THE SHADOW RHETORICS OF INNOVATION: MAKER CULTURE, GENDER, AND TECHNOLOGY

by

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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copies of the dissertation to the Graduate College.

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DEDICATION

You showed me how to defy the odds, how to wield the power of language, and how to pursue a dream with relentless grit.

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ABSTRACT

What are the rhetorics of innovation? This project examines the compelling, persuasive, and often alluring features of innovation. Specifically, this project contends that popularized conceptualizations of innovation affectively shape tech environments in ways that ultimately (dis)place women-identified users and their contributions from these spaces. Compounding popularized conceptualizations of innovation are the silent, yet paradoxically loud, rhetorics of innovation where marginalized communities are invisibilized and innovative making practices undertaken by women are underrepresented. This project pays particular attention to these thresholds and limitations of innovation or, in other words, the *shadow* rhetorics that are always already present in prominent discourses surrounding innovation. In this context, the shadow rhetorics of innovation disrupt common assumptions that undermine the alluring features of innovation.

The project focuses on a specific brand of innovation. Analyses are contextualized and examined within the Maker Movement—a social phenomenon that emerged from Silicon Valley. Using affect theory as the primary theoretical framework for this project, I conducted a mixed-methods approach to examine how innovation has been conceptualized in past, present, and future time frames. In the project, I generate topic models on a textual corpus of twenty innovation websites, analyze pre-event survey responses from a women's-only hackathon, and examine data collected from an institutional review board approved study on making in a makerspace. These three methods function well independently to generate data about the shadow rhetorics of innovation as a persuasive mechanism that continues to shape the innovation environments. Importantly, however, they also function integrally: the results of each study inform the analyses of the others. Based on my analysis of these data sets, I argue that innovation-centric environments are engrained with gender biases that negatively shape the socio-technical relationships that women-identified users develop within these environments.

Chapter One

INTRODUCTION: RHETORICS OF INNOVATION

On August 4, 2017, *Motherboard* reported on a ten-page manifesto titled "Google's Ideological Echo Chamber" had gone viral inside the company's internal network. The manifesto also received widespread public attention, eventually being re-branded in news outlets and social media as the "Anti-Diversity Memo." In the manifesto, the author—a Google software engineer—makes several "non-bias" arguments in an effort to explain the gender gap in the tech