistic regression models. These models present their parameter estimates as modifiers to the log-odds of moving up a likelihood level.

The third dependent variable is a binary variable indicating whether the student intends to pursue a Ph.D. in engineering, referred to as "Engineering PhD." Most engineers do not pursue doctorate-level degrees, and those who do are often interested in academic positions related to engineering involving research and teaching. Still, I take an expressed intent to pursue a Ph.D. in engineering as a demonstration of a commitment to a longer-term relationship with the engineering profession. Logistic regression is the appropriate method for measuring associations with this dichotomous dependent variable.

The fourth dependent variable was constructed as a scale from a ten-component question only for the engineering students about their own confidence in advancing in their pursuit of engineering. I performed a principal components factor analysis with a varimax rotation on the responses to these ten items revealing one factor with an eigenvalue greater than 1, as shown in Table 7. All ten items loaded onto this single factor, with an overall Cronbach's alpha of 0.97. The introduction to the question read, "As a result of the college courses you've taken up to this

point, indicate your confidence with each of the following," and some sample items in the scale included: "Advancing to the next level of courses in engineering," "Completing my engineering degree," and "Engineering is the right profession for me." Taking the average of students' responses to these ten items, I constructed an indicator of "Engineering Commitment," to represent respondents' intent and commitment towards pursuing an engineering career. Because this variable is a scale, varying continuously over a defined range, standard linear regression techniques are appropriate when testing for associations with "Engineering Commitment."

Table 7: Factor Analysis Yielding "Engineering Commitment" Persistence Indicator

Variable	Varimax-rotated factor loadings	Uniqueness
Completing my degree in engineering	**0.91**	0.17
My abilities to be successful in my career	**0.94**	0.11
Finding a satisfying job	**0.89**	0.21
Finding a job in engineering that pays well	**0.91**	0.16
My lab skills	**0.79**	0.37
Developing useful skills	**0.92**	0.16
Selecting the right field of engineering for me	**0.87**	0.24
Engineering is the right profession for me	**0.85**	0.28
My engineering abilities	**0.92**	0.16
Advancing to the next level of courses in engineering	**0.89**	0.21
Eigenvalue	7.92	
Cronbach's alpha	0.97	

Because I have a set of four dependent variables – all four used as indicators of persistence in the engineering profession derived from different sets of survey responses – each of my professional identity indicators will have four estimates of associations with persistence. In the analysis below, I look at the pattern of results for each indicator to determine which professional identity indicators show associations with persistence. Because of the multiple tests for association, I will need to adjust the criterion used to infer a significant result.

The probability that at least one out of four tests will have an estimated measure of association meeting or exceeding the usual $p < 0.05$ threshold by chance (that is, when there is

actually no association) is actually close to 0.19. However, the probability that two of four measures of association meet or exceed the $p < 0.05$ threshold in the presence of no real association is 0.014. Thus, if at least two of the four tests for associations show significance at the 0.05 level, I take that as evidence of a significant association between the professional identity indicator and persistence.

4.5. Analysis: Testing for associations with gendered persistence.

4.5.1. Variable Summaries

Before testing for associations, Table 8 provides summary statistics for the variables involved in the analysis. Table 8 also shows the results of tests for difference in the variables by student sex. Because these data aggregate survey responses from four separate undergraduate institutions, I test for significant differences by sex for each variable while controlling for school-specific effects using an ANOVA. The concern is that school-specific variation could erroneously appear as sex-specific variation as there are large school-specific differences both in variable levels and the sex composition across schools. Given that sex composition does vary significantly across the four schools (indeed, one is an all-women's college), there is a clear need to control for school-specific effects. As shown in Table 8, I find significant school-specific differences in three of the eight professional identity indicators, but find significant differences by sex for only one of the professional identity indicators – "Engineering Self-Competence."

Perhaps most notably, these data show no evidence of significant differences by sex for any of the four persistence variables. When there is such extensive documentation and scholarship concerning gendered persistence in the engineering career pipeline, it is surprising to find no evidence for it in these data. These data do come from students completing surveys during the second-half of their sophomore year – possibly too early to observe significant

differences in major persistence, since most students first declare their major during their sophomore year.

The analyses in this paper do not depend on finding significant differences in persistence by sex. I am investigating for those professional identity indicators that could *contribute* to gendered persistence. Such associations are still identifiable regardless of whether the net persistence outcomes – subject to influence from identity but also many additional factors – show significant differences by sex. As discussed above, particular aspects of professional identity could contribute to gendered persistence if they are directly associated with persistence for men and women, and are significantly unequally distributed by sex. Based on the findings from Table 8, the only candidate for such gendered associations is "Engineering Self-Competence." The other way for professional identity indicators to be associated with gendered persistence is to have significantly different associations with persistence by sex. I turn to seeking this relationship pattern among associations in the analysis below.

Table 8: Summary statistics of analysis variables and tests for significant differences by sex.

Variable	Means (and Standard Deviations)			ANOVA F-Statistics[c]	
	All	Women	Men	Female	School
	N=183	N=83	N=100	df=1	df=3
Female	0.45				
	(0.50)				
Career Persistence	1.91	1.93	1.90	0	0.26
	(1.02)	(1.01)	(1.03)		
Major Persistence	3.31	3.36	3.27	0.31	1.68
	(1.00)	(1.07)	(0.95)		
Engineering Ph.D.	0.37	0.33	0.41	1.55	1.49
	(0.49)	(0.47)	(0.50)		
Engineering Commitment	1.86	1.83	1.89	1.07	1.81
	(0.87)	(0.76)	(0.96)		
Career Category Importance [a]	0.00	0.08	-0.07	1.76	2.06
	(0.86)	(0.83)	(0.89)		
Demographic Category Importance [a]	0.00	0.06	-0.05	0.24	1.04
	(0.98)	(0.93)	(1.01)		
Value Problem Solving [a]	0.00	-0.03	0.03	0.75	0.14
	(0.56)	(0.51)	(0.59)		
Value Social Perspective [a]	0.00	0.05	-0.04	0.11	**3.23***
	(0.78)	(0.74)	(0.82)		
Academic Self-Competence [b]	1.07	1.00	1.13	2.23	**3.17***
	(0.67)	(0.70)	(0.64)		
Engineering Self-Competence[b]	0.09	-0.51	0.59	**28.07*****	**3.49***
	(1.71)	(1.62)	(1.62)		
Sought by Peers [a]	0.00	0.04	-0.04	3.2†	0.11
	(0.29)	(0.26)	(0.31)		
Self-Major Distance [a]	0.00	-0.02	0.02	1.07	0.53
	(0.29)	(0.27)	(0.30)		

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] These variables have been centered on their means to allow for interaction testing.

[b] These variables were already coded with a meaningful zero value, and therefore did not need to be centered.

[c] Given the 183 observations, there are 182 degrees of freedom for these tests: 4 in the model (2 sexes and 4 schools), and 178 residual degrees of freedom.

4.5.2. First order associations: Correlations

Table 9 presents the correlation matrix for the variables described above. As Table 9 shows, all but one of the professional identity indicators are significantly associated with at least two of the four persistence outcomes. One indicator, "Engineering Self-Competence," even has significant positive associations with all four persistence variables, and "Value Problem Solving" has unusually high correlation coefficients with two of the outcomes (0.63 and 0.72 with Career

Persistence and Engineering Commitment, respectively). The "Demographic Category Importance" indicator has no significant associations with persistence. This indicator was not intended to be a standalone indicator of professional identity, but rather was included to be viewed relative to the "Career Category Importance" indicator.

It is worth noting that five out of the six possible pairings among the four persistence variables are significantly correlated. The two persistence variables that are not correlated are "Major Persistence" and "Engineering Ph.D." This result is consistent with previous research demonstrating that the academic career path in engineering is qualitatively different than traditional engineering careers, with the former having greater associations with an undergraduate degree in the sciences (Bailyn & Schein 1980; Schein 1988).

Another interesting pattern is revealed when looking at the correlations among the professional identity indicators. My indicator for role-specific self-worth, "Sought by peers" is for the most part, only weakly correlated with the persistence outcomes (1 strong and 2 weak associations out of 4), but more strongly correlated with the other identity indicators (3 strong associations and 2 weak associations out of 7). This finding is actually quite consistent with theory and empirical findings from other settings in that self-worth, being an aspect of self-esteem, is an integral component of identity. At the same time, of the two self-esteem components: self-efficacy and self-worth, self-efficacy has been found to be the component more directly associated with persistence in a role (Cast & Burke 2002). The only other identity variable showing significant associations with more than half of the other identity variables is "Value Problem Solving" (4 strong associations out of 7). That identity indicators should be associated with persistence is as expected. The contribution I seek to make with this chapter is identifying the aspect of identity associated with *gendered persistence*.

First-order associations: Correlations

Table 9: Correlations among Persistence and Professional Identity Indicators

	1	2	3	4	5	6	7	8	9	10	11
1. Career Persistence	–										
2. Major Persistence	**0.23*** **	–									
3. Engineering Ph.D.	**0.18***	0.09	–								
4. Engineering Commitment	**0.72*** **	**0.24****	**0.16***	–							
5. Career Category Importance	**0.18***	**0.26*** **	0.08	0.13†	–						
6. Demographic Category Importance	0.00	0.10	-0.01	0.04	0.12†	–					
7. Value Problem Solving	**0.63*** **	**0.15***	0.09	**0.72*** **	**0.18***	0.05	–				
8. Value Social Perspective	**0.28*** **	0.10	0.05	**0.39*** **	0.15	-0.02	**0.43*** **	–			
9. Academic Self-Competence	0.08	0.14†	**0.28*** **	**0.20****	0.11	0.07	**0.16***	0.03	–		
10. Engineering Self-Competence	**0.15***	0.13†	**0.28*** **	**0.28*** **	0.09	0.03	0.12	-0.02	**0.36*** **	–	
11. Sought by Peers	0.13†	**0.17***	0.13†	0.07	**0.18***	**-0.18***	0.11	0.15†	**0.19***	0.13†	–
12. Self-Major Distance	**-0.27*** **	-0.09	-0.01	**-0.32*** **	-0.01	-0.04	**-0.24****	**-0.16***	-0.08	-0.03	0.00

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.5.3. Identifying associations with gendered persistence: Regression with interactions by sex

By interacting the professional identity indicators with sex in a regression model predicting persistence, I can estimate whether the association between the identity indicator and the persistence outcome differ significantly based on sex (cf. Holland 2003). I conduct these interaction tests for each of the professional identity indicators using each of the four persistence variables as outcomes. The regression coefficients, their standard errors, and goodness-of-fit statistics are presented in Table 10.

Because the variable "female" used to construct the interaction terms is dichotomous, the main effects have the direct interpretation of the association between the independent variable and the dependent variable for men. The coefficients on the interaction terms test whether this association significantly differs for women relative to men for each of the predictors. (The sum of the main effect and corresponding interaction term for a given identity indicator provides the point-estimate for the association between that indicator and the persistence outcome among women. In Table 11, I have provided these point-estimates for women along with their standard errors.) Surprisingly, there are no significant interaction terms for any of the professional identity indicators across all four persistence outcomes. Given that eight identity indicators and four persistence outcomes yields 24 tests for significance on interaction terms, it is surprising that there isn't even by chance a single significant result.

Because of the correlations among the professional identity indicators, I was concerned that multi-collinearity could have played a role in increasing the variances of the regression estimates, and thus bias towards no effects. I tested for a bias against

significance from multi-collinearity in two ways. For the logit and ordered logit models, I simply re-ran the regressions after removing individual correlated indicators. This exercise did not change the significance of any of the remaining variables. For the regression models (predicting "Engineering Commitment"), I estimated the variance inflation factors (VIFs) for the variables in my regression model. All VIFs were well below the usual threshold of 10 (Marquardt 1970), with all but two below 5. The two above five were the "female" variable and the term for the interaction between "female" and "Academic Self-Competence." Given that correlations among interaction terms are expected, and none of the professional identity indicators themselves had high VIF scores, I am confident that my results are not being obscured by multi-collinearity.

In the section on "Identifying associations with gendered persistence" above, I described the two conditions whereby a professional identity indicator could be determined to contribute to gendered persistence. One of these conditions required that the interaction term (when interacted with sex) be significant. Because none of the eight professional identity indicators have significant interaction terms, none of them can be contributors to gendered persistence in the manner outlined by the first condition.

The second condition had a more complex set of requirements. These included that for both men and women, the association between the identity indicator and persistence be significant. Looking across Tables 10 and 11, this requirement is only partially fulfilled for two identity indicators. Both "Engineering Self-Competence" and "Value Problem Solving" show multiple significant associations with the persistence outcomes for men and women. Of these, "Value Problem Solving" has the stronger effects, but strength of effect (beyond significance) is not part of the criteria. For the

second condition to be met fully, a professional identity indicator must have significant associations with persistence among men and women that do not differ significantly from each other, AND that professional identity indicator must be distributed significantly unequally between men and women. As shown in Table 8, "Engineering Self-Competence" differs significantly by sex. Thus, "Engineering Self-Competence" is the *only* professional identity indicator that meets all the stated requirements for contributing to gendered persistence!

Table 10: Associations between professional identity indicators and persistence with sex interactions.

Professional Identity Predictors with Sex Interactions (N=168)	Career Persistence	Major Persistence	Engineering Ph.D.	Engineering Commitment
Female	-0.507	0.290	0.522	-0.128
	(0.675)	*(0.739)*	*(0.919)*	*(0.213)*
Main Effects (Association Among Men)				
Career Category Importance	0.129	0.367	0.197	-0.037
	(0.240)	*(0.250)*	*(0.296)*	*(0.078)*
Demographic Category Importance	-0.292	0.147	-0.193	-0.020
	(0.213)	*(0.218)*	*(0.241)*	*(0.064)*
Value Problem Solving	**2.353*****	-0.112	-0.324	**0.991*****
	(0.478)	*(0.444)*	*(0.496)*	*(0.130)*
Value Social Perspective	0.133	0.324	-0.004	0.073
	(0.254)	*(0.274)*	*(0.332)*	*(0.084)*
Academic Self-Competence	-0.550	0.203	**1.007***	-0.063
	(0.367)	*(0.372)*	*(0.478)*	*(0.115)*
Engineering Self-Competence	**0.233**†	0.009	0.189	**0.152****
	(0.137)	*(0.136)*	*(0.168)*	*(0.043)*
Sought by Peers	0.242	**1.451**†	0.827	-0.180
	(0.736)	*(0.796)*	*(0.862)*	*(0.233)*
Self-Major Distance	**-1.438**†	0.311	-0.270	-0.293
	(0.841)	*(0.820)*	*(0.972)*	*(0.252)*
Interactions with "Female"				
Career Category Importance	0.016	0.476	-0.151	0.051
	(0.380)	*(0.401)*	*(0.477)*	*(0.118)*
Demographic Category Importance	0.303	-0.167	0.398	0.025
	(0.337)	*(0.378)*	*(0.412)*	*(0.101)*
Value Social Perspective	-0.203	-0.208	-0.102	0.089
	(0.414)	*(0.459)*	*(0.516)*	*(0.132)*
Value Problem Solving	0.256	-0.740	1.186	-0.170
	(0.708)	*(0.804)*	*(0.832)*	*(0.207)*
Academic Self-Competence	0.714	0.248	-0.286	0.178
	(0.514)	*(0.574)*	*(0.680)*	*(0.160)*
Engineering Self-Competence	-0.175	0.261	0.299	-0.055
	(0.212)	*(0.250)*	*(0.256)*	*(0.064)*
Sought by Peers	0.799	-0.537	-1.277	0.077
	(1.148)	*(1.337)*	*(1.405)*	*(0.358)*
Self-Major Distance	1.333	-1.491	1.420	-0.096
	(1.326)	*(1.372)*	*(1.613)*	*(0.398)*
School = O'Brien	-0.200	**-1.037****	**1.203****	0.129
	(0.364)	*(0.394)*	*(0.461)*	*(0.114)*
School = Jackson	0.238	-0.585	0.421	0.001
	(0.768)	*(0.894)*	*(0.826)*	*(0.213)*
School = State	-0.303	-0.690	**1.299***	-0.225
	(0.527)	*(0.558)*	*(0.634)*	*(0.158)*
Constant *(if applicable)*	N/A	N/A	-2.279	1.872
			(0.729)	*(0.164)*
Cut-point 1 *(if applicable)*	-3.231	-4.482	N/A	N/A
Cut-point 2 "	-1.547	-3.108		
Cut-point 3 "	0.575	-2.052		
Cut-point 4 "		-0.471		
Adjusted or Pseudo-R^2	0.160	0.104	0.175	0.480
Log likelihood	-178.8	-163.7	-91.7	N/A

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Point estimates and standard errors for associations among women, derived from Table 10.

Professional Identity Predictors with Sex Interactions (N=168)	Career Persistence	Major Persistence	Engineering Ph.D.	Engineering Commitment
Associations Among Women				
Career Category Importance	0.145	**0.843****	0.047	0.013
	(0.299)	*(0.319)*	*(0.379)*	*(0.090)*
Demographic Category Importance	0.011	-0.021	0.205	0.005
	(0.263)	*(0.310)*	*(0.335)*	*(0.079)*
Value Problem Solving	**2.609*****	-0.851	0.863	**0.820*****
	(0.583)	*(0.679)*	*(0.673)*	*(0.162)*
Value Social Perspective	-0.070	0.117	-0.106	0.162
	(0.336)	*(0.379)*	*(0.405)*	*(0.104)*
Academic Self-Competence	0.163	0.451	0.721	0.115
	(0.367)	*(0.446)*	*(0.499)*	*(0.114)*
Engineering Self-Competence	0.058	0.270	**0.488***	**0.097***
	(0.162)	*(0.210)*	*(0.194)*	*(0.048)*
Self-Major Distance	-0.105	-1.180	1.149	-0.390
	(1.026)	*(1.093)*	*(1.286)*	*(0.308)*
Sought by Peers	1.041	0.914	-0.450	-0.103
	(0.884)	*(1.079)*	*(1.112)*	*(0.273)*

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.6. Discussion

The main finding from this analysis is that promoting the role-specific engineering self-competence among women should translate directly to increased persistence among those women. It is informative that my "Academic Self-Competence" indicator – used as a less role-specific (or at least less engineering-specific) indicator of self efficacy – shows no significant differences by sex. In fact, sex differences in self-assessments of competence are highly role or task dependent. In her longitudinal study of secondary school students going on to college and work, Shelley Correll (2001) showed that for tasks that are culturally stereotyped as being better performed by men, such as mathematics, men are indeed more likely to have higher self-assessments of competence than women of *comparable actual ability.* But for tasks that are culturally stereotyped as

being better performed by women, such as verbal tasks, women also exhibit significantly higher self-assessments of competence than men of comparable actual ability.

The associations between engineering self-competence and the persistence outcomes for women shown in Table 11 suggest that a unit increase in engineering self-competence (which is approximately equivalent to the difference in the mean levels of that indicator between men and women) would yield an approximately 10% increase in engineering commitment, and a 60% increase in the odds of intending to pursue a Ph.D. in engineering. As noted above, the latter association is may still indicate a departure from the traditional engineering career path, albeit for a more academically/professionally oriented engineering career.

One of the more surprising results from my analysis is the consistently strong associations between my "Value Problem Solving" professional identity indicator and persistence (as well as the other aspects of professional identity). This indicator appears to tap into a belief or understanding quite fundamental to an engineering identity. Notably, men and women engineers adopt this understanding to essentially equal degrees by their sophomore year, and holding this understanding is just as necessary for and beneficial to women as for men. This finding bolsters recent calls to increase the inclusion of a values perspective in identity research (Hitlin 2003). Despite this strength of association, this aspect of professional identity is an unlikely lever to promote persistence among women. Attempts to do so would need to focus either on intensifying this understanding about the importance of problem solving to engineering success among female but not male engineers, or on further strengthening the already strong association between this indicator and persistence among women but not men. Neither of

these options is pragmatic. These possibilities also accept the constraint that to reduce men's persistence would be an inappropriate path toward greater equity.

One interesting result of my analysis that is not highlighted simply by looking at significance levels is found in the associations with persistence of the category identity indicators. For the category indicators ("Career Category Importance" and "Demographic Category Importance"), three of the four pairs of association (the career and demographic category association measures from a single model constituting a pair) in Table 10 are of similar magnitude but opposite sign, suggesting the difference assumption is valid. Looking at the same paired associations in Table 11 shows a different pattern, suggesting that although the difference in these category identities may be associated with engineering persistence among men, the same is not true for women. This result is consistent with the literature positing that lower status and stigmatized groups hold those identities as more salient and central than non-stigmatized groups (i.e., most whites rarely think of race and most men rarely think of gender [McIntosh 1988]).

I am aware of no previous study comparing different aspects of professional identity across theories for differences in their associations with role-persistence. There have been studies on the effects of identity on persistence, which are commonly grounded in a single theory of identity, and thus use only those indicators consistent with that theory. One such effort draws upon Identity Theory in a study comparing the associations between the self-efficacy and self-worth components of self-esteem and persistence in marital relationships. This study found the self-efficacy but not the self-worth component of self-esteem to be associated with persistence (Cast & Burke 2002).

This chapter presents my attempt at a theory-driven comprehensive assessment of which aspects of professional identity contribute to gendered persistence. Given the iterative nature of research, I was not able to include indicators for all the identity aspects suggested by the review of theory in Chapter 2. Notably, the "common fate" conceptualization of identity is absent in this analysis. I have no reason to discard the possibility that this aspect of identity does in fact have significant associations with persistence. Future research is needed to assess this relationship. In addition, the self-worth component of self-esteem is under-developed. The role-specific self-worth indicator used in this analysis, though producing results consistent with theory, was developed *post hoc*, and no indicator for global self-worth was available. Given that there is little if any evidence supporting a strong association between self-worth and persistence outcomes, I consider this absence only a small threat to my study.

To reiterate a caveat from earlier in this chapter, my analysis has focused on expressed intentions to persist, and not persistence behavior itself. Although these are closely related (Seymour & Hewitt 1997) they are not identical. It is entirely possible that some of the professional identity indicators tested would have stronger (and potentially gendered) associations with *actual* persistence, though not intentions to persist. This question can only be resolved through further research.

Taking my results regarding intentions to persist, and extending them to predictions about actual persistence, provides some direction about promoting women's persistence in engineering. The solution from this analysis is to promote engineering self-competence among women engineers. But this begs the question of how to do so. How do students develop their engineering self-competence, and is this process similar for

men and women? Mechanism-based understandings of the identity formation process are needed to be able to design policies and strategies to promote self-efficacy among women. What are the mechanisms of self-efficacy formation, and which mechanisms lend themselves to intentional policy-based interventions? These questions motivate the analysis found in the next chapter – the role of peers in the formation of this aspect of professional identity.

APPENDIX A. SURVEY ITEMS FOR CHAPTER 4.

DEPENDENT VARIABLE: Major Persistence

How likely are you to change to another major before graduating?

Likely Somewhat likely Neither likely nor unlikely Somewhat unlikely Unlikely

DEPENDENT VARIABLE: Career Persistence

At this moment, how likely it is that you will be an engineer five years from now?

Very Likely Likely Not very Likely Not Likely at all

DEPENDENT VARIABLE: Engineering Ph.D.

What other graduate degree(s) do you intend to pursue? *(check all that apply)*

Law	Medicine	Business
Masters Degree	Ph.D. in Engineering	Ph.D. in other field
Other	None	

DEPENDENT VARIABLE: Engineering Commitment

As a result of the college courses you've taken up to this point, indicate your confidence with each of the following:

{ Not at all Confident | Not very Confident | Confident | Very Confident }

Completing my degree in engineering
My abilities to be successful in my career
Finding a satisfying job
Finding a job in engineering that pays well
My lab skills
Developing useful skills
Selecting the right field of engineering for me
Engineering is the right profession for me
My engineering abilities
Advancing to the next level of courses in engineering

ROLE IDENTITY ITEMS FOR ROLE-MATCHING INDEPENDENT VARIABLE:

For each of the following qualities, please rate how you view OTHER STUDENTS IN YOUR SAME MAJOR. Usually, other students in my MAJOR are:

Very Happy	Very Unhappy	(Factor: Personable)
Very Individualistic	Very Cooperative	
Very Social	Very Asocial	(Factor: Personable)
Very Honest	Very Dishonest	
Very Illogical	Very Logical	(Factor: Linear)
Very Unsystematic	Very Systematic	(Factor: Linear)
Very Moral	Very Immoral	
Very Emotional	Very Unemotional	
Very Friendly	Very Unfriendly	(Factor: Personable)
Seek practical answers	Seek general truths	
Want to work with people	Want to work with things	(Factor: Personable)

For each of the following qualities, please rate how you see YOURSELF.

Usually I AM: *(the same list of pairs as above)*

INDEPENDENT VARIABLE: GROUP CATEGORY IDENTIFICATION:

How important are the following group memberships to you in defining who you are:
{Very Unimportant | Somewhat Unimportant | Neither Unimportant nor Important | Somewhat Important | Very Important}

"Career Category" factor
My chosen career
My college
My college major

"Demographic Category" factor
My nationality
My sexual orientation
My native language
My race/ethnicity
My gender

INDEPENDENT VARIABLE: SELF-EFFICACY INDICATOR ITEMS:

Rate yourself on each of the following traits as compared with the average person your age. (We want the most accurate estimate of how you see yourself)
{Lowest 10% | Below average | Average | Above average | Highest 10%}

Academic Self-Competence
Drive to achieve
Mathematical ability
Self-confidence (intellectual)
Academic ability

Compared to other students in your engineering courses how would you complete the following:
{Strongly Disagree | Disagree | Agree | Strongly Agree}

Engineering Self-Competence:
I am generally more confident about my abilities
I understand engineering concepts better.
I am better at solving engineering problems.

INDEPENDENT VARIABLE: SOUGHT BY PEERS

How many TIMES in the past two weeks did a fellow student ask you a question outside of class about a class assignment?

INDEPENDENT VARIABLE: ENGINEERING VALUES ITEMS:

What, in your opinion, makes a successful engineer? Please rank the importance of the following items. *{Very Unimportant | Unimportant | Important | Very Important}*

Value Problem Solving factor:
Intuition
Understanding machines
Ability to work in teams
Problem-solving skills
Maintaining updated skills and expertise
Innovative thinking
Math skills
Strong background in science
Persistence
Attention to detail

Value Social Perspective factor:
Social skills
Leadership
Understanding the consequences of technology

ENGINEER INDICATOR:

Below is a list of different undergraduate MAJOR fields grouped into general categories. Please indicate your probable field of study by selecting your intended MAJOR.
Arts and Humanities
Biological Science
Business
Education
Engineering
Physical Science
Professional
Social Science
Technical
Other Field / Don't know

CHAPTER 5. PEER INFLUENCE ON THE PROFESSIONAL IDENTITY OF ENGINEERS

5.1. Overview

At every step along the engineering career pipeline, women exit at rates higher than men. Studies of exits from the profession at the early credentialing stage have identified failures in forming a professional identity as an engineer to be the most consequential reason for exit – exceeding measures of performance and ability, and that cultivating an engineer identity is more difficult for women than for men. Policy recommendations addressing this disparity must be informed by an understanding of the mechanisms of professional identity formation, and how they may be gendered. Theories of role identity formation from both the macro and micro perspectives emphasize the importance of social interactions, but are ambiguous regarding the causal role of peers. This chapter uses a quasi-experimental design, in the form of assigned roommates, to investigate the role of peer influence on identity formation among men and women engineering students. I find both a causal role for peers in professional identity formation and that peer influence is gendered, being less influential for women than for men. I discuss the implications of these findings for policy and future research.

5.2. Introduction

The credentialing phase for engineering, commonly beginning with an undergraduate engineering degree program (Perrucci & Grestl 1969), is particularly consequential for that profession (Committee 2006). Individuals who do not cultivate an identity as an engineer during this phase are more likely to leave the engineering pipeline (Lee 2002; Cross & Vick 2001). Research on engineers in the U.S. shows that women leave engineering at rates higher than their male counterparts (Adelman 1998; Sonnert

1998) even when controlling for academic ability and performance (CPST 1997). Additional research has shown that gendered challenges in cultivating an identity as an engineer during this stage are largely responsible for this disparity in persistence (Correll 2001; Lee 2002; McIlwee & Robinson 1992; Seymour & Hewitt 1997). Hence, in engineering, the professional identity formation process contributes to the enduring gendering of that profession.

The need to address gender disparities in the engineering profession goes beyond moral arguments to include the imperative of maintaining national competitiveness in innovation and the global market (NSF 2000; Porter & van Opstal 2001). Policy recommendations addressing this disparity must be informed by an understanding of the mechanisms of professional identity formation, and how they may be gendered. This chapter takes advantage of roommate assignment among undergraduates in a small engineering-only college as the quasi-experimental manipulation to test for a causal role for peers in professional identity formation in engineers. In addition, I test whether any such peer influence operates differently for men and women.

Although a number of studies on engineering identity formation explicitly embrace the role of peers (e.g., Cross & Vick 2001; Lee 2002; Seymour & Hewitt 1997), the findings thus far are simply consistent with a role for peers – they are not a causal confirmation of such a role. It is clear that the successful formation of an engineering identity during the credentialing phase of the professional career path is essential for persisting in the profession. It is also clear that disparate challenges in engineering identity formation at this stage contribute to the gendering of the engineering profession.

The role of peers in these processes, however, remains an open question from both a theoretical and empirical perspective.

5.3. Data

5.3.1. Data Sources

The data for this study come from a complete cohort of students entering the O'Brien Institute (a pseudonym), a small private engineering-only college[4] in the northeastern United States (N=75). These data consist of three sources: (1) the roommate assignments determined by the school, (2) students responses to the school-administered survey for roommate preferences, and (3) an original survey conducted in the spring term of the students' first year documenting, among other things, the background and high school experiences of the students and their self-assessments of their success at school. The response rate for the third data source from the above list was 55/75 or 73%. For the first two sources, I have full data on all 75 members of the cohort. The sex of the student, coded as 1 for female and 0 for male, was provided by the institution and used to construct the interaction terms.[5] The items from the roommate preference survey and spring-term survey used for the variables in the analysis are presented in Appendix C.

The fact that this college is only an engineering college helps to make it a strategic research site. First, by opting for an engineering-only college, these students have demonstrated a commitment to an engineering education that is more focused than what would be available at a liberal arts college. Second, because all students in the

[4] The school only has three possible majors: Electrical & Computer Engineering, Mechanical Engineering, and General Engineering with concentrations in BioEngineering, Materials Science, Computing, or Systems.

[5] Although I would have liked to include race/ethnicity categories in my analysis, the school did not provide race/ethnicity data, and the self-reported race/ethnicity categories from the first year survey yielded about a third of "prefer not to answer" responses. Including race/ethnicity in this type of analysis is an important opportunity because although roommates are completely sex-segregated, this is not the case for race/ethnicity. For this study, I am limited to looking exclusively at gender differences.

college are engineering majors, the peer environment is more similar to that of a professional school, where all the students are working toward the same professional credential. Further, all roommate assignments in this setting necessarily pair engineering majors with other engineering majors. In most undergraduate institutions, roommates are unlikely to be assigned based on major (or likely major, as majors are commonly not declared until after roommates have been assigned). In these other situations, peer influence from the roommates could more plausibly be irrelevant to or even contrary to the development of an engineering identity. At this site, all students are engaging in the common identity work of figuring out what engineering is and whether it is a profession they wish to pursue. Finally, the entire curriculum structure of the school is designed towards training engineers. For these reasons, the engineering students at the O'Brien Institute have an undergraduate experience much more similar to a professional school environment than engineering students at most other colleges (Perrucci & Gerstl 1969). It is within this favored setting I test for roommate influence on professional identity formation.

With regard to analysis of the roommate data, it is important to note that despite the high response rate from the first year spring survey, I could not use all the responses. I only analyze roommate pairs where I have survey response data from both roommates. If roommate status was independent of completing the survey (i.e., roommates neither encouraged nor discouraged each other from completing the survey), then I would expect 73% of 73% or just fewer than 54% of the students to be represented in the analyses.[6] In

[6] I test for an association between roommate status and survey response. Using a chi-square test, the test statistic is 0.026 with 1 degree of freedom. The corresponding p-value for this statistic is 0.87, suggesting that any missing data mechanism is unrelated to roommate status. In addition, I test whether missing data is

addition, I exclude two roommate pairs that were assigned based on their personal requests to room together. Obviously, these four cases of self-selected roommates cannot be included in the analysis of roommate influence where roommate assignment needs to be a quasi-experimental manipulation. Finally, the three students who were assigned to single rooms are also excluded. After these exclusions, 36 students remain for my analysis.

5.3.2. Dependent Variable: Engineering Self-Competence (ESC)

Engineering Self-Competence (ESC) measures a student's self-assessed abilities as an engineer relative to her peers. Chapter 4 provided the analysis of data from engineering students across four undergraduate institutions (including the one that is the subject of this paper) that establishing ESC as the focal aspect of professional identity contributing to gendered persistence among these engineers-in-training. As described in Chapter 4, the ESC variable is a scale with a Cronbach's α of 0.81 across the four schools. Among O'Brien Institute survey respondents, the scale reliability of ESC is $\alpha = 0.84$.

The items in this scale refer to role-specific competence as a form of self-efficacy. This focus is consistent with the theorized distinctions between occupational identity and organizational identity, where the former is more associated with what one does, and the latter is more associated with where one is (Van Maanen & Barley 1984). The analysis in Chapter 4 shows that ESC is directly related to intentions to persist in engineering among men and women alike, but that men have significantly higher levels of ESC than women. Among O'Brien Institute students, men's ESC is also numerically higher than women's ESC, but the difference does not meet the threshold for statistical significance.

---

associated with sex, finding a chi-square statistic of 0.20 (1d.f.), corresponding to a p-value of 0.66, suggesting sex is unrelated to students' decisions to respond to the survey.

5.3.3. Independent Variables: Students' background characteristics

Predicting this ESC outcome measure are a set of four background variables that were neither a source of variation in roommate assignment, nor subject to change based on roommate influence. These four background variables are as follows:

1. Number of engineers in the student's family.
2. The importance the student placed on the quality of the engineering program when selecting her college.
3. High school participation in science fair (none, some, often).
4. Maximum education level of both parents (a proxy for class).

The means and standard deviations for the dependent variable, independent variables, and roommate survey responses used for assignment are provided in Table 12. There are no significant differences between men and women on any of the four background variables, and only the weakest of differences on the outcome variable and one of the roommate preference variables ($p<0.10$, one-tailed test). Although a one-tailed test is reasonable for testing ESC differences, given the literature as well as the findings from Chapter 4, I do not have any *a priori* reason to think that men prefer to study while listening to music to a greater extent than women, so I cannot consider the latter difference meaningfully different.

As discussed, many students for whom I have data could not be included in the analysis because of missing roommate data. Summary statistics for and correlations among the variables used in the analysis of peer influence are presented in Table 13. I tested to see whether any of the analysis variables were associated with the data exclusion mechanism, and found no significant associations. Table 13 shows that none of the

correlations among the analysis variables are significant. The correlation coefficient of the greatest magnitude is that between ESC and the number of engineers in a student's family (0.27). In the next section, I conduct the analysis to test for peer influence on students' engineering self-competence.

Table 12: Summary statistics of variables

Variable	All N=71	Men N=42	Women N=29
Engineering Self-Competence (ESC) [a]	2.67	2.77‡	2.52‡
	(0.61)	(0.66)	(0.52)
Background Characteristics [a]			
Engineers in family	1.14	1.07	1.25
	(1.16)	(1.28)	(0.97)
Engineering program importance	3.69	3.71	3.65
	(0.55)	(0.53)	(0.59)
Parents' education	9.22	9.23	9.20
	(1.27)	(1.19)	(1.40)
Science fair participation	0.43	0.39	0.50
	(0.76)	(0.72)	(0.83)
Roommate Preference Items			
Study to music	0.55	0.63‡	0.42‡
	(0.50)	(0.49)	(0.50)
Stay up late	0.55	0.59	0.50
	(0.50)	(0.50)	(0.51)
Get up early	0.41	0.36	0.50
	(0.50)	(0.48)	(0.51)
Were neat at home	0.35	0.36	0.35
	(0.48)	(0.48)	(0.49)
Plan to be neat at school	0.44	0.48	0.38
	(0.50)	(0.51)	(0.50)

‡ Men and women differences are very weakly significant: $p < 0.10$, one-tailed.

[a] The dependent variable, ESC and the background characteristics variables come from survey responses, not the school, so from a set of 51 students: 31 men and 20 women.

Table 13: Summary statistics for and correlations among the variables used in the analysis

	Women (N=14)		Men (N=22)		All (N=36)		Correlation Coefficients			
	Mean	SD	Mean	SD	Mean	SD	**1**	**2**	**3**	**4**
Dependent Variable										
1. Engineering Self-Competence (ESC)	2.5	0.55	2.7	0.64	2.6	0.61				
Independent Variables										
2. Number of engineers in the Family	1.3	0.99	1.0	1.09	1.1	1.05	0.27			
3. Importance of engineering program quality in school choice	3.6	0.65	3.7	0.57	3.6	0.59	-0.04	-0.04		
4. High School science fair Participation	0.3	0.61	0.4	0.66	0.3	0.63	0.18	0.00	-0.20	
5. Maximum education of both Parents	9.6	0.85	9.1	1.28	9.3	1.14	-0.07	-0.16	0.00	0.17

NOTES:

- None of these five variables are associated with the excluded data mechanism.
- None of the independent variables differ significantly by sex.
- None of the correlation coefficients are significant.
- I center the independent variables before generating the interaction terms, and estimate the model with the centered variables.

5.4. Analysis

The analytical agenda proceeds as follows: First, I use an established statistical method - Inverse Probability of Treatment Weighting (IPTW) to turn the non-random process of roommate assignment into a statistically and analytically random assignment design. Next, I test that roommate assignment was not by chance associated with any of the background variables described above. This serves both as a check that roommate assignment was not based on external factors, and that there is no prior-to-assignment correlation among roommates on the variables used in my analysis. Finally, I regress student's ESC on her own and her roommate's background variables, first without and then with interactions on sex. This design allows strong causal inferences on the role of peers on ESC, and including interaction terms tests whether this role differs significantly between men and women.

5.4.1. Non-random assignment & Inverse Probability of Treatment Weighting

Although roommates are assigned ties, they are not randomly assigned ties. In addition to the sex-segregated nature of roommate assignment, the school attempted to pair students with similar habits and preferences along a number of dimensions (e.g., going to sleep late, being tidy, and studying to music). This pairing was achieved by matching students based on their responses to a survey administered by the school during the summer before enrollment. This non-random assignment poses a direct threat to causal inferences regarding peer effects.

In a study of roommate effects, this survey-based assignment of roommates could generate spurious results. For example, if going to sleep late and keeping an untidy room are behavioral norms among people more likely to pursue engineering careers, then the roommate assignment process would be associated with the likelihood of pursuing an engineering career

(cf. Zimmerman 2003). I address this concern using a method developed in epidemiology – Inverse Probability of Treatment Weighting (IPTW).[7]

IPTW allows the estimation of treatment effects correcting for endogenously-determined treatment assignments (Hernan, Brumback & Robins 2001). IPTW makes two fundamental assumptions. First, IPTW assumes that the non-random component of assignment to treatment is known without any unobserved variables. Second, IPTW assumes that all subjects are at risk for assignment to treatment, preserving the experimental nature of the design. Both assumptions hold for my setting.

Using IPTW requires an accurate estimate of the probability of treatment for all subjects. Often, this is an individual-level analysis. Roommate assignment is fundamentally dyadic. Assignment of student A to student B is also an assignment of B to A, and both are prevented from being assigned to C no matter how "good" a match they are. Because assignments are dyadic, the probability of assignment must also be estimated on the dyads. To accomplish this, I use the "p-star" (also, "p*") approach developed within social network analysis, also known as exponential random graph modeling (Pattison & Wasserman 1999). The goal of this probability estimation is not to test for associations, but rather to get the best statistical model of the actual assignment procedure used by the housing office - that is, to minimize the unexplained variance. To this end, I iteratively estimated p-star models predicting roommate assignment based on the variables in the roommate preference survey and their interactions. Interaction terms that significantly improved the model based on a likelihood ratio test were adopted, while additional terms that did not improve the model were discarded. This process was repeated separately for men and women. Table 14 provides the results from this iterative process.

[7] I am indebted to Pierre Azoulay who alerted me to this method.

For both men and women, the initial model used in this iterative process included the roommate preference survey variables, translated into dyadic variables. For a given variable, a dyad could have responded identically or differently. Rather than treating "Yes/Yes" matches as equal in meaning as "No/No" matches, I distinguish the two. So each roommate preference variable has two associated parameters in the models: matching in agreement to the question, and matching in disagreement.

For women, no additional interaction terms made any significant improvements beyond the initial model. For men, the interaction term where a dyad matched both in their early morning and late night preferences significantly increased the likelihood of assignment, and significantly improved the model (LRT=11.6, df=1, $p< 0.001$).

Table 14: Initial and final predictive models for roommate assignment for men and women using p*.

Dyad Constraint	Women (N=29)	Men (N=42)	
	Initial & Final	Initial	Final
Number of Edges in Network	-9.96***	-8.59***	-8.30***
	(1.84)	*(1.21)*	*(1.23)*
Neither study to music	2.70*	2.54**	3.08**
	(1.11)	*(0.92)*	*(1.02)*
Both study to music	3.29**	2.12**	2.80**
	(1.16)	*(0.80)*	*(0.89)*
Neither like to stay up late	2.77*	0.92	-1.39
	(1.18)	*(0.67)*	*(1.09)*
Both like to stay up late	3.15**	0.84	-1.49
	(1.18)	*(0.58)*	*(0.97)*
Neither like to get up early	0.11	0.74	-1.73
	(0.98)	*(0.64)*	*(1.20)*
Both like to get up early	0.33	0.93	-1.35
	(0.84)	*(0.77)*	*(1.26)*
Neither kept a clean room at home	2.46*	1.03	1.07
	(1.11)	*(0.78)*	*(0.82)*
Both kept a clean room at home	3.49**	0.97	0.82
	(1.20)	*(0.93)*	*(0.95)*
Neither will keep a clean room at school		1.96*	1.97*
		(0.83)	*(0.84)*
Both will keep a clean room at school [a]		2.17*	2.30**
		(0.87)	*(0.89)*
Both late AND early preferences match			4.05**
			(1.40)
Log likelihood	-37.97	-76.3	-70.5

[a] For women, no students were assigned as roommates who did not match in their intent to keep a clean room in college. Because there was no variation in this dyadic relationship, it could not be included in the model.

Note: Because these variables were used to test for associations with the dyadic outcome of roommate assignment, dyadic versions of the variables had to be used. Dyadic variables are constructed from the values of both members of the dyad. The absolute difference is the absolute value of the difference of that variable between the members of the dyad. It is a dissimilarity measure. The sum of the variable values for the members of the dyad is simply twice the mean value for the dyad. It is an absolute level measure.

Once identified, the best model predicting roommate assignment is used to estimate the probabilities of the observed roommate ties. The reciprocal of these probability estimates then serve as a weighting factor for the final regression testing for peer effects. Adding these weights to the regression has the effect of testing for peer effects based on a pseudo-population where the

observed roommate assignment could have resulted from true random assignment. Scholars have proven that treatment effects estimated from this pseudo-population converge to the true treatment effect in the actual population (van der Laan & Robins 2003).

5.4.2. Roommate Correlations on the Background Variables

One key purpose of random assignment in experimental designs is to reduce bias arising from heterogeneity on unobserved variables. The concern is that some unobserved variable may be associated with one or more variables in the analysis, which could result in either type I or type II errors. Random assignment does not guarantee the elimination of this bias, but rather makes the bias less likely. The risk of heterogeneity on unobserved variables even under random assignment designs persists particularly for small sample studies.

For this reason, I test to check that roommate assignment is not associated with variables beyond the summer rooming preference survey, and specifically not associated with the variables involved in the final analysis. A coarse version of this test is simply testing for roommate-level correlations on the analysis variables. I present these correlations in Table 15. Not only do none of the correlations reach a 0.05 significance threshold (and the one variable showing weak significance, science fair participation, shows a *negative* correlation with ego's roommate), but I highlight that the correlation between ego and alter's (roommate's) ESC is not significant. A study assuming that convergence is necessary to infer influence, as in theories of influence via contagion (cf. Cialdini & Goldstein 2003 for a review), would conclude no evidence for peer influence. Although interesting and supportive, these results do not definitively demonstrate that the background variables are not associated with roommate assignment.

Table 15: Correlations between roommates on analysis variables.

	Correlation with Roommate on Same Variable		
	Men	**Women**	**All**
Engineering Self Competence (ESC)	0.12	0.38	0.23
Number of engineers in the Family	-0.24	0.22	-0.06
Importance of engineering program quality in school choice	0.18	-0.11	0.07
High School science fair Participation	-0.35†	-0.24	-0.31†
Maximum education of both Parents	-0.10	-0.27	-0.13

† $p < 0.10$

I perform a more definitive test by taking the initial predictive model of roommate assignment from above that is based solely on the rooming preference survey variables, and add each of the four background variables defined in the previous section. Either a significant coefficient for any of these four variables or a significant improvement in model fit would suggest that: (1) roommate assignments were not effectively randomizing regarding variables beyond the rooming preference survey, and (2) the resulting roommate assignment resulted in pairings that could bias the analysis towards identifying a null effect. Employing both of the parameter estimate and model fit tests is useful, because the small number of individuals in the network combined with the many dyadic constraint variables being included in the model can result in parameter estimates that "blow up" in terms of their standard errors. The model fit test Table 16 shows the p* model estimates from adding each of the four background variables to the initial model for men, and Table 17 shows the same for women. For both men and women, neither any of the parameter estimates nor any changes in model fit meet the threshold of even weak significance from adding the background variables to the model.

Table 16: Tests for model fit and associations in roommate assignments of men based on student background characteristics using p* giving estimated coefficients as log odds (and standard errors).

Dyadic Constraint on Network Tie (N=30)	Model 1	Model 2	Model 3	Model 4
Number of edges in the Network	-8.07***	-10.87†	-154.29	-8.31***
	(1.69)	*(5.56)*	*(14740)*	*(1.67)*
Neither study to music	2.65*	2.61*	2.51*	2.47*
	(1.21)	*(1.22)*	*(1.21)*	*(1.20)*
Both study to music	1.99†	2.00†	2.12†	2.05†
	(1.17)	*(1.17)*	*(1.22)*	*(1.17)*
Neither like to stay up late	1.39	1.31	1.36	1.27
	(0.94)	*(0.93)*	*(0.94)*	*(0.93)*
Both like to stay up late	0.47	0.51	0.40	0.48
	(0.89)	*(0.90)*	*(0.90)*	*(0.89)*
Neither like to get up early	0.21	0.31	0.14	0.41
	(0.92)	*(0.93)*	*(0.91)*	*(0.91)*
Both like to get up early	-0.46	-0.67	-0.56	-0.81
	(1.31)	*(1.27)*	*(1.33)*	*(1.26)*
Neither kept a clean room at home	1.18	0.91	1.08	1.00
	(1.01)	*(1.03)*	*(1.01)*	*(0.99)*
Both kept a clean room at home	1.71	2.01†	1.58	1.95†
	(1.10)	*(1.11)*	*(1.11)*	*(1.10)*
Neither will keep a clean room at school	2.24†	2.25†	2.13†	2.23†
	(1.20)	*(1.21)*	*(1.20)*	*(1.20)*
Both will keep a clean room at school	2.19†	2.16†	2.09†	2.21†
	(1.21)	*(1.22)*	*(1.24)*	*(1.21)*
Difference in # engineers in their families	0.11			
	(0.39)			
Sum of # engineers in their families	-0.25			
	(0.30)			
Difference in engineering program importance		0.14		
		(0.81)		
Sum of engineering program importance		0.33		
		(0.67)		
Difference in parental education level			7.56	
			(737.00)	
Sum of parental education level			7.29	
			(737.00)	
Difference in science fair participation				7.78
				(788.31)
Sum of science fair participation				-7.78
				(788.31)
Log likelihood	-39.35	-39.67	-37.53	-39.01
Comparison Log likelihood [a]	-39.80	-39.80	-39.80	-39.80
Likelihood Ration Test Statistic (df=2)	0.90	0.26	4.55	1.58

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] The comparison log likelihood differs from that shown in Table 14 above because the set of students had to be restricted to those roommate pairs who both completed the survey responses providing the background variables.

Table 17: Tests for model fit and associations in roommate assignments of women based on student background characteristics using p* giving estimated coefficients as log odds (and standard errors).

Dyadic Constraint on Network Tie (N=22)	Model 1	Model 2	Model 3	Model 4
Number of edges in the network	-5.67***	-3.35	-88.18	-5.42***
	(1.57)	*(5.26)*	*(10655)*	*(1.42)*
Neither study to music	1.94†	1.84	2.10†	1.77
	(1.13)	*(1.14)*	*(1.15)*	*(1.13)*
Both study to music	1.39	1.46	1.15	1.64
	(1.46)	*(1.46)*	*(1.47)*	*(1.48)*
Neither like to stay up late	1.90	1.80	1.48	2.12†
	(1.22)	*(1.22)*	*(1.24)*	*(1.21)*
Both like to stay up late	2.30†	2.38†	3.00*	2.26†
	(1.33)	*(1.34)*	*(1.47)*	*(1.35)*
Neither like to get up early	-0.71	-0.81	-1.20	-0.93
	(1.29)	*(1.29)*	*(1.38)*	*(1.34)*
Both like to get up early	-0.51	-0.38	-0.41	-0.60
	(1.03)	*(1.03)*	*(1.02)*	*(1.01)*
Difference in # engineers in their families	-0.16			
	(0.45)			
Sum of # engineers in their families	-0.01			
	(0.31)			
Difference in engineering program importance		-0.29		
		(0.85)		
Sum of engineering program importance		-0.32		
		(0.65)		
Difference in parental education level			3.76	
			(533)	
Sum of parental education level			4.14	
			(533)	
Difference in science fair participation				6.87
				(840)
Sum of science fair participation				-7.35
				(840)
Log likelihood	-26.83	-26.80	-25.46	-25.85
Comparison Log likelihood [a]	-26.91	-26.91	-26.91	-26.91
Likelihood Ratio Test Statistic (df=2)	0.17	0.22	2.89	2.12

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[a] The comparison log likelihood differs from that shown in Table 14 above because the set of students had to be restricted to those roommate pairs who both completed the survey responses providing the background variables. For women, these exclusions also eliminated the variation in the "kept a clean room at home" dyadic variables, and so had to be removed from the model.

5.4.3. First Causal Test of Peer Influence: Ignoring Gender

Having established first a weighting procedure to correct for non-random tie assignment, and second that with regard to the variables under investigation, there is no association between those variables and tie assignment, I proceed to conduct a causal test of peer effects on the ESC

outcome. Denoting the ESC of student s as y_s, the background variables of student s as the vector X_s, and the background variables of student s's roommate X_r, the basic structure of the model is given in equation (1).

$$y_s = x_o + \beta_s X_s + \beta_r X_r + e \quad (1)$$

This approach would provide an estimation of peer effects ignoring gender described as Analytic Scenario A – an analysis that ignores gender as described in detail in Appendix B. Estimating the peer effects for men and women together simply constrains the parameters for both groups to be equal. Significant coefficients associated with the roommate's characteristics would provide evidence of peer influence. The results of estimating equation (1) using the data from the engineers are shown below in Table 18. This estimation uses OLS linear regression weighted using the IPTW method described, and using the HC2 small-sample correction method. Of the four roommate characteristics variables, only one – science fair participation – achieves weak significance. Regarding the influence of students' own characteristics on their ESC, they are most influenced by the number of engineers in their families, and weakly by their own level of science fair participation. Each additional engineer in the family adds almost 0.3 engineering self-competence "points," where the uncentered ESC from the data ranges from 1.67 to 4.0. That the background of an individual would influence their own professional identity outcomes is hardly a novel contribution. The main purpose of this analysis – to test for peer influence via roommate ties – produced underwhelming results, but this analysis has ignored gender. I next test for peer influence on professional identity formation allowing for the possibility of gendered dynamics.

Table 18: Analysis of roommate influence on ESC ignoring gender, weighted using the IPTW method, and including the HC2 small sample adjustment.

N=36	Estimated Coefficients (and standard errors)
Characteristics for the Focal Student (Ego)	
Number of Engineers in Family	**0.289****
	(0.085)
Engineering Program Importance	-0.097
	(0.597)
Parents Education	-0.052
	(0.106)
Science Fair Participation	0.646†
	(0.345)
Characteristics of the Roommate (Alter)	
Number of Engineers in Family	0.052
	(0.144)
Engineering Program Importance	0.441
	(0.368)
Parents Education	0.076
	(0.233)
Science Fair Participation	0.200†
	(0.111)
Constant	3.100
	(0.189)
R^2	0.833

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$

5.4.4. Second Causal Test of Peer Influence: Gendered Dynamics

Because roommate ties are completely sex segregated, it is worth considering a revision of equation (1) allowing the effects for men and women to be estimated separately. To statistically compare the identified effects between men and women, I pool both the male and female data and include interaction terms with sex for all the predictors in equation (1). Using sex to generate interaction allows the causal inference in the study design to be extended to causal associations for different processes between men and women (Holland, 2003). With the interaction term (based on a new variable, *f*, for female), the new model for estimation is given in equation (2).

$$y_s = f + x_o + \beta_s X_s + \beta_{sf} f X_s + \beta_r X_r + \beta_{rf} f X_r + e \quad (2)$$

My inferences regarding the causal role of peers in influencing ESC comes from the parameter estimates β_r and β_{rf}, and their significance. The point estimates for peer influence among males are taken from the β_r parameters, while the point estimates for peer influence among females are given by the sum of the β_r and β_{rf} parameters. Finally, evidence of significant differences in these peer effects by sex is found in the β_{rf} parameters and their significance. Because peers are perfectly sex-segregated in the case of roommates, there is no distinction between Analytic Scenarios B, C or D. Differentiating by sex on exertion of influence concomitantly differentiates by sex on the experience of influence, and vice-versa.

When estimating the regression model described in equation (2), I use standard OLS linear regression, weighted using the IPTW method described above. In addition, because of the small number of observations in the analysis, I use the small-sample correction, HC2, which adjusts the assumed variance of the independent variables to allow more robust inferences.[8]

Table 19 shows the parameter estimates for the model in (2). The results are divided into four sections corresponding to the main effects and interaction terms the background variables of ego, and the main effects and interaction terms for ego's roommate. For ego's own background variables on ego's ESC, the significant positive main effect (0.32, SE=0.076) of the number of engineers in ego's family, and the small, positive and insignificant interaction effect (0.007, SE=0.076) means that having more engineers in the family is directly associated with ESC for both men and women. This result is essentially the same as the one from above in Table 18. On the other hand, the positive and (weakly) significant main effect (0.429, SE=0.213) of science fair participation, and the negative and significant interaction term (-0.534, SE=0.213) means

[8] Another small-sample correction method, HC3, also corrects for heteroskedasticity. This more conservative correction could not be used in my fully-specified model; however, I did confirm my main finding for peer effects on the importance of engineering program quality variable among men but not women with the HC3 correction.

that although science fair participation is directly associated with ESC among men, there is no such association among women.

The bottom two sections of Table 19 show the effects of ego's roommate on ego's ESC. Three out of the four background variables show no effects, but the "importance of engineering program quality in college choice" variable is significant both for the main effect and for the interaction term. The main effect (equivalent to the estimate for the effect among men) is positive and significant, meaning that a unit increase (or decrease) in a male student's *roommate's* prior commitment to engineering (as measured by the "importance of engineering program quality on college choice" variable) yields an additional (or a loss of) 0.654 "points" of engineering self-competence for the student. This finding reveals a direct influence of the student's roommate on the student's own engineering identity. The interaction term for this variable is *negative* and significant. The point estimate for the roommate effect among women is the sum of the main and interaction effects, or -0.13, but is not significantly different from zero. Thus, I find that men's roommates have a significant direct causal effect on men's ESC, but there is no similar roommate effect among women. The significance of the difference between the peer effect for men and women is robust to a Bonferroni adjustment to account for the fact that I'm looking for peer effects simultaneously on four different variables without strong priors as to which variable should be consequential.

Table 19: Test for peer effects regressing ESC on ego's and alter's background characteristics with sex interactions using IPTW weighting and HC2 small-sample correction.

N=36	Coefficient	Std. Err.
Female = 1	**-0.858*** **	(0.091)
Main Effects for Ego (Effect for men)		
Number of engineers in family	**0.320** **	(0.076)
Importance of engineering program quality on school choice	-0.318	(0.272)
Maximum education level for both parents	0.032	(0.096)
High school science fair participation	0.429†	(0.213)
Interaction Effects for Ego (Effect for women minus effect for men)		
Number of engineers in family	0.007	(0.076)
Importance of engineering program quality on school choice	0.301	(0.272)
Maximum education level for both parents	-0.064	(0.096)
High school science fair participation	**-0.534***	(0.213)
Main Effects for Alter (Effect for men)		
Number of engineers in family	0.062	(0.141)
Importance of engineering program quality on school choice	**0.654***	(0.270)
Maximum education level for both parents	0.105	(0.098)
High school science fair participation	0.064	(0.134)
Interaction Effects for Alter (Effect for women minus effect for men)		
Number of engineers in family	0.172	(0.141)
Importance of engineering program quality on school choice	**-0.781** **	(0.270)
Maximum education level for both parents	-0.016	(0.098)
High school science fair participation	-0.058	(0.134)
Constant	3.155***	(0.091)
F	1233.8***	
R^2	0.890	

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$, two-tailed tests.

These findings provide the first example of a field study showing a causal link from peer interactions to professional self-efficacy. This particular self-efficacy measure, ESC, is shown in Chapter 4 to be associated with intentions to persist in the engineering profession. Students with a high ESC are more likely to plan to remain in engineering, while students with a lower ESC are less likely to plan to remain in engineering. Rather than being solely an individual endowment, trait or pre-existing propensity, I have shown that this consequential construct is importantly

subject to the influence of peers. Further this mechanism of peer influence operates differently for women than it does for men.

5.5. Conclusion

With the knowledge that peers do play a significant role in the development of professional identity, managing peer interaction becomes a policy lever to aid in the cultivation of professionals. Importantly, grouping strategies to promote professional identity formation should not merely pair individuals with strong and positive professional identities with others. As described in the summary of the reflection problem, and as illustrated in the absence of any significantly positive correlation between roommates on ESC, even among men, the mechanism of influence may not be mere contagion of the desired outcome. It is important to attend to which characteristics act as the source of influence. In the present analysis, prior commitment to the field of engineering, in the form of the importance of engineering program quality on college choice, serves as the indicator for influence.

The test I have used to assess this influence is extremely conservative. If peers are influential, then it stands to reason that students have many simultaneous influences. Although roommates are a unique type of social tie, with more intimate and regular contact than other classmates, it would be surprising if roommates were the sole source of peer influence. I have focused on roommates simply because they are an example of an assigned tie rather than a self-selected one. This quasi-experimental design has allowed me to conduct the careful causal analysis that is the substance of this paper. Indeed, a recent review of causal analyses using roommates cited the conservative nature of this approach to caution against rejecting the existence of peer effects even when roommate studies find small or null effects (Mouw 2006:97).

On the other hand, evidence of peer effects via roommate studies "are, arguably, the cleanest estimates we will get of social capital effects"[9] (Mouw 2006:97).

One of the striking findings in this study is the lack of peer effects among women compared to the significant positive effects among men. Interestingly, Mouw's review points out that one of the few roommate studies finding significant peer effects showed positive influence among men and no influence among women (Mouw 2006:98, citing Duncan *et. al.* 2005). This finding begs the question as to why peer influence operates differently between the sexes. The current analysis demonstrates this empirically to be the case.[10] Although the study by Cast and Burke (2002) discussed above suggests that status differences in gender could be in part responsible for differences in men's and women's abilities to successfully engage in self-verification, it is far from clear that a similar explanation would apply to the Duncan *et. al.* (2005) finding, that for men only, a student was more likely to engage in binge-drinking in college if he had a roommate who engaged in binge-drinking in high school. Further research is needed to shed light on the gendered nature of influence mechanisms; however roommate studies are not the best settings to gain traction on these gendered influence dynamics.

One limitation of roommate analyses, and hence this study, derives from the sex-segregated nature of the roommate ties. The school examined in this study is co-educational, so male and female students certainly have cross-sex ties. However, my analysis is limited exclusively to same-sex ties. As a result, there are numerous possible explanations for my finding of sex differences in influence among which I cannot distinguish. Women may be

[9] Mouw uses the term "social capital" broadly, explicitly including peer effects as a type of social capital. (Mouw 2006:80)

[10] In a more inductive analysis pursuant to this finding, I found that men and are both subject to peer influence contingent on the sex-composition of their academic (but not social) networks. Although this finding is compelling in its agreement with related literatures (e.g., Ibarra 1993), this finding lacks the empirical rigor that is the focus of this chapter. I provide some additional detail regarding this finding in the following chapter.

particularly unlikely to influence others, or may simply be less likely to be influenced. Similarly, men may be particularly influential or particularly subject to influence. In addition, the norms and scripts around male-male interactions may promote activities allowing this type of influence to occur, while such interactions may be less common in female-female dyads. Qualitative differences in dyadic relationships by sex are familiar findings in the social science literature (Booth 1972; Caldwell & Peplau 1982; Turner & Marino 1994; Williams 1985). To explore these possibilities, it would be important to include other types of assigned ties that include cross-sex assignment, such as project teams. This alternative approach to studying assigned ties could help elucidate the sex differences in influence processes.

I have performed just such an analysis using extant data on professional school students randomly assigned to semester-long project teams. Unfortunately, the data on the desired outcome variable – an efficacy-related measure of professional identity, was not among the existing dataset, and the students themselves had long since graduated. In Appendix D, I present my analysis of these data using a set of four professionally-relevant outcomes. The results from this analysis suggest that while both men and women may exert influence on their peers, it is the men who are more influenced by their peers. Further, when men influence men, that influence falls across a broad spectrum of outcomes, but when women influence men, it is in a more circumscribed set of outcomes. Although the findings presented in Appendix D may be a useful contribution in the study of social influence, the absence of a clearly relevant professional identity outcome variable makes it less germane to the main topic of this dissertation.

This study of engineers demonstrates an unambiguously causal role for peers in influencing professional identity outcomes whereas previous theoretical and empirical work had equivocated on the question. In fact, the possibility of a decrement to identity as a result of

interactions with an assigned peer presents a challenge to the strong cognitive versions of self-verification theory and identity control theory. Those theories suggest that individuals can "opt out" of influence, especially if attending to particular peers will have a disconfirming effect on their identity. My empirical findings show this is not always the case. Having established that peers can have this direct influence, strategic assignment of associations becomes a method for retaining at-risk professional entrants. Such strategic assignments must be based on the background characteristics that are the vehicle of influence rather than assuming contagion or conformity. Additional research using cross-sex as well as same-sex assigned ties is needed to identify the conditions under which such strategies may aid in the retention of women in engineering.

APPENDIX B. ANALYTICAL SCENARIOS FOR STUDYING GENDERED PEER INFLUENCE

B.1. Analytical Scenario Taxonomy

I have made a taxonomy of analytical approaches for identifying gendered aspects of peer effects at the individual level (that is, assuming an individual subject, versus a group, is being tested for evidence of a peer influence effect), and refer to this taxonomy throughout the analyses contained herein. This taxonomy has four scenarios, described below. These four scenarios are defined by two dimensions:

1. Sex differentiation of subject – Presence or absence of interaction terms which test whether peers influence men in the same way that they influence women. When there is no differentiation by the sex of the subject, the interaction terms are absent, and peer influence is tested without regard to the sex of the subject. Peers are assumed to exert a similar level and direction of influence on both men and women. When differentiating by the sex of the subject, the interaction terms are present, and the difference in peer influence exerted on men as compared to women can be tested for statistical significance (Holland 2003).

2. Sex differentiation of peers – Presence or absence of sex-differentiated peer predictors. When separated, the analysis can test whether male peers exert influence differently than female peers. These dimensions define a 2x2, shown in Table 20, defining the four scenarios.

Table 20: Four Analytical Scenarios to Test for Gendered Peer Influence Processes.

Sex Differentiation of Peers	**Sex Differentiation of Subject**	
	No Differentiation by Sex of Subject	**Differentiation by Sex of Subject**
No Peer Differentiation	**Scenario A.** Tests for peer influence ignoring gender.	**Scenario B.** Tests for sex differences in the experience of influence.
Sex-Differentiated Peer Indicators	**Scenario C.** Tests for sex differences in exerting influence.	**Scenario D.** Simultaneously tests for sex differences in experiencing and exerting influence.

B.2. Descriptions of Individual Analytical Scenarios

In Table 21, I illustrate the assumptions entailed by each of the scenarios and how to parameterize an estimation model testing each of the four Analytical Scenarios. I also describe these scenarios in more detail below.

Table 21: Description of Assumptions and Parameterization of the Four Analytical Scenarios to Identify Gendered Peer Influence Processes.

Analytical Scenario Description	Analytical Scenario Parameterization
A. Testing for peer influence while ignoring gender. Assumes all peer influence operates identically for men and women, whether influencing or being influenced.	<table><tr><th></th><th colspan="2">Subjects</th></tr><tr><th>Peers</th><th>Men</th><th>Women</th></tr><tr><td>Male Peers</td><td>β_1</td><td>β_1</td></tr><tr><td>Female Peers</td><td>β_1</td><td>β_1</td></tr></table>
B. Testing for sex differences in the experience of influence. Using an interaction term, allows for the possibility that men and women experience peer influence differently, but still assumes men and women exert influence identically.	<table><tr><th></th><th colspan="2">Subjects</th></tr><tr><th>Peers</th><th>Men</th><th>Women</th></tr><tr><td>Male Peers</td><td>β_1</td><td>$\beta_1 + \beta_2$</td></tr><tr><td>Female Peers</td><td>β_1</td><td>$\beta_1 + \beta_2$</td></tr></table>
C. Testing for sex differences in exerting influence. By separating peer influence variables into their male and female components, this approach allows for the possibility that men and women exert influence differently, but assumes that the experience of influence does not differ by sex.	<table><tr><th></th><th colspan="2">Subjects</th></tr><tr><th>Peers</th><th>Men</th><th>Women</th></tr><tr><td>Male Peers</td><td>β_1</td><td>β_1</td></tr><tr><td>Female Peers</td><td>β_2</td><td>β_2</td></tr></table>
D. Simultaneously tests for sex differences in experiencing and exerting influence. By sex-separating the peer influence variables and including interaction terms, sex differences in both the projection and reception of influence can be tested statistically.	<table><tr><th></th><th>Men</th><th>Women</th></tr><tr><td>Male Peers</td><td>β_1</td><td>$\beta_1 + \beta_2$</td></tr><tr><td>Female Peers</td><td>β_3</td><td>$\beta_3 + \beta_4$</td></tr></table>

NOTE: Each β_x represents a vector of independent variables tested for peer influence.

B.2.1. Scenario A. Ignoring gender

A researcher seeking to test for the presence of peer effects may assume the influence process is gender-neutral, either explicitly or implicitly, by constraining the estimation model to treat the exertion and experience of peer influence as identical regardless of sex (e.g., Sacerdote 2001). Studies in single-sex settings would naturally take this approach without necessarily "ignoring" gender, but rather analyzing peer effects within just one sex by design.

B.2.2. Scenario B. Sex differences in the experience of influence

Because the person experiencing the influence can usually be categorized as either male or female, the interaction term is the product of the peer-influence variable and variable indicating the sex of the subject. A significant parameter on the interaction variable is evidence that the effect of peers on men significantly differs from the effect of peers on women. The interaction term tests the hypothesis: does the effect of peer influence vary significantly depending on whether the target of influence is a man or woman? (cf. Holland 2003). Also, a significant interaction term will be positive or negative, indicating a stronger or weaker peer influence effect for one sex as compared to the other.

The structure of this type of model and the inclusion of an interaction term are important. Some studies test for peer effects and include "female" (for example) as a control variable (e.g., Zimmerman 2003). The interpretation that significant coefficients on the peer variable and the female variable indicate distinct influence processes for men and women is false. The only interpretation is that net of the other independent variables, women and men have a significantly different level in the outcome variable that is being tested for peer influence, not that the actual peer effect differs by sex.

Another possible approach is to stratify the analysis by sex; that is, estimate a model of peer influence on women's outcomes and another model of peer influence on men's outcomes separately (e.g., Duncan *et. al.* 2005). The disadvantage of this approach is that it makes it more difficult to estimate the significance of any difference in the peer effect between men and women. By pooling men and women and including an interaction term with sex of subject for each independent variable included in the stratified analysis, the parameter estimates will be identical, but there will also be the interaction terms serving as tests of sex-differences in the effects.

B.2.3. Scenario C. Sex differences in the exertion of influence.

If the study design has only a single peer for each subject (as is often the case for assigned roommates), and both male and female subjects can have either male or female peers (which is not usually the case for assigned roommates), then the significance of the difference in the influence of male or female peers may be tested directly. Testing this difference requires creating an interaction term that is the product of the peer-influence variable and the variable indicating the sex of the peer. The test for significant difference in the influence of peers by sex is the significance of the parameter estimate on this interaction variable.

If the study design entails multiple peers for each subject (as in assigned project teams, such as the analysis in Appendix D), and those peers can be both male and female for both men and women subjects, testing for a significant difference in the influence of male or female peers is less straightforward. Each subject would have a male-peer-influence variable and a female-peer-influence variable. Testing whether two parameter estimates within the same model differ significantly from each other requires either: (1) comparing the fit of the model (such as log likelihood) to that of the more constrained one in Scenario A, and testing whether this less

constrained one is significantly different (F-test using residual sum of squares, or likelihood ratio test using log likelihood), or (2) comparing the parameter estimates and estimated variances to each other using a Wald test.

B.2.4. Scenario D. Sex differences in both exerting and experiencing peer influence.

Scenario D combines scenarios B and C. If there is only one peer, and both men and women can have either male or female peers, then both interactions (subject sex x peer variable, and peer sex x peer variable) may be included simultaneously, along with the interaction of the subject and peer sex indicators. Otherwise, there may be two interaction terms using the sex of the subject indicator to generate products with both the male-peer-influence variable and the female-peer-influence variable.

APPENDIX C. SURVEY ITEMS FOR THE ANALYSIS VARIABLES IN CHAPTER 5.

The analysis in Chapter 5 was based on data from two surveys, and institutional data provided by the school (roommate assignments). Below are the items from both surveys providing the data for the analysis.

C.1. Roommate Preference Survey

Items from the roommate preference survey, and their response counts, are provided below in Table 22.

Table 22: Roommate Preference Survey with Response Counts (N=75)[a]

Survey Items	Men		Women		Total
True or False:	True	False	True	False	
I study with music	26	15	17	13	71
I stay up late	25	17	15	15	72
I get up early	15	28	14	16	73
I'm particularly neat at home	15	28	10	20	73
I plan to be neat at college	21	22	10	20	73
I smoke[b]	0	43	0	30	73

[a] Two students who specifically requested a particular roommate did not respond to the questions beyond their request.

[b] Because there is no variation in this item, it could not be used to assign roommates, and thus is excluded from the analysis.

C.2. Items from the First Year Survey

C.2.1. DEPENDENT VARIABLE: ENGINEERING SELF-COMPETENCE

Compared to other students in your engineering courses how would you complete the following:

Strongly disagree *Disagree* *Agree* *Strongly agree*

I understand engineering concepts better.
I am generally more confident about my abilities
I am better at solving engineering problems.

C.2.2. INDEPENDENT VARIABLES

C.2.2.1. Number of Engineers in the Family

Before coming to college, did you know anyone who is an engineer?
Yes
No

What is this person's relationship to you? (Check all that apply)
Mother
Father
Uncle
Aunt
Grandfather
Grandmother
Brother
Sister
Cousin

C.2.2.2. Importance of Engineering Program Quality on College Choice

Below are some reasons that might have influenced your decision to attend this particular college. How important was each reason in your decision to come here?

	Not important	*Somewhat important*	*Important*	*Very important*
Quality of engineering program				

C.2.2.3. Parents' Education

What is the highest level of formal education obtained by each of your parents?

Father	Mother
Unknown	*Unknown*
Grammar school or less	*Grammar school or less*
Some high school	*Some high school*
High school graduate	*High school graduate*
Post-secondary school other than college	*Post-secondary school other than college*
Some college	*Some college*
College degree	*College degree*
Some graduate school	*Some graduate school*
Graduate degree	*Graduate degree*

C.2.2.4. Science Fair Participation

During your last year in high school, indicate how frequently you participated in each of the activities listed below.

	Not at all	*Occasionally*	*Frequently*
Participated in science fair			

APPENDIX D. GENDERED PEER EFFECTS IN ASSIGNED PROJECT TEAMS

D.1. Introduction

The analysis of peers' contributions to professional identity formation in Chapter 5 highlighted that peer influence processes operate differently for men and women. Because the analysis was limited to roommate peers – who are necessarily the same sex as the subject – many aspects of the possible gender dynamics of peer influence could not be explored. For example, I could not determine whether men are more likely to exert influence over their peers, or if men are more likely to be influenced by their peers, or both. Investigating these dynamics requires a dataset where men and women both have male and female assigned peers.

I was able to secure access to a dataset that provided just this situation. A pair of studies of a cohort of public policy students included surveys of this cohort before and after exposure to externally-assigned semester-long project teams. Importantly, full information on the team assignments of these students were available and could be linked to the students' responses to the pre-team exposure and post-team exposure surveys. Understandably, these studies were not focused on studying the constructs I have detailed in the chapters of this dissertation. Still, this dataset provides an opportunity to investigate the gender dynamics of peer influence in a way I could not accomplish with my original dataset.

D.2. Data

There is no dearth of studies using public policy students as subjects; they just are not usually about professions or professionals (for an exception, see Chetkovich 2003). My dataset of public policy students is the only secondary data analysis in my dissertation. The data collected were uniquely well-suited for testing peer influence on professional identity formation,

even though that had not been the original intended use for the data. In fact, these data come from the combined efforts of two studies on the same cohort of public policy students. One included a network study of peer interactions during a semester-long course where students were randomly assigned to project teams. The second was a longitudinal study on the professional development of the public policy students including surveys every semester for the two-year long program.

There were 164 students in the cohort. Of these, 151 participated in the first-year spring semester course and where students were assigned to one of 32 project teams which remained constant for the duration of semester. 126 students responded to the first-year, first-semester survey of the longitudinal study, with some growing attrition from this number in every subsequent survey. Of these 126 students, I could match 118 of them with valid team assignments. The first professional development survey to be administered after this semester-long project team exposure unfortunately deviated from the regular set of professional development questions, focusing instead almost exclusively on summer internship experiences and reactions to the students' first year of the public policy degree program. As a result, I use the survey administered during the final semester of the students' degree program – completed by 98 students at least eight months after the dissolution of their semester-long project teams. Of these, 89 had valid responses for the analysis variables and could be matched to a team, but four of these were the only members of their team still in the sample. These 85 remaining subjects serve as the basis for my analyses in this setting. The sex composition of this sub-sample (51.7% female) is not significantly different from the sex composition of the full cohort (47.0% female). I also tested whether certain teams were disproportionately under- or over-represented in the final sample, and found no evidence for team-specific non-participation (χ^2=1.00, df=31, p=1).

For this test, I compared the original team assignment compositions with the team compositions of the final sub-sample. Testing for differences using the distribution of dropouts isn't possible with a χ^2 test because the reliability of the test diminishes as the number of low-frequency cells in the estimation table increases. Thus, I am confident that the mechanisms responsible for my missing observations are unlikely to add a systematic bias to my findings.

In this setting, the assignment to semester-long project teams provides the quasi-experiment addressing the issue of selection bias in peer effects. Like roommates, project teammates interacted frequently and repeatedly over the course of the semester. Unlike roommates, the relationship was primarily academic, rather than primarily social; and the formal ties dissolved after one semester, where roommates usually last a year and possibly longer.

Variables

My analysis is based on a set of eight variables. Four variables come from survey responses prior to team assignment and exposure, and four variables come from survey responses following semester-long team interactions. Of these, six are based on three identical questions asked in both the pre-exposure and post-exposure surveys. These variables were identified by selecting those items from both surveys that fulfilled two requirements: (1) they addressed some aspect of professional identity as described in Chapter 2; and (2) there was sufficient variance in the responses to allow for analysis. (For example, the surveys included a yes/no question of personal intent to run for elected office – a good candidate variable for inclusion, but because no more than 5% of students responded "yes" in both surveys, it was not useable.) Descriptions of these variables and their reasons for inclusion are detailed below.

Academic Confidence (Pre-exposure only): An ordinal scale from 1 to 3 based on students' self-reported confidence using the following coding:

3 = “I am confident of my ability to do well academically in all subjects.”

2 = “I am confident of my ability in some subjects but uncertain about others.”

1 = “I am uncertain of my ability to do well in most subjects.”

Role confidence is certainly central to professional identity. This question speaks more to the role of student than professional, although it is worth noting that the context of this question includes an implied “at this school’s Master’s in Public Policy (M.P.P) program” appended to the end of the options. Even though professional confidence would be the preferred measure, it was neither available in the existing survey, nor is it clear that a reasonable assessment of professional confidence could be made upon entry to the profession’s credentialing program. Thus, I am using academic confidence upon entering the M.P.P program as a more general indicator of self-reported confidence.

Managing People (Pre-exposure and Post-exposure): The 1 to 3 ordinal scale indicating the desired level of responsibility in future work for managing people based on responses to the survey item below. Note that smaller numbers correspond to higher levels of desired responsibility. “Jobs are distinguished in part by the level and types of responsibility they carry. For example, some involve supervising many other people (managing people), some involve decision-making about large expenditures or budgetary allocations (managing money), and some involve a mix. For each category shown here, please indicate the level of responsibility you would eventually like to have in your work (perhaps five to ten years from now).

(a) Managing people

[1 =] high level of responsibility

[2 =] medium level of responsibility

[3 =] low level of responsibility

(b) Managing money

[1 =] high level of responsibility

[2 =] medium level of responsibility

[3 =] low level of responsibility.”

Note that in the post-exposure survey, there was an altered and shorter preamble to these items, "What level of responsibility--for people and money--are you seeking/will you have in your next job?" also suggesting the forecast horizon for the later question is shorter than that for the pre-exposure question. This difference is the likely explanation for the significant drop in desired responsibility from the pre-exposure responses to the post-exposure responses (see Table 23 below).

Managing Money (Pre-exposure and Post-exposure): The 1 to 3 ordinal scale indicating the desired level of responsibility in future work for managing money based on the same survey item presented above. As with the "Managing People" variable, smaller numbers correspond to higher levels of desired responsibility.

Although these measures nominally fit my definition of professional identity involving what professionals actually do, they are admittedly something of a stretch imposed by working with a secondary dataset. In the context of public policy professionals, there is no *a priori* pattern of responses to these two items indicating an embracement or rejection of professional identity. Rather, these two items provide a general indicator of the type of work the individual sees herself doing in her chosen profession. In this regard, it is more like an indicator for a particular specialty than a characteristic that may be consistent or inconsistent with the profession as a whole.

Political Views (Pre-exposure and Post-exposure): Self-reported location on a seven-item political spectrum presented as follows:

“Please indicate on the following scale where you would place your political views:

extremely liberal/left						extremely conservative	don’t know
1	2	3	4	5	6	7	DK”

Although political views arguably would play little if any role in constituting a professional identity for most occupations and professions, public policy professionals are a natural exception. The work of public policy professionals can be seen as informing decision-makers or otherwise organizing and acting to affect policy. In this work, political views are central. Is the public policy professional trying to reduce regulation and emphasize market-based solutions, or trying to manage regulations to balance the concerns and needs of producers and consumers? Political views represent a philosophical approach directing the work of public policy professionals, much like religious views are particularly relevant to professional identities of the clergy.

Satisfaction (Post-exposure only): Towards the end of their two-year degree program, the post-exposure survey included the following item: “On balance, what is your assessment of KSG's M.P.P. program at this stage?

[1 =] The program has contributed very significantly to my professional and personal development.

[2 =] The program has contributed to my development at an acceptable but not significant level.

[3 =] I have derived some benefits from the program, but not as much as I think I should have.

[4 =] I'm dissatisfied enough that I think I should have gone elsewhere.”

Admittedly, this scale is problematic for a number of reasons. Two options are about development, one about benefits, and one about satisfaction. In addition, how should someone whose personal and professional development went in opposite directions over the course of the

M.P.P. program respond? Acknowledging these issues, the clear intent is that lower numbers reflect greater satisfaction with the M.P.P. program, and higher numbers reflect greater dissatisfaction, so the analysis reflects a reverse-coded version of this variable. Trusting that the intent was accurately conveyed to the respondents, I assume that potential difficulties in answering did not introduce any systematic bias relevant to my analyses.

Satisfaction is an important component of socialization (e.g., Jones 1986). High levels of dissatisfaction can indicate a breakdown in socialization or a lack of fit with the organization or occupational role. Similarly, high levels of satisfaction can indicate the successful internalization of norms and beliefs or the subjective experience of a well-fitting role. Although it is certainly possible to be dissatisfied with a particular M.P.P. program and go on to be a very successful public policy professional, dissatisfaction is taken as an indicator of mismatch between personal professional goals, and the credentialing activities of a highly regarded credentialing program within the profession.

Peer Variables and Interactions: For each of the four pre-exposure variables, I construct three sets of peer variables: the mean value of the variable among one's teammates (excluding oneself), the mean value of the variable among one's male teammates (excluding oneself if male), and the mean value of the variable among one's female teammates (excluding oneself if female). Finally, I use a dummy variable for student sex ("female") to construct interactions with the peer variables. Summary statistics for each of the eight variables and their peer-level counterparts are given in Table 23 below. The correlation matrix for this same set of variables is provided in Table 24.

Table 23: Summary Statistics for Analysis Variables

Variable	Observations	Mean	Standard Deviation
1. Satisfaction	84	3.16	0.97
2. Post-Exposure Managing People	85	2.07[a]	0.72
3. Post-Exposure Managing Money	85	2.39[a]	0.73
4. Post-Exposure Political View	85	3.07	1.33
5. Initial Academic Confidence	84	2.36	0.57
6. Initial Managing People	83	1.30[a]	0.51
7. Initial Managing Money	82	1.77[a]	0.73
8. Initial Political View	80	2.86	1.18
9. Mean Peers' Academic Confidence	85	2.37	0.36
10. Mean Peers' Managing People	85	1.29	0.29
11. Mean Peers' Managing Money	84	1.77	0.41
12. Mean Peers' Political View	85	2.89	0.68
13. Male Peers' Academic Confidence	76	2.47	0.43
14. Male Peers' Managing People	77	1.22	0.39
15. Male Peers' Managing Money	76	1.66	0.58
16. Male Peers' Political View	77	2.89	0.82
17. Female Peers' Academic Confidence	79	2.24	0.53
18. Female Peers' Managing People	77	1.43	0.49
19. Female Peers' Managing Money	77	1.90	0.61
20. Female Peers' Political View	76	2.88	1.08
21. Female	85	0.52	0.50

[a] Indicates a significant shift from the initial mean to the post-exposure mean.

In Table 23, I do not note the significant differences between the corresponding means of male and female peers (which are present in all cases except for political view). These differences are a mathematical result rather than a substantive one. Peer means aggregate over a number of students, so the standard deviations will be smaller even without a change in the overall means. Further, men and women both have male and female peers, so the number of observations used for the comparison is greater than the observations used for individual-level difference-in-means t-tests. More observations and smaller variance increases the likelihood that a difference in means will be significant, even if the means themselves do not change.

Table 24: Correlation Matrix for Analysis Variables

	Outcome Variables				Pre-Exposure Variables				Means of Undifferentiated Peers			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1. Dissatisfaction	1.00											
2. Post-Exposure Managing People	0.18	1.00										
3. Post-Exposure Managing Money	0.10	**0.45**	1.00									
4. Post-Exposure Political View	-0.11	-0.16	-0.15	1.00								
5. Initial Academic Confidence	-0.02	-0.04	-0.15	0.01	1.00							
6. Initial Managing People	0.10	**0.23**	0.05	-0.10	-0.02	1.00						
7. Initial Managing Money	-0.05	-0.02	**0.26**	-0.08	**-0.30**	0.14	1.00					
8. Initial Political View	-0.09	-0.07	-0.18	**0.88**	0.03	-0.10	-0.08	1.00				
9. Mean Peers' Academic Confidence	0.03	0.15	0.00	-0.10	0.04	-0.06	0.02	-0.03	1.00			
10. Mean Peers' Managing People	-0.07	-0.06	-0.11	-0.05	-0.09	-0.12	0.01	-0.02	-0.15	1.00		
11. Mean Peers' Managing Money	-0.11	-0.12	-0.10	0.11	0.01	0.03	-0.11	0.11	**-0.28**	**0.25**	1.00	
12. Mean Peers' Political View	-0.16	-0.16	-0.13	-0.01	-0.19	-0.07	0.05	-0.01	-0.07	-0.19	-0.07	1.00
13. Male Peers' Academic Confidence	-0.16	0.17	0.04	0.00	0.03	-0.02	0.07	0.10	**0.79**	0.08	-0.02	-0.10
14. Male Peers' Managing People	-0.02	0.03	-0.16	-0.04	-0.17	0.03	0.07	-0.01	-0.10	**0.69**	**0.32**	-0.12
15. Male Peers' Managing Money	-0.06	-0.09	-0.11	0.07	-0.04	0.08	0.04	0.07	-0.13	**0.29**	**0.74**	-0.18
16. Male Peers' Political View	-0.20	0.02	-0.13	-0.05	-0.04	-0.06	0.18	-0.06	0.06	-0.15	0.02	**0.69**
17. Female Peers' Academic Confidence	0.10	0.19	-0.03	-0.13	-0.01	-0.07	0.03	-0.08	**0.79**	**-0.28**	**-0.35**	-0.05
18. Female Peers' Managing People	-0.08	-0.13	0.01	0.05	0.02	-0.22	-0.05	0.03	-0.12	**0.64**	0.05	**-0.23**
19. Female Peers' Managing Money	0.06	-0.17	0.05	0.11	0.08	0.01	-0.13	0.04	**-0.25**	0.08	**0.60**	-0.06
20. Female Peers' Political View	0.01	-0.15	0.12	0.01	**-0.30**	0.08	0.00	-0.01	**-0.23**	**-0.21**	-0.15	**0.69**
21. Female	-0.02	-0.10	0.16	-0.02	-0.20	**0.25**	0.19	-0.08	0.15	-0.12	-0.14	0.10

Cont'd from above	Means of Male Peers				Means of Female Peers				
	13	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
13. Male Peers' Academic Confidence	1.00								
14. Male Peers' Managing People	0.17	1.00							
15. Male Peers' Managing Money	-0.17	**0.34**	1.00						
16. Male Peers' Political View	0.01	0.08	0.05	1.00					
17. Female Peers' Academic Confidence	**0.29**	-0.21	-0.04	0.09	1.00				
18. Female Peers' Managing People	-0.03	-0.10	0.03	**-0.35**	**-0.25**	1.00			
19. Female Peers' Managing Money	0.13	0.03	-0.09	-0.17	**-0.54**	0.15	1.00		
20. Female Peers' Political View	-0.16	**-0.31**	**-0.34**	-0.10	-0.20	-0.01	0.16	1.00	
21. Female	0.13	0.01	-0.09	0.09	0.02	-0.03	0.01	0.02	1.00

Correlations in **bold** are significant at the 0.05 level.

Gendered outcomes

There is a small stream of literature documenting the lack of attention to gender in public policy pedagogy (Kenney 2004). Like other realms, this scholarship has focused on the formal curricular content and student-faculty interactions (e.g., Crawford & MacLeod 1990; Wilkinson & Marrett 1985). My study of the public policy students includes four outcome variables associated with professional identity. None of these variables differ significantly by sex. Of the four predictor variables in my analysis, one – initial academic confidence – differs weakly by sex ($p < 0.1$), with women being less confident than men. Of the three of these variables for which I can calculate individual-level changes over time, one – desired level of responsibility for managing people – differs weakly by sex. That is, men's desired level of responsibility for managing people drops more than women's (though both drop significantly, as shown in Table 23). Initially, men have a higher desired level of responsibility relative to women, but shift to having a lower desired level of responsibility relative to women. Neither of these cross-sectional differences rises to the level of significance. Of these eleven tests for gendered outcomes I described, only two showed weak significance, which does not meet any overall significance threshold even in the aggregate. Thus, I have no evidence for the gendered professional outcomes of public policy students based on these data. Still, I can use this dataset to test for peer effects in the formation of professional identity, and for gendered differences in the operation of those peer effects. Fundamentally, this series of studies looks to identify gendered processes. As discussed in Chapter 3, these processes may not give rise to gendered outcomes in every situation.

D.3. Analysis

D.3.1. Gendered role of peers in professional identity

As discussed above, each of the four post-exposure variables has an association with some aspect of professional identity in the context of public policy professionals. The correlation matrix in Table 24 shows that of the six correlations among these four variables, only one is significant (managing people and managing money, r=0.45). It is clear that these variables do not address a single construct associated with professional identity. Unlike my analysis of engineers in Chapter 5, my analysis of peer influence on public policy professional identity outcomes makes no *a priori* assumptions regarding which of these variables is the best indicator of professional identity. As a result, my analysis treats these variables as independent and equipotent indicators of professional identity. My conclusions are therefore based on an aggregated analysis across these four outcomes. Even without a single professional identity indicator, these data allow for a causal analysis of peer effects among novitiate public policy professionals.

D.3.2. Testing for Non-random Team Assignment

The causal analysis of peer effects depends importantly upon a non-biasing assignment of peer ties as a quasi-experimental manipulation. The first step in my analysis is to check the assignment procedure using two sets of tests. One set tests for associations between demographic variables and assignment that could have actually been used by the person assigning individuals to teams. The second set tests for coincidental associations between the analysis variables and team assignment. These tests serve to answer the question whether the team assignment was truly random, and if not, whether the non-random assignment is a threat to causal inferences.

As with the engineer study, I use ERG models to test for associations with team assignment. First, I test for assignment associations with demographic characteristics (age, sex, and race) that may have been considerations when creating the teams. The results of these analyses are presented below in Table 25. Model 0 in Table 25 provides the baseline result showing that the probability of a tie (assignment to the same team) between any arbitrary dyad given the number of ties in this network (= exp(-3.767) / (1+exp(-3.767) = 0.0226)) is equal to the density of the network (178 ties divided by the C(126,2)=7875 possible ties in the 126-node network equals 0.0226). Adding additional dyadic constraints changes the probability of a tie between a dyad based on the characteristics of the nodes (students) involved in the dyad.

Model 1 in Table 25 shows the change in the log odds based on demographic similarities and dissimilarities among dyads. The results from Model 1 show that for all dimensions except sex, there were no associations between demographic similarity and team assignment. Model 2 in Table 25 limits the demographic parameters to sex similarity. A likelihood ratio test shows that Model 1 and Model 2 do not differ significantly ($\chi^2 = 3.44$, df=5, $p>0.1$), and that Model 0 and Model 2 do differ significantly ($\chi^2 = 7.13$, df=2, $p<0.05$). Thus I can use the simpler Model 2 to capture the aspects of demographic similarity playing any role in team assignment when I later test for unintended biases in team assignment based on my analysis variables.

Table 25: Tests for Demographic Sources of Non-random Team Assignment using p*

Dyadic Constraint (Network size = 126 nodes)	**Model 0**	**Model 1**	**Model 2**
Number of network ties	**-3.767*** **	**-4.118** **	**-3.596*** **
	(0.076)	*(1.463)*	*(0.098)*
Dyad members are both Female		**-0.504***	**-0.500***
		(0.202)	*(0.201)*
Dyad members are both Male		-0.260	-0.265
		(0.190)	*(0.189)*
Absolute Value of Age Difference of Dyad		0.066	
		(0.046)	
Sum of Ages in Dyad		0.007	
		(0.029)	
Dyad Members both Asian		0.165	
		(0.518)	
Dyad Members both White		0.035	
		(0.157)	
Dyad Members both "Other" Race		0.931	
		(0.737)	
Log Likelihood	-850.533	-845.246	-846.967

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

For dyads where both members are female, interestingly, the coefficient (i.e., the change in log odds) is negative. That means that matching on the sex dimension makes it *less* likely that a pair will be assigned to the same team. This is in fact evidence of *heterophily*, or a likely intentional effort on the part of the person assigning students to team to "mix them up" and keep any team from being uneven in its sex composition (which would inevitably happen to some degree under truly random team assignment).

There is compelling evidence that this priority for keeping each team gender-balanced was in fact the case. Figure 1 is a histogram of the sex composition of just the sample of team members responding to the surveys. In addition, I have the original team assignments with student names. Coding the sex of the non-responding students by name, and leaving

ambiguously-gendered names missing, Figure 2 gives the histogram of the sex composition of all 21 teams where there is full and unambiguous information for the entire team. All but one of these teams has an even division by sex (with odd numbered teams having an additional male or female student in a way representative of the slightly majority male cohort). Together, this evidence strongly suggests that the individual conducting the team assignment tried to keep each team gender-balanced, but that assignment was otherwise random with respect to the tested demographic categories.

Figure 1: Histogram of the sex composition of the teams in the sample based on survey responses.

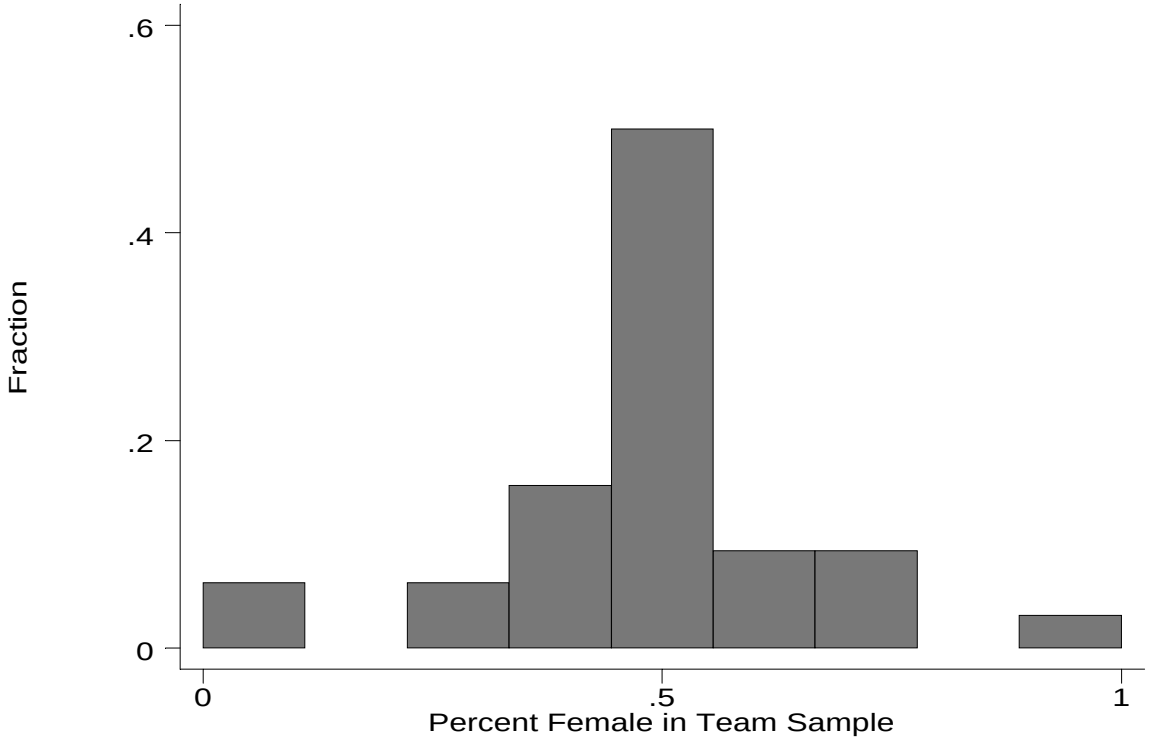
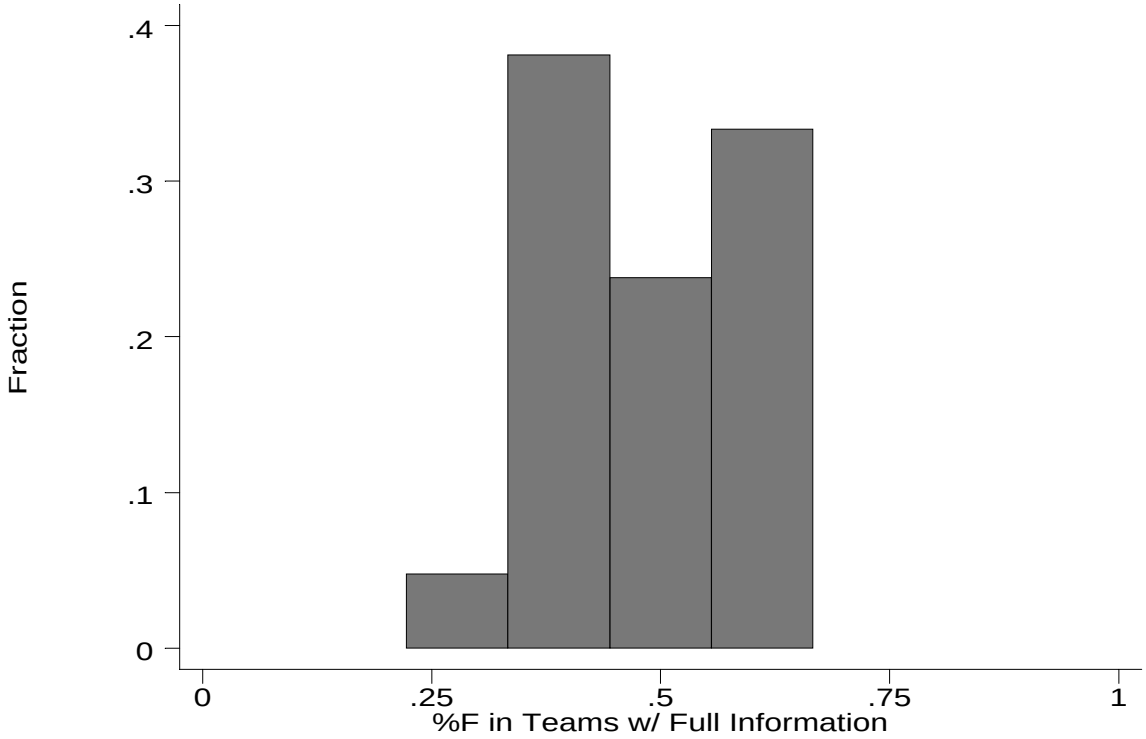


Figure 2: Histogram of the sex composition of the teams with full team-member data.



Given this association between same-sex dyads and the lower probability of being assigned to the same team, the question is whether and how it needs to be corrected to proceed with the analysis. A consequence of this bias is that the within-team variation in sex composition is likely to be higher as a result of this team assignment bias, and the across-team variation in sex composition is likely to be lower. In effect, the sex composition of each individual team is more likely to reflect the sex composition of the population than would be expected by chance. The result is similar in essence to holding constant the sex composition of teams. One concern would be if team sex composition plays a moderating role in peer influence. If so, then without making adjustments to these data or their analyses, I would not be able to detect this team sex-composition effect. Also, if there were such an effect, it could bias the measure of peer influence either downward or upward. That is, I cannot be certain whether or not this assignment bias

exaggerates or mitigates peer influence. Acknowledging this limitation, the concern that any peer influence detected would be illusory but instead *caused by* this particular sex composition of teams is without basis. A claim that peer influence exists only in gender-balanced settings is contradicted by the evidence from the other settings analyzed in this dissertation. Thus, even without any adjustments in response to this assignment bias, evidence of the *presence* of peer influence is not challenged, merely its magnitude. So rather than adjusting for this bias, I simply treat it as additional constraint: the sex composition of the teams was held invariant in the assignment process.

In the models in Table 25, I intentionally omitted one important aspect of the team assignment process. This cohort of students was divided into three sections, and the teams were assigned within section. Because there are no section-spanning team assignments, a section-matching parameter is not estimable. Still, because I know that sections are important structural feature in these data, all my analyses include section dummy variables to accommodate section-specific differences.

Next, I look at associations between team assignment and the pre-exposure variables. In Table 26 below, I test for associations between the predictors I'm using in my analysis and assignment-to-team probabilities. The test includes controls for the assignment bias based on the sex of the students, as identified above, and adds dyadic measures for the four predictor variables used in my analyses. The shaded rows of Table 26 show the parameter estimates for these tests for assignment bias.

Table 26: Testing for Non-Random Team Assignment Among the Independent Variables used in the Analysis using p*.

Dyadic Constraint	Predictors Tested for Assignment Bias			
	Academic Confidence	Managing People	Managing Money	Political View
Number of ties in network	**-3.858*** **	**-3.846*** **	**-3.626*** **	**-3.420*** **
	(0.310)	*(0.303)*	*(0.305)*	*(0.306)*
Dyad members are both female	**-0.511***	**-0.488***	**-0.483***	**-0.555***
	(0.205)	*(0.207)*	*(0.208)*	*(0.223)*
Dyad members are both male	-0.248	-0.281	-0.255	-0.271
	(0.190)	*(0.191)*	*(0.192)*	*(0.192)*
Dyadic difference in predictor	-0.040	-0.199	**0.208†**	0.006
	(0.126)	*(0.164)*	*(0.119)*	*(0.080)*
Dyadic sum of predictor	0.086	0.136	-0.031	-0.029
	(0.089)	*(0.119)*	*(0.085)*	*(0.053)*
Log likelihood	-832.495	-819.011	-811.759	-769.682

† $p < 0.1$, * $p < 0.05$, *** $p < 0.001$

The one weak finding shown in Table 26 – that dyads that are more *dissimilar* in desired responsibility for managing money are more likely to be assigned to the same team – is not a cause for concern. First, I do control for a student's own pre-exposure value for this variable in all the peer-effects analysis. Second, the nature of this bias cannot serve as an alternative explanation for a peer effect. The positive coefficient on the absolute value of the difference in scores between a pair of students means the greater the difference, the more likely they are to be assigned to the same team. Again, this is an indicator of a slight bias towards heterophily. This heterophily could affect the variance in the levels of this variable within and across teams as discussed above. Evidence of heterophily in team assignment increases the likelihood that the team means for that particular variable resemble the population mean, along with lower variation in team means. As a result, there would be little variation in this particular variable to explain

variation in the outcome variables, suggesting this variable as an independent variable would produce less stable parameter estimates. With this caveat, and with the knowledge that the analysis controls for individuals' own pre-exposure value for this variable, I can be confident that any identified peer influence results are not a result of this bias.

D.3.3. Analysis of peer effects

As described above, my four outcome variables do not show significant differences by sex. My analysis for peer influence tests whether the mean values of students' teammates on four pre-exposure variables of influence the post-exposure values of the students, while controlling for students' own responses to those four pre-exposure variables. This analysis is an individual-level analysis with clustering by teams to account for the non-independence of observations within teams but independence across teams. In addition, I include dummy variables for the three sections into which the cohort was divided. Because each of the outcome variables come from student survey responses to ordinal-scale items, all of the regressions on these data used the ordered logit method. With these data, I can test for peer influence under each of the four gendered analysis scenarios described in Appendix B.

Scenario A: Influence ignoring gender. This analysis tests whether students are influenced by their undifferentiated peers without regard to sex. The null hypothesis is that students' outcomes are not influenced by their peers. I test this hypothesis with four identical regression models, varying only in their dependent variables. The regression results are shown in Table 27.

Table 27: Testing for peer effects using analytical scenario A (ignoring gender) across four outcomes using ordered logit regression models, and clustering by team.

	Satisfaction	Managing People	Managing Money	Political View
Value for Self				
Confidence	0.780	-0.527	-0.431	**1.159***
	(0.502)	*(0.495)*	*(0.471)*	*(0.564)*
Managing People	-0.217	**0.699***	-0.657	-0.044
	(0.669)	*(0.344)*	*(0.471)*	*(0.328)*
Managing Money	0.267	-0.511†	**0.761***	-0.132
	(0.370)	*(0.279)*	*(0.373)*	*(0.388)*
Political View	-0.131	**-0.327***	**-0.493***	**3.950*****
	(0.199)	*(0.163)*	*(0.237)*	*(0.714)*
Mean Value of Peers				
Confidence	0.536	**1.364***	-0.032	**-1.879****
	(0.429)	*(0.640)*	*(1.013)*	*(0.686)*
Managing People	0.590	-1.133	**-2.017***	-0.576
	(0.906)	*(0.997)*	*(0.931)*	*(0.789)*
Managing Money	0.932	-0.302	0.193	-0.171
	(0.879)	*(0.771)*	*(0.718)*	*(0.649)*
Political View	**1.078***	-0.609	**-0.770***	0.597
	(0.444)	*(0.450)*	*(0.340)*	*(0.541)*
Section 2 Dummy	0.938	**-1.400****	**-0.973***	**-1.666***
	(0.867)	*(0.536)*	*(0.520)*	*(0.719)*
Section 3 Dummy	0.525	-0.756	0.346†	**-1.773***
	(0.581)	*(0.466)*	*(0.562)*	*(0.709)*
Cut-point 1	3.830	-4.934	-8.727	3.506
Cut-point 2	5.400	-2.407	-6.693	6.732
Cut-point 3	6.711			11.585
Cut-point 4				14.858
Cut-point 5				19.331
N	76	74	73	77.000
Pseudo R2	0.062	0.120	0.125	0.527
Log Likelihood	-84.1	-68.3	-63.3	-59.100

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results in Table 27 show that of the sixteen parameter estimates testing for evidence of peer influence, indicated by the boxed region, five are significant at the 0.05 level or better. The probability of such a result (at least five in sixteen meeting a 0.05 threshold) in aggregate is less than 0.001. Thus even this high-level analysis allows me to reject the null hypothesis that students are not influenced by their peers.

Scenario B: Interactions by sex. This analytical approach answers the question of whether peers influence men in the same way that they influence women. The null hypothesis is that peers influence men and women identically. Table 28 presents the four regression models testing this hypothesis.

Table 28: Testing peer influence using analytic scenario B (sex-interaction effects) across four outcomes using ordered logit regressions and clustering by team.

	Satisfaction	Managing People	Managing Money	Political View
Value for Self				
Confidence	1.192†	-0.928	-0.679	**1.420***
	(0.676)	*(0.621)*	*(0.633)*	*(0.576)*
Managing People	-0.276	0.760†	**-1.295***	-0.011
	(0.635)	*(0.452)*	*(0.658)*	*(0.429)*
Managing Money	0.495	-0.509	0.756	-0.264
	(0.500)	*(0.327)*	*(0.491)*	*(0.449)*
Political View	-0.163	-0.402†	**-0.530***	**4.006*****
	(0.241)	*(0.211)*	*(0.232)*	*(0.743)*
Female	1.943	7.418	2.332	2.034
	(6.986)	*(9.354)*	*(6.434)*	*(9.273)*
Mean Value of Peers (effect for influence on men)				
Confidence	0.962	1.704†	-0.490	-1.384
	(0.665)	*(1.035)*	*(1.422)*	*(1.177)*
Managing People	-1.188	0.782	-0.015	-1.427
	(1.836)	*(1.785)*	*(1.344)*	*(1.335)*
Managing Money	0.663	0.796	0.717	0.401
	(1.184)	*(1.450)*	*(0.759)*	*(1.163)*
Political View	**1.864****	-0.686	**-1.219****	0.619
	(0.577)	*(0.532)*	*(0.422)*	*(0.605)*
Mean Value of Peers Interacted with Female (difference in effects for men and women)				
Confidence	-1.131	0.091	0.890	-1.280
	(1.105)	*(1.512)*	*(1.589)*	*(1.758)*
Managing People	2.431	-3.458	-3.687	2.462
	(2.092)	*(3.081)*	*(2.835)*	*(1.968)*
Managing Money	1.004	-1.999	-0.403	-1.758
	(1.601)	*(1.863)*	*(1.463)*	*(1.785)*
Political View	-1.517†	-0.030	0.816	0.377
	(0.831)	*(0.711)*	*(0.985)*	*(0.856)*
Section 2 Dummy	0.943	-1.339†	-0.720	**-2.019****
	(1.048)	*(0.709)*	*(0.782)*	*(0.735)*
Section 3 Dummy	0.786	-0.865	0.114	**-1.974***
	(0.686)	*(0.553)*	*(0.614)*	*(0.786)*
Cut-point 1	3.510	-1.225	-8.681	5.004
Cut-point 2	5.133	1.520	-6.462	8.282
Cut-point 3	6.540			13.265
Cut-point 4				16.738
Cut-point 5				21.327
N	76	74	73	77
Pseudo R2	0.105	0.164	0.196	0.538
Log Likelihood	-80.2	-64.9	-58.1	-57.7

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

This analysis tests for differences in how male and female students experience influence. The results do not support conclusive evidence for any such differences. The two boxed areas in Table 28 show the estimated effects for peer influence on men on the top, and the difference in the estimated effects for peer influence between men and women on the bottom. The question of whether peers influence men and women differently is answered with the results in the lower boxed area. Of the sixteen tests for significant differences in peer influence for men and women, only one test shows a weakly significant effect. In the aggregate, these results do not come close to meeting any significance threshold. Based on this analysis, I cannot reject the null hypothesis that men and women are similarly influenced by their peers.

These analysis results also provide specific estimates of peer influence on men and women. As mentioned, the upper boxed area provides the estimates of peer influence on men directly. Note that for the two significant findings for male students experiencing peer influence, the corresponding interaction term estimates are of similar magnitude and opposite sign. The point estimates for peer influence on female students is the sum of these corresponding pairs. In both cases of possible peer influence experienced by male students shown in Table 28, female students do not experience a similar influence.

The significance tests for the point estimates for peer influence on women are not shown in Table 28. These test results can be obtained by re-running the analysis as above, but using interactions with a "male" variable instead of the "female" variable. When re-doing the analysis with a reversal of the interaction term, all parameter estimates remain identical with the exception of the new "main effect" terms, which are the sum of the corresponding main effect and interaction terms from the previous analysis, and the "male" and interaction term parameters, which are of the same magnitude but opposite sign as their complements in the previous analysis.

I have provided the subset of main effect terms in this complementary analysis in Table 29 below, to more easily show the tests for peer influence on female students. Note that all of the peer effects identified when ignoring gender – shown in the boxed area from Table 27 above – are also significant or weakly significant effects reflected in either Table 28 or Table 29, but having been split over 32 tests, and with larger standard errors, significance in the aggregate is lost.

Table 29: Results sub-set - Point estimates and standard errors for peer effects on women in scenario B.

	Satisfaction	**Managing People**	**Managing Money**	**Political View**
Mean Value of Peers (effect for peer influence on women)				
Confidence	-0.169†	1.795	0.400	**-2.664***
	(0.769)	*(1.087)*	*(1.159)*	*(1.129)*
Managing People	1.242	-2.676	-3.702†	1.035
	(1.174)	*(1.973)*	*(2.125)*	*(1.372)*
Managing Money	1.667	-1.203	0.314	-1.357
	(1.390)	*(0.960)*	*(1.316)*	*(1.154)*
Political View	0.347	-0.717	-0.402	0.996
	(0.675)	*(0.639)*	*(0.853)*	*(0.804)*

† $p < 0.1$, * $p < 0.05$

Scenario C: Separation of peer variables into their male peers and female peers components. This analytical approach answers the question of whether male peers exert influence differently than female peers. The null hypothesis for this scenario is that male peers and female peers exert influence identically. The results from the four regressions testing this hypothesis are presented in Table 30.

Table 30: Testing gendered pnfluence using analytic scenario C - peer effects of male and female peers across four outcomes using ordered logits and clustering by team.

	Satisfaction	Managing People	Managing Money	Political View
Value for Self				
Confidence	**1.170***	-1.097	-0.653	**1.571***
	(0.588)	*(0.719)*	*(0.552)*	*(0.701)*
Managing People	-0.566	0.389	-1.044†	0.343
	(0.559)	*(0.441)*	*(0.603)*	*(0.505)*
Managing Money	-0.395	-0.611†	0.892†	0.116
	(0.469)	*(0.342)*	*(0.460)*	*(0.562)*
Political View	-0.201	-0.225	-0.521	**4.329*****
	(0.228)	*(0.264)*	*(0.353)*	*(0.867)*
Mean Value of Male Peers				
Confidence	**2.120****	**1.606***	1.091	-0.860
	(0.777)	*(0.673)*	*(1.101)*	*(0.689)*
Managing People	**-2.174****	-0.565	**-2.113*****	-1.006
	(0.820)	*(0.658)*	*(0.573)*	*(0.665)*
Managing Money	0.980†	0.104	**0.976***	**1.045***
	(0.514)	*(0.450)*	*(0.437)*	*(0.501)*
Political View	**1.637*****	-0.008	-0.500	0.668†
	(0.404)	*(0.452)*	*(0.406)*	*(0.373)*
Mean Value of Female Peers				
Confidence	-2.082†	0.480	-0.131	-0.176
	(1.073)	*(0.878)*	*(0.873)*	*(0.641)*
Managing People	1.210†	-0.931	-1.216	**0.937***
	(0.641)	*(0.626)*	*(0.758)*	*(0.410)*
Managing Money	**-1.498***	-0.318	0.439	0.226
	(0.650)	*(0.624)*	*(0.795)*	*(0.405)*
Political View	0.262	-0.526†	0.071	0.448
	(0.287)	*(0.272)*	*(0.263)*	*(0.521)*
Section 2 Dummy	1.067	**-1.808****	-0.693	-0.896
	(0.913)	*(0.633)*	*(0.722)*	*(0.741)*
Section 3 Dummy	0.392	-0.146	**1.196***	-1.581†
	(0.470)	*(0.497)*	*(0.539)*	*(0.956)*
Cut-point 1	1.092	-5.157	-5.689	13.067
Cut-point 2	3.015	-1.995	-3.214	16.865
Cut-point 3	5.183			22.226
Cut-point 4				25.599
Cut-point 5				30.702
N	64	61	60	64
Pseudo R2	0.221	0.188	0.193	0.579
Log Likelihood	-58.9	-49.9	-47.3	-42.7

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Sixteen parameters test for the influence of male peers. Of these, seven meet or exceed a significance threshold of 0.05 (and nine meet or exceed 0.1). The probability of such a result in the presence of no influence by male peers is $p << 0.001$. I can confidently reject the null hypothesis that students are not influenced by their male peers.

Sixteen parameters also test for the influence of female peers. Of these, two meet or exceed a significance threshold of 0.05 (and five meet or exceed 0.1). The aggregated analysis of these results is inconclusive at best. Two of sixteen results at the 0.05 threshold is not significant, and could have resulted in the case of no influence by female peers. The probability of five weakly significant results of sixteen tests is $p < 0.05$. I cannot definitively reject the null hypothesis that students are not influenced by their female peers.

Interestingly, for both of the significant results for female peer influence (and for two of the three weakly significant results), the corresponding parameter estimate for male peer influence is oppositely signed. If students are influenced by their female peers, that influence operates very differently than the influence of male peers.

Scenario D: Both gendered analysis approaches combined. This analytical scenario provides a saturated test of whether male and female peers exert influence equally, and whether male and female students are equally subject to those influences. The null hypotheses are that no such differences by sex exist. The results of the four regression models in Tables 31 and 32 are split into two parts: Part I (Table 31) provides the individual and section controls in the models, as well as model summary and fit measures; and Part II (Table 32) provides the parameter estimates for the gendered exertion and experience of peer influence.

Table 31: Testing for gendered peer effects in analytical Scenario D across four outcomes using ordered logit and clustering by team, part I.

	Satisfaction	Managing People	Managing Money	Political View
Value for Self				
Confidence	**3.011***	-1.698†	**-3.380***	**3.087***
	(1.239)	*(0.991)*	*(1.504)*	*(1.282)*
Managing People	0.077	-0.267	**-3.835*****	0.756
	(0.532)	*(0.742)*	*(1.013)*	*(0.756)*
Managing Money	0.267	-1.020	0.105	0.629
	(0.881)	*(0.700)*	*(0.785)*	*(0.584)*
Political View	0.059	-0.649	**-1.753****	**5.320*****
	(0.280)	*(0.319)*	*(0.628)*	*(1.598)*
Female	7.526	-25.495	-2.978	-6.709
	(12.540)	*(19.206)*	*(15.894)*	*(10.017)*
Section 2 Dummy	1.283†	**-2.646****	-2.444	-2.238†
	(0.715)	*(0.862)*	*(1.714)*	*(1.268)*
Section 3 Dummy	0.489	0.360	-0.635	-1.825
	(0.679)	*(0.619)*	*(0.803)*	*(1.163)*
Cut-point 1	25.233	-32.497	-24.396	21.016
Cut-point 2	27.483	-28.376	-20.387	24.981
Cut-point 3	30.134			31.808
Cut-point 4				35.790
Cut-point 5				42.052
N	64	61	60	64
Pseudo R2	0.323	0.357	0.505	0.624
Log Likelihood	-51.2	-39.5	-29	-38.2

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 32: Testing for gendered peer effects in analytical Scenario D across four outcomes using ordered logit and clustering by team, part II.

	Satisfaction	Managing People	Managing Money	Political View
Mean Value of Male Peers (effect of male peers on men)				
Confidence	3.022	**4.113*** **	-0.274	-0.812
	(2.641)	*(1.116)*	*(2.605)*	*(1.291)*
Managing People	**-3.216*** **	0.253	0.945	**-2.636***
	(0.942)	*(0.987)*	*(1.279)*	*(1.163)*
Managing Money	**1.739***	-0.510	**2.082***	**1.111***
	(0.680)	*(0.522)*	*(0.989)*	*(0.537)*
Political View	**2.582*** **	-0.860	**-2.111** **	0.691
	(0.679)	*(0.576)*	*(0.768)*	*(0.484)*
Mean Value of Male Peers Interacted with "Female" (sex difference in male peer effects)				
Confidence	-2.049	-0.665	**6.790***	-1.459
	(2.822)	*(3.118)*	*(3.410)*	*(3.171)*
Managing People	3.905†	-3.877	**-11.734** **	**4.257***
	(2.182)	*(2.809)*	*(3.692)*	*(1.924)*
Managing Money	0.126	1.225	-2.062	0.657
	(1.306)	*(1.670)*	*(2.158)*	*(1.619)*
Political View	-0.010	0.772	**4.016***	0.869
	(1.395)	*(2.141)*	*(1.810)*	*(1.068)*
Mean Value of Female Peers (effect of female peers on men)				
Confidence	-0.146	**-4.121** **	1.219	0.678
	(2.983)	*(1.582)*	*(2.841)*	*(1.358)*
Managing People	1.604	**-4.705***	-0.073	-1.050
	(1.371)	*(1.839)*	*(1.808)*	*(1.330)*
Managing Money	-0.264	**-2.868***	-1.418	2.033†
	(2.199)	*(1.309)*	*(2.102)*	*(1.212)*
Political View	**2.176*** **	**-2.173*** **	-0.140	0.704
	(0.599)	*(0.532)*	*(0.392)*	*(0.454)*
Mean Value of Female Peers Interacted with "Female" (sex difference in female peer effects)				
Confidence	0.475	4.306†	-5.502	-0.098
	(3.609)	*(2.208)*	*(4.824)*	*(1.506)*
Managing People	-0.151	3.675†	-0.801	**3.036***
	(1.318)	*(2.224)*	*(3.578)*	*(1.321)*
Managing Money	-1.068	2.974†	1.846	-2.236†
	(2.356)	*(1.540)*	*(2.164)*	*(1.193)*
Political View	**-2.250*** **	**1.945** **	1.795	0.389
	(0.632)	*(0.636)*	*(1.259)*	*(0.648)*

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Looking across the main effects in the two boxed areas of Table 32 shows manifold evidence of peers influencing male students. Of the sixteen tests for male peers influencing male students, eight are significant at the 0.05 threshold ($p < 0.0001$).

For tests of female peers influencing male students, five of the sixteen are significant ($p < 0.001$). Men influence men to some extent on each of the four outcomes tested. Women's influence on men, although significant, also appears more localized – with four of the five significant effects associated with a single outcome: desire to be responsible for managing people – the outcome for which there are the fewest significant effects of male peers influencing men. Clearly, male peers influence men differently than female peers influence men. Further evidence of this is found when comparing the two of the five significant results for female peers influencing men that are also significant in the corresponding coefficients for male peers influencing men. Although in both cases, peers' political view had a similar negative association with dissatisfaction; peers' confidence associations with the "managing people" outcome both operated significantly but *oppositely*. For men, exposure to confident male peers lowers their desire for responsibility in managing people, but exposure to confident female peers raises the desire for this same responsibility. So both male peers and female peers influence male students, but they influence male students in strikingly different ways.

Do male peers influence male and female students differently? Four significant effects of sixteen tests suggest yes they do. Notably three of the four effects were all associated with a single outcome – managing money priority. Do female peers influence male and female students differently? Three significant effects of sixteen tests suggest they do. Notably all three have corresponding coefficients of opposite sign; suggesting the interaction serves to cancel out any influence female peers may have on female students. Indeed, re-running the analyses after

reversing the interaction variable to "male" rather than "female" (results shown in Table 33) reveals only two significant effects out of sixteen tests for female peers influencing female students – not enough to reject the null hypothesis of no influence. Similarly, two significant results of sixteen tests show male peers also do not influence female students significantly in the aggregate.

Table 33: Results sub-set – Point estimates and standard errors for peer effects on women students separated by sex of peers.

	Satisfaction	Managing People	Managing Money	Political View
Mean Value of Male Peers (effect of male peers on women)				
Confidence	0.973	3.449	**6.516*** **	-2.271
	(0.934)	*(3.136)*	*(1.771)*	*(2.352)*
Managing People	0.689	-3.624†	**-10.789*** **	1.621
	(1.609)	*(2.144)*	*(2.938)*	*(1.207)*
Managing Money	1.865	0.715	0.020	1.768
	(1.221)	*(1.428)*	*(1.822)*	*(1.416)*
Political View	2.571†	-0.088	1.905	1.560
	(1.362)	*(1.953)*	*(1.488)*	*(1.278)*
Mean Value of Female Peers (effect of female peers on women)				
Confidence	0.330	0.185	-4.283†	0.580
	(1.896)	*(1.338)*	*(2.523)*	*(0.996)*
Managing People	**1.453***	-1.030	-0.874	**1.986** **
	(0.717)	*(1.129)*	*(2.180)*	*(0.712)*
Managing Money	-1.332	0.106	0.428	-0.203
	(1.176)	*(0.969)*	*(1.138)*	*(0.619)*
Political View	-0.074	-0.228	1.655	1.093
	(0.304)	*(0.439)*	*(1.177)*	*(0.910)*

† $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

This analysis of gendered dynamics of peer influence reveals that male and female peers do exert influence differently, and ignoring gender when investigating peer effects acts to hide much of the strong evidence for peer influence. Once separating peer influence into sex-specific components, stark sex differences in the recipient of peer influence become clear. My analysis

demonstrates strong and consistent evidence of male students as subject to peer influence (from both male and female peers) but essentially no evidence for peers influencing female students. Although male students are subject to peer influence from both their male and female peers, this influence operates in very different – and in some cases opposite – ways.

D.4. Summary and Discussion

My analysis of public policy students provides strong evidence both for peer influence on professional identity outcomes in general and gendered effects in the operation of that peer influence. Buttressing my findings from my analysis of engineers, I again find that men influence men, but women do not influence women. The public policy dataset has also allowed me to investigate cross-sex influence, revealing that although men are subject to influence from their female peers, women do not appear to be subject to influence from their male peers.

Some major limitations of this analysis arise from the fact that these data were not originally collected to serve this analysis. As a result, my outcome variables, although all arguably associated in some way with professional identity, are indicators neither of a common aspect of professional identity, nor of a theoretically based aspect of professional identity as identified in Chapter 2. Absent a single validated indicator of professional identity, I used a set of four indicators, relying on aggregated statistical analysis to improve reliability. Also, the effort to hold the sex composition of teams constant meant I could not investigate this likely moderator of peer effects and/or professional development (cf. Cohen, Broschak & Haveman 1998).

Several other intentional features of my analysis also serve as limitations. First, I use randomly assigned teammates as the only peers under analysis. Students have many more peers than their teammates, all of whom could and likely do exert influence. I limit my investigation to teammate peers because of the quasi-experiment afforded by teammate assignment. This

assignment allows me to make causal inferences from my analysis, whereas analysis of selected peers would not allow such unambiguously causal inferences. Second, my linear-in-means assumption regarding the operation of peer influence could hide more complex dynamics. For example, although men may be influenced by means, women may be influenced by other structural or variance-related aspects of their peer networks. As I did not investigate these other possible influence dynamics, my findings are limited to those from a linear-in-means assumption.

In all, my claim is not that women are not influenced by their peers, just that whereas using this analytical approach I could find evidence of men being influenced, I could not find evidence of women being influenced. The possibility that social capital dynamics are gendered is not a new concept (Ibarra 1992; Burt 1998), but an unambiguously causal analysis demonstrating such gendered effects is unequivocally novel.

CHAPTER 6. SUMMARY, DISCUSSION AND CONCLUSION

6.1. Summary

This dissertation began with the problem of gendered professions, and sought to better understand processes that perpetuate inequality in the professions. The literature on gender inequalities in the professions revealed sex differences in professional identity outcomes as one important contributor to these inequalities. The next natural question was what causes these differences in professional identity outcomes between men and women?

A review of the literature showed professional identity formation to be a well-theorized but under-tested process. The disparate theories agree that professional identity forms through social interactions, and is informed by the observation of role-models, processing of appraisals, and incorporation of other observable outcomes of the interaction process. But which, if any, of these processes contribute to differences in professional identity outcomes between men and women? There has not yet been a clear answer.

Numerous analytical and design challenges have stymied attempts to conduct quantitative empirical hypothesis testing on the theorized mechanisms of professional identity formation. Professional identity, forming gradually over the life course, and becoming an integral part of a person's self-concept, does not lend itself well to laboratory experiments. In addition, tests for influence from social alters must overcome the selection and reflection problems before causal inferences can be warranted. By taking advantage of the quasi-experimental manipulation of roommate assignment in an engineering school, I overcame these challenges to test for a causal role for peers (roommates) in influencing professional identity outcomes.

Before conducting this test for peer influence, I needed to operationalize the professional identity outcome. As the review in Chapter 2 demonstrated, the diversity of theories regarding

professional identity formation entails a diversity of proposed indicators for professional identity outcomes. Given my overarching and motivating goal of understanding the processes perpetuating gender inequalities in the professions, I cast the task of selecting a particular identity outcome as an empirical question: which of the professional identity indicators are associated with gendered persistence in engineering?

Using a dataset of engineering undergraduates across four undergraduate institutions, I tested a set of eight variables representing four of the five professional identity indicators identified from the literature review for associations with gendered persistence. (Common fate was not tested.) I operationalized persistence with a set of four variables including intent to persist in the career, intent to persist in the major, intent to pursue a Ph.D. in engineering, and commitment to the engineering profession. My tests showed two variables with positive associations with more than one persistence indicator: one of the "values" variables and engineering-self competence (ESC). Of the two, the values variable had stronger associations with two of the dependent variables, but it was not associated with gendered persistence. That is, the values variable was neither unequally distributed by sex nor differing in its association with persistence by sex. The second variable, ESC, did have associations with gendered persistence. Although ESC was positively associated with multiple persistence outcomes for men and women, women had significantly lower ESC scores than men. Thus, greater equity in ESC would promote persistence among women, and the current inequity in ESC has a depressing effect on persistence among women.

Having identified the professional identity outcome of interest in Chapter 4, in Chapter 5 I conduct the test for peer influence on ESC. My analysis testing for peer influence on ESC that ignores gender does not show any strong peer effects. My analysis that allows for gender

differences in the operation of peer influence does show strong peer effects. Men's ESC scores are significantly influenced their (necessarily male) roommates, but there is no such roommate influence on women. This measured peer influence among men is not merely a statistical association; my research design and methods allow me to conclude that male professional identity outcomes are causally influenced by their male roommates among the engineers tested. I also conclude that women differ significantly from men and that the observed influence among men is absent among women.

6.2. Discussion

6.2.1. Discussion of Findings

6.2.1.1. Chapter 4: Discriminating Persistence

The analysis in Chapter 4 provided several surprising findings. One big surprise was the small number of professional identity indicator variables showing significant and robust associations with professional persistence. Only two out of eight professional identity indicator variables showed significant associations with at least two of the four dependent variables for persistence. Those were "Value Problem Solving" and "Engineering Self-Competence" (ESC).

Given the broad theoretical agreement on the importance of role-specific self-efficacy (also referred to as mastery or competence) on identity and role acquisition, I was not surprised that ESC was one of the two important variables. The strength of associations with the values variable was surprising. There has not been much explicit focus on values as an identity indicator or as a consequence of socialization practices since Merton. My findings provide support to Hitlin's (2003) call to re-emphasize values in identity research.

Another interesting pattern of associations is that despite the fact that most of the professional identity indicators showed significant correlations with most of the persistence

variables – which is entirely consistent with theory – most professional identity indicators did not show significant associations with most of the other professional identity indicators ("Sought by Peers" was robustly correlated with the other indicators). This pattern of results suggests that professional identity is indeed a multi-dimensional and multi-faceted construct. The idea that there can be different aspects of professional identity that are generated by the same socialization processes but nonetheless are not directly related to each other helps somewhat to understand the final surprise – that of the eight variables serving as indicators for professional identity among engineers, only one, ESC, showed significant sex differences.

This analysis had a number of shortcomings. Primarily, my indicators for persistence relied on self-reported intentions rather than actual behaviors. These data come from a longitudinal study which will allow me to follow some subset of this panel beyond their undergraduate career and find out which students actually did or did not pursue a career in engineering. Secondly, of the five professional identity indicator categories identified in my review in Chapter 2, I only collected data providing indicators for four of them. The concept of a sense of common fate as an indictor for identification should also be explored for associations with persistence and gendered persistence. Given the surprise over the strong associations between "Value Problem Solving" and persistence, I have no reason to discount the possible importance of the "common fate" construct.

6.2.1.2. Chapter 5: Peer Effects among Engineers

Because my study used roommates as the manipulated peer assignment, all my data are necessarily sex-segregated. That is, although I find evidence that men influence men, and no evidence that women influence women, I cannot look at cross-sex influence dynamics. Included in Appendix D is my analysis of a dataset of students in a public policy professional degree

program. These students were assigned semester long project teams (random assignment except for keeping an equal sex-ratio across the teams). Using the teammates as assigned peers, I test for peer influence on four professional identity related outcomes.

As with my analysis of the engineers, the research design and data structure allow for unambiguous causal inferences in my findings. Unfortunately, because these data come from an extant source, the outcome variables are only loosely related to professional identity and to each other. As such, I cannot be certain my causal inferences from my findings relate to professional identity formation. I can be confident that the evidence of peer influence or lack thereof relates to social influence and that the associations are causal.

My analysis of social influence among these public policy students revealed evidence that men's outcomes were significantly influenced by both male and female peers, and that women's outcomes were not significantly influenced by either male or female peers. Also, men influenced men broadly – that is, significantly for all of the four tested outcomes; whereas women influenced men narrowly – primarily on a single outcome (desired level of responsibility in managing people). Although I did not have comparable professional identity indicator data in these data as outcomes, the gendered influence pattern for same-sex peer influence did match that of the engineers.

In these two settings, I have evidence of a causal role for peers in social influence, and that this influence operates differently among men and women. Within engineers specifically, I found conclusive evidence that men's ESC – an indicator of professional identity – is significantly influenced by their roommates. I found no such evidence for influence among women, and men and women significantly differed from each other in this operation of roommate influence.

6.2.1.2.1. What can explain these differences?

First, it is important to clarify the scope of my conclusions. My results do not generalize beyond the tests I conducted. My tests focused exclusively on influence from undifferentiated roommates operating through four distinct background characteristics. While the experimental design ensures that identified effects are unlikely to appear by chance, there is no way to be sure that these are the only effects. That is, women's ESC may still be influenced by their roommates, but via a pathway not captured by the four background characteristics included in my analysis. My conclusion is that men's ESC is influenced significantly by their undifferentiated roommates, while I have no evidence for such influence among women. With this clarification in mind, what can explain this pattern of findings?

There are many possible explanations consistent with previous theory and scholarship. I provide several explanations, but not an exhaustive list. The theories reviewed in Chapter 2 showed near unanimity for the importance of social alters for identity formation. The theories were also unanimous in the idea that individuals can determine whose appraisals will be used in their identity formation. Therefore, it is more likely that the social influence on women's ESC comes from other sources rather than being entirely absent. Women may give more weight to the input of more established role models (e.g. faculty and more advanced students), and discount the input of essentially random peers (Collier 2001, who suggests that all social influence regarding identity formation should come from those already established in the role). Similarly, women may select influential peers more deliberately than men. If so, then peer influence would be hard to detect using assigned alters. However, this very act of selection introduces the endogeneity that makes testing for peer effects so challenging. The complement to this explanation is that both status differences by sex and men being more role-typical result in a

situation where it is easier for men to engage in role-verifying interactions (Cast & Burke 2002; Stets & Harrod 2004). As a result, they can build identity with the most convenient alters rather than having to select them with more care.

The possibility of sex-status differences influencing identity formation such that both men and women would be more likely to be influenced by men and less likely to be influenced by women (Stets & Harrod 2004) is consistent with my finding, but cannot be tested with these data. However, the findings from Appendix D regarding the influence of mixed-sex peers from assigned project groups run counter to that hypothesis. In that analysis, men were influenced by both male and female peers, while women were influenced by neither male nor female peers.

Finally, the nature of interactions between roommates may differ significantly by sex. Men's interactions may include efficacy and competence relevant communications and cues, while women's interactions may include less of those types of communications and fewer such cues, or those communications and cues are muted in a relationship characterized by greater levels of communication than men's. There is a significant literature suggesting sex differences in the nature of dyadic interactions (Caldwell & Peplau 1982; Davidson & Duberman 1982; Umberson *et. al.* 1996; Williams 1985; Wright 1982) – often finding "richer" or more intense relationships among women than among men (e.g., Booth 1972; Turner 1994). One older study of professional socialization in an all-female nursing school documented "the formation of a considerable number of intensive and interactionally exclusive friendships ... the emotional access which partners grant *each other* is grossly disproportionate to that which they grant other members of the student group" (Davis & Olesen 1966:350, emphasis preserved). Similar differences have also been documented in social structures beyond the dyad (Burt 1998). If the interactions among women differ so completely from the interactions among men, there should

be some sex differences in the role of peers in professional identity formation (e.g., Schwalbe & Staples 1991).

Sewell, Haller, and Portes (1969) suggested that the social component of professional identity formation processes held the most promise for planned interventions. One goal of my investigation was to identify a policy lever to help promote professional identity formation among women as a way to reduce inequalities within the professions. My mechanism-based approach did reveal a potential policy level, but among men, not women. My findings suggest that strategic assignment of male interactants can influence their professional identity formation. Additional research focusing on the mechanisms of professional identity formation among women is still needed to identify policy levers to promote the professional persistence of women.

6.2.1.2.2. Exploring beyond the original design

The main problem with the endogeneity of self-selected ties, as discussed in Chapter 3, is that the tie may be a result of some intrinsic and possibly latent characteristic or trait of the person or persons forming the tie, so related outcomes may occur absent any influence from the relational tie. In other words, both the tie (or tie structure as in a network) and a given outcome could result from an *ex ante* individual-level factor, thus the individual causes both the tie and the outcome, allowing observers to erroneously associate the tie as causally related to the outcome. Many studies have simply ignored this endogeneity (e.g., Thomas 2000, who explicitly labels network variables "exogenous"). Taking this endogeneity critique seriously actually presents an opportunity for exploring the gender dynamics of peer influence beyond the original design of the study.

If individual characteristics help to determine an individual's later network ties, then people's later networks can provide some information about their network-determining

characteristics. Part of the longitudinal study of this cohort of engineers included a detailed network study during their sophomore year. Following the example of other scholars interested in the impact of interactions on identity or professional development or both (e.g., Becker et. al. 1961; Ibarra 1992), I distinguished between academic ties and social ties. From these network data, I constructed some very basic measures, such as the size of each network (a count of alters), percent same-sex for each network, and the degree of overlap of one with the other. Embracing the endogeneity critique, I assume some these may measures include some information about the individual-level characteristics that gave rise to these network outcomes (e.g., later networks that are large in size may be indicative of an extroverted individual). With this assumption, I can test whether these indicators of individual-level characteristics related to interactions can help shed more light on the findings from Chapter 5.

The basic finding from Chapter 5 was that men's roommates' influenced their engineering self-competence, but there was no such roommate influence for women. This effect was revealed by the significant coefficient on the roommates' "importance of engineering program quality in college choice" variable for men (in Table 19), and the significant negative interaction term resulting in a non-significant effect of that same roommate variable for women. To test whether the network variables described above modify this effect, I estimated regression models including interaction terms interacting the individual student's network variable (over the set of network variables) with that student's roommate's "importance of engineering program quality in college choice" variable. This model structure tests whether the effect of roommate influence depends upon the individual student's network variable.

For each type of network (academic and social), I tested for interaction effects for each of the three network variables (size, percent same-sex and overlap) with the consequential

roommate variable from Chapter 5 for both men and women. Before showing these results, it is helpful to provide the baseline of the one-variable model regressing students' year 1 engineering self-competence (ESC) on their roommates' importance of engineering program quality on college choice. These regressions for both men and women are shown in Table 34. I am starting with this one-variable regression because of my small sample. Table 19 in Chapter 5 identifies peer influence via regression models including an interaction term. Now, I seek to add another interaction in the form of network variables. Simply adding this interaction to the previous model would result in a three-way interaction model. Such a model would both be difficult to interpret and would have a high cost in degrees of freedom for estimation. These additional tests are a type of inductive exploration of my findings from Chapter 5, intended to provide some additional insights on the possible gender dynamics of peer influence. These tests do not have the same unambiguously causal interpretations as the findings from Chapter 5. Table 34 shows that even in the one-variable model, men show a significant peer effect, while the peer effect for women is less, but this time weakly significant. My tests for dependencies on peer influence based on the network variables build upon the one-variable models shown in Table 34.

Table 34: Regressing year 1 Engineering Self-Competence (ESC) on only the significant variable from Chapter 5, using IPTW and HC2 small sample correction.

	Men	**Women**
Roommate's Importance of Engineering Program Quality on College Choice	**0.98***	0.56†
	(0.37)	(0.29)
Constant	**2.49*****	**2.24*****
	(0.31)	(0.22)
R2	0.23	0.33
N	23	14

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results of these tests are given in Table 35. The two network types combined with the three network measures means six tests for network dependencies of peer influence for men and women. For men, I find one significant positive dependency and one weakly significant positive dependency out of the six tests. The former suggests that the characteristics that make a man likely to have a larger academic network also *increase* the degree to which he is influenced by his roommate on his ESC. The latter weak finding suggests that the characteristics that prompt a man to have a very male social network also *increase* the degree to which he is influenced by his roommate on his ESC. For women, I find four out of six interaction terms with some level of significance: two weak and two stronger; two positive and two negative. The descriptive interpretations for the findings from Table 35 are provided below in Table 36 for both men and women. Notably for women, all three of the academic network variables were weakly significant (network size and percent of academic network in social network) or significant (percent same sex) moderators of the peer influence effect. This analysis suggests that women may also be influenced by their roommate peers, depending on the characteristics of the woman. Women who tend to form smaller academic networks, women who tend to form more female academic networks, women who tend to form academic networks with people they also socialize with, as well as women who tend to form smaller social networks, are significantly influenced by their roommate peers.

These findings are presented as hypotheses requiring more careful testing in future research. Although men's peer influence is a robust finding, the suggestion from this analysis is that under certain conditions, or for certain subsets of women, peer influence is also an important component of professional identity formation.

Table 35: Tests of network variable interactions with roommate influence effects regressing year 1 Engineering Self-Competence (ESC) using IPTW and HC2 small sample correction.

Model with the network variable, the roommate variable, and their interaction	Men (N=20)		Women (N=13)	
	Academic	Social	Academic	Social
Network Size	0.01	0.01	0.01	**0.04*** **
	(0.01)	*(0.01)*	*(0.01)*	*(0.00)*
Roommate's "Importance of Engineering Program…"	**0.80****	0.58†	**1.02****	**0.79****
	(0.25)	*(0.28)*	*(0.29)*	*(0.15)*
Interaction	**0.05***	0.02	-0.03†	**-0.06*** **
	(0.02)	*(0.02)*	*(0.01)*	*(0.01)*
Constant	**2.51*** **	**2.53*** **	**2.05*** **	**2.20*** **
	(0.22)	*(0.23)*	*(0.04)*	*(0.02)*
R^2	0.56	0.50	0.75	0.81
Percent Same-Sex in Network	1.74	-2.27	**-1.49****	-1.84†
	(2.95)	*(1.34)*	*(0.34)*	*(0.81)*
Roommate's "Importance of Engineering Program…"	0.96†	**0.84***	-0.03	0.48†
	(0.49)	*(0.36)*	*(0.17)*	*(0.26)*
Interaction	-1.40	2.93†	**3.14****	1.08
	(2.88)	*(1.67)*	*(0.95)*	*(1.39)*
Constant	**2.52*** **	**2.67*** **	**2.57*** **	**2.25*** **
	(0.34)	*(0.20)*	*(0.13)*	*(0.10)*
R^2	0.22	0.29	0.79	0.69
Percent in network also in the other network	-2.69	-1.25	**-4.18***	**2.33***
	(2.04)	*(1.81)*	*(1.32)*	*(1.01)*
Roommate's "Importance of Engineering Program…"	**0.82***	**1.09***	0.02	**1.05****
	(0.30)	*(0.40)*	*(0.32)*	*(0.31)*
Interaction	3.77	3.55	3.56†	-1.80
	(2.20)	*(2.23)*	*(1.61)*	*(1.14)*
Constant	**2.37*** **	**2.34*** **	**2.90*** **	**1.63*** **
	(0.26)	*(0.29)*	*(0.28)*	*(0.18)*
R^2	0.30	0.32	0.73	0.70

† $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 36: Text interpretations of the results from Table 35.

Network Variable	Effect for Men	Effect for Women
Academic network size	The characteristics prompting men to form smaller academic networks significantly *reduce* peer influence for men. Conversely, characteristics for larger academic networks significantly *enhance* peer influence for men.	The characteristics prompting women to form smaller academic networks significantly (but weakly) *enhance* peer influence for women. Conversely, characteristics for larger academic networks significantly (but weakly) *reduce* peer influence for women.
Academic network percent same sex	No significant effect for men.	The characteristics prompting women to form academic networks with more sex-similarity (higher proportion female) significantly *enhance* peer influence for women. Conversely, characteristics for a higher proportion male in women's academic networks *reduce* peer influence for women.
Academic network percent in social network	No significant effect for men.	The characteristics prompting women to form academic networks with a greater percent of members who are also in a woman's social network significantly (but weakly) *enhance* peer influence for women.
Social network size	No significant effect for men.	The characteristics prompting women to form smaller social networks significantly *enhance* peer influence for women. Characteristics for larger social networks significantly *reduce* peer influence for women.
Social network percent same sex	The characteristics prompting men to form social networks with greater sex-similarity (higher proportion male) significantly (but weakly) *enhance* peer influence for men. Conversely, characteristics for a greater proportion female in men's social networks significantly (but weakly) *reduce* peer influence for men.	No significant effect for women.
Social network percent in academic network	No significant effect for men.	No significant effect for women.

6.2.2. Limitations

Some overall limitations to this study result from the choice of sample. Although the undergraduate setting provides an excellent quasi-experimental design for testing peer effects in the form of roommate assignment (cf. Muow 2006; Sacerdote 2001; Zimmermann 2003), the undergraduate setting is not the ideal location for tests on professional identity formation. My particular setting had many features making it more like a professional school for engineers than other undergraduate institutions, but even so, it is hard to assess whether participation in an engineering undergraduate degree program indicates a comparable degree of commitment to the profession as that found among students at the professional schools. Engineering is also often considered a "quasi-profession" (Perrucci & Gerstl 1969; Raelin 1985), and does not have the higher status associations characteristic of lawyers and doctors. In addition, the size of my sample was quite small. Of course, that is why statistical corrections for small sample analysis were developed, but future research should seek to replicate this type of study on a larger sample of students.

I created another limitation in my definition of profession. Because I wanted to study a professional socialization process in settings where a large cohort of students simultaneously experienced the same institutional exposures, I necessarily limited the range of socialization practices represented in my sample. In terms of the six dimensions of socialization practices defined by Van Maanen and Schein (1979), I effectively limited my consideration to professional credentialing programs that socialized via collective (not individualistic), formal (where entrants are separated from practitioners, rather than informal), sequential (with predictable stages for advancement, rather than random), fixed (with a timetable for completing socialization and adopting the role, rather than variable), and divestiture (where the entrant's previous identity is

replaced with a new one, rather than investiture) practices. Whether professional schools tend to practice serial or disjunctive socialization hinges on whether the faculty could be considered role models, and the degree of apprenticeship included in the program. For these engineers, the socialization was disjunctive. Of the six dimensions, five are fixed, and all are fixed at the more "custodial" or culture-preserving values. I believe this custodial emphasis on producing similar new professionals is a necessary truth in professional credentialing. Still, if there are professional credentialing programs that are more innovative, they were beyond my consideration for this study.

In general, this study has been a clear example of "lamp post research." I could only look for evidence of gendering professional identity mechanisms where my methodological approach was able to cast light (i.e., undifferentiated roommates as assigned peers, constraining the pathways of influence to four pre-college background characteristics). There are likely many more gendering mechanisms operating where I cannot currently shed any revelatory analytical light.

6.3. Conclusion

6.3.1. Lessons

This study has provided many affirmations to related findings, as well as a number of novel and surprising contributions. The large literature referenced early in this dissertation linking identity, and particularly self-efficacy to persistence has an additional replication documenting this association. And the re-emerging literature on the importance of values in identity literature has another voice of support.

Perhaps most importantly, the (at least) half-century-old hypothesis that peer interactions contribute to professional identity formation now has a positive causal finding to supplement the

myriad suggestive associations previously recorded over the decades. In addition, the gendered nature of this peer influence has also been causally demonstrated. Whereas peer influence is a significant contributor to the development of engineering self-competence for men, I found no evidence that peer influence plays a similarly significant role for women. Thus, men have an additional resource in professional identity formation not apparently available to women (or, as my later analysis suggests, perhaps available only to a restricted subset of women).

This lack of peer influence in the professional identity formation of women engineers begs a new question: which social interaction processes do influence women's professional identity formation? This question highlights the fact that my investigation did not identify a specific mechanism or policy lever to promote persistence among female engineers. Identifying such opportunities will require additional careful research into the mechanisms giving rise to gendered outcomes in the professions. My investigation has demonstrated how traditionally "soft" concepts such as identity and difficult constructs like peer influence may be studied rigorously with empirical methods to support strong causal inferences.

6.3.2. Future Research

Because one of the key questions remaining at the end of this investigation asks for more detail about gendered peer influence, these processes need to be studied in settings beyond roommate pairs to allow all four of the analytical scenarios defined in Appendix B to be investigated. Project team assignments, such as analyzed among the public policy students in Appendix D, is one example of a promising setting. The public policy dataset would have been a natural partner to my analysis of engineers but for the inappropriate outcome variables. As demonstrated in both Chapters 2 and 4, professional identity is a multi-faceted, multi-dimensional construct. More care needs to be take when selecting indicators for professional

identity, and one aspect or facet of professional identity will not have the same associations with other variables and dynamics as another facet. In addition to a sex-integrated peer setting, a setting where the composition of same-sex and opposite-sex peers varies would be a needed supplement to this line of analysis.

Beyond the data presented in my analyses, I have other types of self-report data collected from these same subjects. One survey collected full-roster network data complete with evaluations by each student of each other student as being "more of an engineer" "less of an engineer" or "about the same" as the subject. This supplemental data will allow detailed comparison of the social influence mechanisms of reflected appraisals versus actual appraisals on professional identity development.

Finally, this investigation opportunistically analyzed peer effects, because those were the mechanisms for which causal inferences were possible. Similar to the older ethnographies, current studies of professional identity formation (e.g., Ibarra 1999; Kellogg 2005; Pratt, Rockmann & 2006) often either neglect the potential role for peers, or have evidence of peer influence, but still emphasize role models. One recent paper suggested that peers are influential in ongoing, but not initial socialization (Gibson 2003). An important question then is the relative influence of peers and role models in professional identity formation. Randomly (or semi-randomly) assigned mentors would provide just as adequate an experimental manipulation as assigned roommates. A socialization structure including many randomly assigned teams composed of all peers and one experienced mentor/leader would allow such an analysis to proceed, and I believe there are some firms (management consulting, for example) that have a socialization programs that bear some resemblance to this structure.

Efforts to reduce inequality in professions must be informed by mechanism-based understandings of the processes that generate these inequalities. As these processes are elucidated, opportunities for influence are revealed. Gendered professional identity formation is an example of one such process – a process upon which this dissertation has shed new light.

REFERENCES

Abbott, A. D. 1988. *The system of professions: An essay on the division of expert labor.* Chicago: University of Chicago Press.

Abrahamson, M. 1967. *The professional in the organization.* Chicago: Rand McNally.

Abrams, D., & Hogg, M.A. 1988. Comments on the motivational status of self-esteem in social identity and intergroup discrimination. *European Journal of Social Psychology*, 18(4): 317-334.

Adelman, C. 1998. *Women and men of the engineering path: A model for analysis of undergraduate careers*. Washington, DC: U.S. Department of Education and the National Institute for Science Education.

Akerlof, G. A. & Kranton, R. E. 2000. Economics and identity. *Quarterly Journal of Economics*, 115(3): 715-753

_____. 2002. Identity and Schooling: Some Lessons for the Economics of Education. *Journal of Economic Literature*, 40(4): 1167-1201.

Alper, Joe. 1993. The pipeline is leaking women all the way along. *Science*, 260(5106):409-411.

Anonymous. 1998. Making docile lawyers: An essay on the pacification of law students. *Harvard Law Review*, 111: 2027-2044.

Appold, S. J., Siengthai, S., & Kasarda, J. D. 1998. The employment of women managers and professionals in an emerging economy: Gender inequality as an organizational practice. *Administrative Science Quarterly*, 43(3):538-565.

Ashforth, B. E., & Mael, F. 1989. Social identity theory and the organization. *Academy of Management Review*, 14(1): 20-39.

Astin, A. W. 1998. The changing american college student: Thirty-year trends, 1966-1996. *Review of Higher Education*, 21(2): 115-136.

Atkinson, P. 1983. The reproduction of the professional community. In R. Dingwall & P. S. C. Lewis (Eds.), *The Sociology of the professions: Lawyers, doctors, and others*: ix, 314 p. New York: St. Martin's Press.

Atkinson, P. & Delamont, S. 1990. Professions and powerlessness - female marginality in the learned occupations. *Sociological Review*, 38(1): 90-110.

Bailyn, L. & Schein, E. H. 1980. *Living with technology: Issues at mid-career*. Cambridge, MA: MIT Press.

Banaji, M. R. & Prentice, D. A. 1994. The self in social contexts. *Annual Review of Psychology*, 45: 297-332.

Bandura, A. 1969. *Principles of behavior modification*. New York: Holt.

_____. 1977. *Social Learning Theory*. Upper Saddle River, NJ: Pearson Professional.

_____. 1986. *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice-Hall.

_____. 1989. Social cognitive theory. In R. Vasta (Ed.), *Annals of child development. Vol. 6. Six theories of child development* (pp. 1-60). Greenwich, CT: JAI Press.

Bank, B. J., Slavings, R. L., & Biddle, B. J. 1990. Effects of peer, faculty, and parental influences on students' persistence. *Sociology of Education*, 63(3): 208-225.

Beagan, B. L. 2001. "Even if I don't know what I'm doing I can make it look like I know what I'm doing": Becoming a doctor in the 1990s. *Canadian Review of Sociology and Anthropology*, 38(3): 275-292.

Becker, H. S. 1999. The chicago school, so-called. *Qualitative Sociology*, 22 (1): 3-12.

Becker, H. S. & Carper, J. W. 1956a. The development of identification with an occupation. *American Journal of Sociology*, 61(4): 289-298.

_____. 1956b. The elements of identification with an occupation. *American Sociological Review*, 21(3): 341-348.

Becker, H. S. & Geer, B. 1958. The fate of idealism in medical school. *American Sociological Review*, 23(1): 50-56.

Becker, H. S., Geer, B., Strauss, A. L., & Hughes, E. C. 1961. *Boys in white: Student culture in medical school*. Chicago: University of Chicago Press.

Betz, N. E. & Hackett, G. 1983. The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior*, 23(3): 329-345.

Biddle, B. J. 1986. Recent developments in role-theory. *Annual Review of Sociology*, 12: 67-92.

Biddle, B. J., Bank, B. J., Anderson, D. S., Hauge, R., Keats, D. M., Keats, J. A., Marlin, M. M., & Valantin, S. 1985. Social-influence, self-referent identity labels, and behavior. *Sociological Quarterly*, 26(2): 159-185.

Blau, F. D. & Kahn, L. M. 2000. Gender differences in pay. *Journal of Economic Perspectives*, 14(4): 75-99

Blumer, H. 1956. Sociological analysis and the "variable." *American Sociological Review*, 21(6): 683-690.

_____. 1969. *Symbolic Interactionism: Perspective and method*. Englewood Cliffs, NJ: Prentice-Hall.

Booth, A. 1972. Sex and social participation. *American Sociological Review*, 37(2): 183-193.

Boulis, Ann, Jerry Jacobs, and J. Jon Veloski. 2001. Gender segregation by specialty during medical school. *Academic Medicine*, 76(10): S65-S67.

Broadbent, J., Dietrich, M., & Roberts, J. 1997. *The end of the professions? The restructuring of professional work.* London ; New York: Routledge.

Brown, B. B., & Lohr, M. J. 1987. Peer-group affiliation and adolescent self-esteem: an integration of ego-identity and symbolic-interaction theories. *Journal of Personality and Social Psychology*, 52(1): 47-55.

Burke, P. J. 1997. An identity model for network exchange. *American Sociological Review*, 62(1): 134-150.

_____. 2004. Identities and social structure: The 2003 Cooley-Mead Award address. *Social Psychology Quarterly*, 67(1): 5-15.

_____. 2006. Identity change. *Social Psychology Quarterly*, 69(1): 81-96.

Burke, P. J. & Reitzes, D. C. 1981. The link between identity and role performance. *Social Psychology Quarterly*, 44(2): 83-92.

Burke, P. J. & Stets, J. E. 1999. Trust and commitment through self-verification. *Social Psychology Quarterly*, 62(4): 347-366.

Burke, P. J. & Tully, J. C. 1977. The measurement of role identity. *Social Forces*, 55(4):881-897.

Burt, R. S. 1998. The gender of social capital. *Rationality and Society*, 10(1): 5-46.

Caldwell, M. A. & Peplau, L. A. 1982. Sex-differences in same-sex friendship. *Sex Roles*, 8(7): 721-732.

Campbell, D. T. 1958. Common fate, similarity, and other measures of the status of aggregates of persons as social entities. *Behavioral Science,* 3(1): 14-25.

Carless, S. A. & Prodan, O. 2003. The impact of practicum training on career and job search attitudes of postgraduate psychology students. *Australian Journal of Psychology*, 55(2): 89-94.

Carli, L. L. 1999. Gender, interpersonal power, and social influence. *Journal of Social Issues*, 55(1): 81-99.

_____. 2001. Gender and social influence. *Journal of Social Issues*, 57(4): 725-741.

Carr-Sanders A. M., & Wilson P. A. 1933. *The Professions*. Oxford: Clarendon Press.

Cast, A. D. & Burke, P. J. 2002. A theory of self-esteem. *Social Forces*, 80(3): 1041-1068.

Cast, A. D., Stets, J. E., & Burke, P. J. 1999. Does the self conform to the views of others? *Social Psychology Quarterly*, 62(1): 68-82.

Castano, E., Yzerbyt, V., Paladino, M. P., & Sacchi, S. 2002. I belong, therefore, I exist: Ingroup identification, ingroup entitativity, and ingroup bias. *Personality and Social Psychology Bulletin*, 28(2): 135-143.

Chetkovich, C. 2003. What's in a sector? The shifting career plans of public policy students. *Public Administration Review*, 63(6): 660-674.

Cialdini, R. B. & Goldstein, N. J. 2004. Social influence: Compliance and conformity. *Annual Review of Psychology*, 55: 591-621.

Cogan, M. L. 1955. The problem of defining a profession. *Annals of the American Academy of Political and Social Science*, 297: 105-111.

Cohen, L. E., Broschak, J. P., & Haveman, H. A. 1998. And then there were more? The effect of organizational sex composition on the hiring and promotion of managers. *American Sociological Review*: 711-727.

Collins, R. 1979. *The credential society: An historical sociology of education and stratification*. New York: Academic Press.

Committee: Committee on the Guide to Recruiting and Advancing Women Scientists and Engineers in Academia, Committee on Women in Science and Engineering, National Research Council. (Committee) 2006. *To Recruit and Advance: Women Students and Faculty in Science and Engineering.* Washington DC: National Academies Press.

Cooley, C. H. 1922. *Human nature and the social order. (Revised edition)*. New York: Charles Scribner's Sons.

Correll, S. J. 2001. Gender and the career choice process: The role of biased self-assessments. *American Journal of Sociology*, 106: 1691–730.

_____. 2004. Constraints into preferences: Gender, status, and emerging career aspirations. *American Sociological Review*, 69(1): 93-113.

CPST: Commission on Professionals in Science & Technology. 1997. *Best & Brightest: Education and Career Paths of Top Scientists and Engineering Students.* Report by the Commission on Professionals in Science & Technology. http://www.cpst.org/.

Crawford, M. & MacLeod, M. 1990. Gender in the college classroom: An assessment of the "chilly climate" for women. *Sex Roles*, 23(3-4): 101-122.

Cross, S. E., and Vick, N. V. 2001. The interdependent self-construal and social support: The case of persistence in engineering. *Personality and Social Psychology Bulletin*, 27(7): 820-832.

Davis, F. & Olesen, V. L. 1966. Sex status and occupational dilemmas. In H. M. Vollmer & D. L. Mills (Eds.), *Professionalization*: 346-354. Englewood Cliffs, NJ: Prentice-Hall.

Deaux, K. & Martin, D. 2003. Interpersonal networks and social categories: specifying levels of context in identity processes. *Social Psychology Quarterly*, 66(2): 101-117.

Denzin, N. K. 1966. The significant others of a college population. *Sociological Quarterly*, 7(3): 298-310.

Dornbusch, S. M. 1955. The military academy as an assimilating institution. *Social Forces*, 33(4): 316-321.

Duncan, O. D., Haller, A. O., & Portes, A. 1968. Peer influences on aspirations: a reinterpretation. *American Journal of Sociology*, 74(2): 119-137.

Duncan, G. J., Boisjoly, J., Kremer, M., Levy, D. M., & Eccles, J. 2005. Peer effects in drug use and sex among college students. *Journal of Abnormal Child Psychology*, 33(3): 375-385.

Edwards, J. R. 1993. Problems with the use of profile similarity indices in the study of congruence in organizational research. *Personnel Psychology*, 46(3): 641-665.

_____. 1994. The study of congruence in organizational behavior research: Critique and a proposed alternative. *Organizational Behavior and Human Decision Processes*, 58: 51-100.

Elliott, P. 1972. *The Sociology of Professions.* New York: McGraw-Hill.

Epstein, C. F. 1970. Encountering the male establishment: sex status limits on women's careers in the professions. *American Journal of Sociology*, 75(6): 965-982.

Fenstermaker, S. & West, C. 2002. *Doing gender, doing difference: Inequality, power, and institutional change.* New York: Routledge.

Fernandez, R. M. and Sosa, L. 2005. Gendering the job: networks and recruitment at a call center. *American Journal of Sociology*, 111 (3): 859–904

Fineberg, I. C., Wenger, N. S., & Forrow, L. 2004. Interdisciplinary education: Evaluation of a palliative care training intervention for pre-professionals. *Academic Medicine*, 79(8): 769-776.

Fischer, J. D. 1996. Portia unbound: The effects of a supportive law school environment on women and minority students. *UCLA Women's Law Journal*, 7: 81-115.

Flexner, A. 1910. *Medical education in the United States and Canada: a report to the Carnegie Foundation for the Advancement of Teaching.* Boston: Merrymount Press.

Fox, Renee C. 1957. Training for uncertainty. In Merton, Robert K., Reader, G., & Kendall, Patricia L., eds. *The student physician: Introductory studies in the sociology of medical education.* Cambridge, MA: Harvard University Press: 207-241.

Freidson, E. 1970. *Professional dominance: the social structure of medical care.* New York: Atherton Press.

Gecas, V. 1982. The self-concept. *Annual Review of Sociology*, 8: 1-33.

_____. 1989. The social psychology of self efficacy. *Annual Review of Sociology*, 15: 291-316.

Gecas, V. & Schwalbe, M. L. 1983. Beyond the looking-glass self: social structure and efficacy-based self-esteem. *Social Psychology Quarterly*, 46(2): 77-88.

Gibson, D. E. 2003. Developing the professional self-concept: Role model construals in early, middle, and late career stages. *Organization Science*, 14(5): 591-610.

Giddens, Anthony, Mitchell Duneier, and Richard P. Applebaum. 2003. *Introduction to Sociology*. 4th edition. New York, NY: W.W. Norton & Company, Inc.

Gist, M. E. 1987. Self efficacy: implications for organizational behavior and human resource management. *Academy of Management Review*, 12(3): 472-485.

Goffman, E. 1959. *The presentation of self in everyday life*, Doubleday, New York.

_____. 1961a. *Asylums*. New York: Anchor.

_____. 1961b. *Encounters: Two studies in the sociology of interaction.* Indianapolis: Bobbs-Merril.

Goode, William J. 1957. Community within a community: The professions. *American Sociological Review*, 22 (2): 194-200.

Gouldner, A. W. 1957. Cosmopolitans and locals: Toward an Analysis of latent social roles.I. *Administrative Science Quarterly*, 2(3): 281-306.

_____. 1958. Cosmopolitans and locals: Toward an analysis of latent social roles. II. *Administrative Science Quarterly*, 2(4): 444-480.

Grace, S. L. & Cramer, K. L. 2003. The elusive nature of self-measurement: The Self-Construal Scale versus the Twenty Statements Test. *Journal of Social Psychology*, 143(5): 649-668.

Granfield, R. & Koenig, T. 1992. The fate of elite idealism: Accommodation and ideological work at Harvard Law School. *Social Problems*, 39(4): 315-331.

Guinier, L., Fine, M., Balin, J., Bartow, A., & Stachel, D.L. 1994. Becoming gentlemen: Women's experiences at one Ivy League law school. *University of Pennsylvania Law Review*, 143: 1-55.

Gurin, P. & Townsend, A. 1986. Properties of gender identity and their implications for gender consciousness. *British Journal of Social Psychology*, 25(2): 139-148.

Hedström, P. 2005. *Dissecting the social: On the principles of analytical sociology*. Cambridge: Cambridge University Press.

Hernan, M. A., Brumback, B., & Robins, J. M. 2001. Marginal structural models to estimate the joint causal effect of nonrandomized treatments. *Journal of the American Statistical Association*, 96(454): 440-448.

Hitlin, S. 2003. Values as the core of personal identity: Drawing links between two theories of self. *Social Psychology Quarterly*, 66(2): 118-137.

Hitlin, S. & Piliavin, J. A. 2004. Values: Reviving a dormant concept. *Annual Review of Sociology*, 30: 359-393.

Hoelter, J. W. 1984. Relative effects of significant others on self evaluation. *Social Psychology Quarterly*, 47(3): 255-262.

Hogg, M. A. & Terry, D. J. 2000. Social identity and self-categorization processes in organizational contexts. *Academy of Management Review*, 25(1): 121-140.

Hogg, M. A., Terry, D. J., & White, K. M. 1995. A tale of two theories: A critical comparison of identity theory with social identity theory. *Social Psychology Quarterly*, 58(4): 255-269.

Holland, P. W. 1986. Statistics and causal inference. Journal of the American Statistical Association, 81(396): 945-960.

_____. 2003. Causation and race, ETS Research Report Series: Educational Testing Service.

Hughes, E. C. 1958. *Men and their work.* New York: New York Free Press. pp. 116–30.

_____. 1960. The professions in society. *Canadian Journal of Economics and Political Science / Revue Canadienne d'Economique et de Science Politique*, 26(1): 54-61.

Huntington, M. J. 1957. The development of a professional self-image. In Merton, Robert K., Reader, G., & Kendall, Patricia L., eds. *The student physician: Introductory studies in the sociology of medical education*. Cambridge, MA: Harvard University Press: 179-187.

Hyman, H. H. & Singer, E. 1968. *Readings in reference group theory and research.* New York: Free Press

Ibarra, H. 1992. Homophily and differential returns: Sex differences in network structure and access in an advertising firm. *Administrative Science Quarterly*, 37(3): 422-447.

_____. 1993. Personal networks of women and minorities in management - a conceptual-framework. *Academy of Management Review*, 18(1): 56-87.

_____. 1999. Provisional selves: experimenting with image and identity in professional adaptation. *Administrative Science Quarterly*, 44(4): 764-791.

Ibarra, H., Kilduff, M., & Tsai, W. 2005. Zooming in and out: Connecting individuals and collectivities at the frontiers of organizational network research. *Organization Science*, 16(4): 359-371.

Jones, G. R. 1986. Socialization tactics, self-efficacy, and newcomers adjustments to organizations. *Academy of Management Journal*, 29(2): 262-279.

Kalof, L. & Cargill, T. 1991. Fraternity and sorority membership and gender dominance attitudes. *Sex Roles*, 25(7): 417-423.

Katz, D. & Kahn, R. L. 1966. *The social psychology of organizations*. New York: Wiley.

Kellogg, K. C. 2005. *Challenging operations: Changing interactions, identities, and institutions in a surgical teaching hospital*. Unpublished Ph.D. Thesis. Massachusetts Institute of Technology Sloan School of Management.

Kenney, S. J. 2004. Gender, the public policy enterprise, and case teaching. *Journal of Policy Analysis and Management*, 23(1): 159-178.

Kilduff, M. & Tsai, W. 2003. *Social networks and organizations*. Thousand Oaks, CA: Sage.

Klegon, D. 1978. The sociology of professions. *Work and Occupations*, 5(3): 259-283.

Kristof, A. L. 1996. Person-organization fit: An integrative review of its conceptualizations, measurement, and implications. *Personnel Psychology,* 49 (1), 1–49.

Krueger, J. I., Hasman, J. F., Acevedo, M., & Villano, P. 2003. Perceptions of trait typicality in gender stereotypes: Examining the role of attribution and categorization processes. *Personality and Social Psychology Bulletin*, 29(1): 108-116.

Kruger, J. & Dunning, D. 1999. Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments. *Journal of Personality and Social Psychology*, 77(6): 1121-1134.

Kuhn, Manford H. and Thomas S. McPartland. 1954. An empirical investigation of self-attitudes. *American Sociological Review*, 19(1):68-76.

Lawrence, B. S. 2006. Organizational reference groups: A missing perspective on social context. *Organization Science*, 17(1): 80-100.

Lee, J. D. 2002. More than ability: Gender and personal relationships influence science and technology involvement. *Sociology of Education*, 75(4): 349-373.

Leicht, K. T. & Fennell, M. L. 2001. *Professional work: A sociological approach*. Malden, MA: Blackwell Publishers.

Lent, R. W., Brown, S. D., & Hackett, G. 1994. Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior*, 45: 79-122.

Lickel, B., Hamilton, D. L., Wieczorkowska, G., Lewis, A., Sherman, S. J. & Uhles, A. N. 2000. Varieties of groups and the perception of group entitativity. *Journal of Personality and Social Psychology*, 78(2): 223-46.

Littlewood, S., Ypinazar, V., Margolis, S. A., Scherpbier, A., Spencer, J., & Dornan, T. 2005. Early practical experience and the social responsiveness of clinical education: systematic review. *British Medical Journal*, 331(7513): 387-391.

Litwak, E. 1960. Reference group theory, bureaucratic career, and neighborhood primary group cohesion. *Sociometry*, 23(1): 72-84.

MacIver, R. M. 1922. The social significance of professional ethics. *Annals of the American Academy of Political and Social Science*, 101: 5-15.

_____. 1955. *Academic freedom in our time.* New York: Columbia University Press.

_____. 1966. Professional groups and cultural norms. In H. M. Vollmer & D. L. Mills (Eds.), *Professionalization*: 49-54. Englewood Cliffs, NJ: Prentice-Hall.

Mael, F. & Ashforth, B. E. 1992. Alumni and their alma mater: A partial test of the reformulated model of organizational identification. *Journal of Organizational Behavior*, 13(2): 103-123.

Major, B. 1994. From social inequality to personal entitlement: The role of social comparisons, legitimacy appraisals, and group membership. Advances *in Experimental Social Psychology*, 26: 293-355.

Manski, C. F. 1993. Identification of endogenous social effects: The reflection problem. *Review of Economic Studies*, 60(3): 531-542.

Marquardt, D. W. 1970. Generalized inverses, ridge regression, biased linear estimation, and nonlinear estimation. *Technometrics*, 12(3): 591-612.

Marsden, P. V. 2005. The sociology of James S. Coleman. *Annual Review of Sociology*, 31: 1-24.

McFarland, D. & Pals, H. 2005. Motives and contexts of identity change: A case for network effects. *Social Psychology Quarterly*, 68(4): 289-315.

McIlwee, J. S. & Robinson, J. G. 1992. *Women in engineering: Gender, power, and workplace culture*. Albany: State University of New York Press.

McIntosh, P. 1988. *White privilege and male privilege: A personal account of coming to see correspondences through work in women's studies*. Wellesley College. Working Paper 189.

McPherson, M., Smith-Lovin, L., & Cook, J. M. 2001. Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, 27: 415-444.

Mead, G. H. 1934. The Self. In G. H. Mead & C. W. Morris (Eds.), *Mind, self & society from the standpoint of a social behaviorist*: 173-179. Chicago: University of Chicago press.

Merton, R. K. 1957a. Preface. In R. K.Merton, G. Reader, & P. L. Kendall (Eds.), *The student physician: Introductory studies in the sociology of medical education*. Cambridge, MA: Harvard University Press: i-vii.

_____. 1957b. Some Preliminaries to a Sociology. In R. K.Merton, G. Reader, & P. L. Kendall (Eds.), *The student physician: Introductory studies in the sociology of medical education*: 3-80. Cambridge, MA: Harvard University Press.

_____. 1957c. *Social theory and social structure*. New York: Free Press.

Merton, R. K. 1982. Functions of the professional association. In R. K. Merton & A. Rosenblatt & T. F. Gieryn (Eds.), *Social research and the practicing professions*: 199-209. Cambridge, MA: Abt Books.

Merton, R. K. & Gieryn, T. F. 1982. Institutionalized altruism: The case of the professions. In R. K. Merton & A. Rosenblatt & T. F. Gieryn (Eds.), *Social research and the practicing professions*: 109-134. Cambridge, MA: Abt Books.

Morrison, E. W. 2002. Newcomers' relationships: The role of social network ties during socialization. *Academy of Management Journal*, 45(6): 1149-1160.

Mouw, T. 2006. Estimating the causal effect of social capital: A review of recent research. *Annual Review of Sociology*, 32: 79-102.

National Center for Education Statistics. 2005a. Table 262. Bachelor's degrees conferred by degree-granting institutions, by sex, racial/ethnic group, and major field of study: 2003-04. *Digest of education statistics 2005.* Washington, DC: U.S. Department of Education. http://nces.ed.gov/programs/digest/d05/tables/dt05_262.asp

National Center for Education Statistics. 2005b. Table 281. Degrees in engineering and engineering technologies conferred by degree-granting institutions, by level of degree and sex of student: Selected years, 1949-50 through 2003-04, *Digest of education statistics 2005.* Washington, DC: U.S. Department of Education. http://nces.ed.gov/programs/digest/d05/tables/dt05_281.asp

National Science Foundation. 1999. *Women, minorities, and persons with disabilities in science and engineering: 1998*. Arlington, VA. NSF 99-338.

NSF: National Science Foundation. 2000. Access to higher education: Undergraduate degrees in science and engineering: Bachelor's degree completion in science and engineering. Chapter in: *Land of plenty: Diversity as America's Competitive edge in science, engineering, and technology.* National Science Foundation. http://www.nsf.gov/od/cawmset.

Nunnally, J. C. 1970. *Introduction to psychological measurement*. New York: McGraw-Hill.

_____. 1978. *Psychometric theory (2d ed.).* New York: McGraw-Hill.

Palmer, G. H. 1914. *Trades and professions*. Boston: Houghton Mifflin.

Parsons, T. 1951. *The social system*. Glencoe, IL: Free Press.

Pattison, P. & Wasserman, S. 1999. Logit models and logistic regressions for social networks: II. Multivariate relations. *British Journal of Mathematical & Statistical Psychology*, 52(2): 169-193

Payne T. J., Connor J. M., & Colletti G. 1987. Gender-based schematic processing: an empirical investigation and reevaluation. *Journal of Personality and Social Psychology*, 52(5): 937-945.

Perrucci, R. & Gerstl, J. E. 1969. *Profession without community: Engineers in American society.* New York: Random House.

Porter, M.E. and van Opstal, D. 2001. *U.S. competitiveness 2001: Strengths, vulnerabilities and long-term priorities.* Council on Competitiveness, Washington, DC.

Pratt, M., Rockmann, K., & Kaufmann, J. 2006. Constructing Professional Identity: The Role of Work and Identity Learning Cycles in the Customizationof Identity among Medical Residents. Academy of Management Journal, 49: 235-262.

Quarantelli, E. L. & Cooper, J. 1966. Self-conceptions and others: A further test of meadian hypotheses. *Sociological Quarterly*, 7(3): 281-297.

Raelin, J. A. 1985. The basis for the professional's resistance to managerial control. *Human Resource Management*, 24(2):147-175.

Reskin, B. F. 1978. Scientific productivity, sex, and location in the institution of science. *American Journal of Sociology*, 83(5): 1235-1243.

Rosenberg, M. 1979. *Conceiving the self*. New York: Basic Books.

Rosenberg, M., Schooler, C., Schoenbach, C., & Rosenberg, F. 1995. Global self esteem and specific self esteem: Different concepts, different outcomes. *American Sociological Review*, 60(1): 141-156.

Sacerdote, B. 2001. Peer effects with random assignment: Results for Dartmouth roommates. *Quarterly Journal of Economics*, 116(2): 681-704.

Saks, A. M. 1995. Longitudinal field investigation of the moderating and mediating effects of self-efficacy on the relationship between training and newcomer adjustment. *Journal of Applied Psychology*, 80(2): 211-25.

Salaman, Graeme. 1971. Some sociological determinants of occupational communities. *Sociological Review*, 19: 53-77.

Schein, E. H. 1988. *Organizational psychology*. Englewood Cliffs, NJ: Prentice Hall.

Sewell, W. H., Haller, A. O., & Portes, A. 1969. The educational and early occupational attainment process. *American Sociological Review*, 34: 82-92.

Sewell, W. H., Haller, A. O., & Ohlendorf, G. W. 1970. The educational and early occupational status attainment process: Replication and revision. *American Sociological Review*, 35(6): 1014-1027.

Seymour, E. and Hewitt, N. 1997. *Talking about leaving*. Boulder, CO: Westview.

Smith, A. & Rogers, V. 2000. Ethics-related responses to specific situation vignettes: Evidence of gender-based differences and occupational socialization. *Journal of Business Ethics*, 28(1): 73-86.

Smith-Lovin, L. & McPherson, M. 1993. You are who you know: A network perspective on gender. In Paula England (Ed.) *Theory on gender/feminism on theory*: 223–51. New York: Aldine.

Soetevent, A. R. 2006. Empirics of the identification of social interactions: An evaluation of the approaches and their results. *Journal of Economic Surveys*, 20(2): 193-228.

Sonnert, G. 1999. Women in science and engineering: Advances, challenges, and solutions. *Annals of the New York Academy of Sciences*, 869 (Women in science and engineering: choices for success): 34-57.

Stets, J. E. & Harrod, M. M. 2004. Verification across multiple identities: The role of status. *Social Psychology Quarterly*, 67(2): 155-171.

Stryker, S. 1980. *Symbolic interactionism: A social structural version*. Menlo Park, CA: Benjamin/Cummings Pub. Co.

Stryker, S. & Burke, P. J. 2000. The past, present, and future of an identity theory. *Social Psychology Quarterly*, 63(4): 284-297.

Swann, W. B., 1983. Self-verification: Bringing social reality into harmony with the self. In J. Suls & A. G. Greenwald (Eds.), *Social psychological perspectives on the self, vol. 2*: 33–66. Hillsdale, NJ: Lawrence Erlbaum Associates.

Swann, W. B. & Ely, R. J. 1984. A Battle of wills: Self-werification Versus behavioral confirmation. *Journal of Personality and Social Psychology*, 46(6): 1287-1302.

Tajfel, H. 1970. Experiments in intergroup discrimination. *Scientific American*, 223 (May): 96-102.

Tajfel, H., & Turner, J. C. 1986. The social identity theory of intergroup behavior. In S. Worchel & W. Austin (Eds.), *Psychology of intergroup relations* (pp. 7–24). Chicago: Nelson-Hall.

Thomas, S. L. 2000. Ties that bind - A social network approach to understanding student integration and persistence. *Journal of Higher Education*, 71(5): 591-615.

Tisak, J. Smith, C. S. 1994. Defending and extending difference score methods. *Journal of Management*, 20(3): 675-682.

Torres, J. B. & Solberg, V. S. 2001. Role of self-efficacy, stress, social integration, and family support in Latino college student persistence and health. *Journal of Vocational Behavior*, 59(1): 53-63.

Turner, J. C. 1987. *Rediscovering the social group: Self-categorization theory*. New York: Basil Blackwell.

Turner, R. H. 1978. The role and the person. *American Journal of Sociology*, 84:1–23.

Turner, R. H. 1988. Personality in society: Social psychology's contribution to sociology. *Social Psychology Quarterly*, 51(1): 1-10.

Turner, R. J. & Marino, F. 1994. Social support and social structure: A descriptive epidemiology. *Journal of Health and Social Behavior*, 35(3): 193-212.

Turow, Scott. 1977. *One L*. New York: Farrar Straus & Giroux.

van der Laan, M. J. & Robins, J. M. 2003. *Unified methods for censored longitudinal data and causality*. New York: Springer.

Van Maanen, J. 1975. Police socialization: A longitudinal examination of job attitudes in an urban police department. *Administrative Science Quarterly*, 20(2): 207-228.

Van Maanen, J. & Barley, S. R. 1984. Occupational communities: Culture and control in organizations. *Research in Organizational Behavior*, 6: 287-365.

Van Maanen, J. & Schein, E. H. 1979. Toward of theory of organizational socialization. *Research in Organizational Behavior*, 1: 209-264.

Van Vugt, M. & Hart, C. M. 2004. Social identity as social glue: The origins of group loyalty. *Journal of Personality and Social Psychology*, 86(4): 585-598.

Wallace, W. L. 1966. *Student culture*. Chicago: Aldine Publishing.

Wagner, D. G. & Berger, J. 1997. Gender and interpersonal task behaviors: Status expectation accounts. Sociological *Perspectives*, 40(1): 1-32.

Weinstein, E. A. & Deutschberger, P. 1963. Some dimensions of altercasting. *Sociometry*, 26(4): 454-466.

Whetten, D. A. & Godfrey, P. C. 1998. *Identity in organizations: Building theory through conversations*. Thousand Oaks, CA: Sage Publications.

Whitt, E. J., Edison, M. I., Pascarella, E. T., Terenzini, P. T., & Nora, A. 2001. Influences on students' openness to diversity and challenge in the second and third years of college. *Journal of Higher Education*, 72(2): 172-204.

Wightman, L. F. 1996. *Women in legal education: A comparison of the law school performance and law school experiences of women and men.* Law School Admission Council.

Wilkinson, L. C. & Marrett, C. B. 1985. *Gender influences in classroom interaction*. Orlando, FL: Academic.

Williams, C. L. 1989. *Gender differences at work : women and men in nontraditional occupations*. Berkeley: University of California Press.

Williams, D. G. 1985. Gender, masculinity femininity, and emotional intimacy in same-sex friendship. *Sex Roles*, 12(5-6): 587-600.

Winship, C. & Mandel, M. 1983-1984. Roles and positions: A critique and extension of the blockmodeling approach. *Sociological Methodology*, 14: 314-344.

Winship, C. & Mare, R. D. 1992. Models for sample selection bias. *Annual Review of Sociology*, 18: 327-350.

Working Group on Student Experiences. 2004. *Study on Women's Experiences at Harvard Law School*. Online report: http://www.law.harvard.edu/students/experiences/FullReport.pdf.

Zimmerman, D. J. 2003. Peer effects in academic outcomes: Evidence from a natural experiment. *Review of Economics and Statistics*, 85(1): 9-23.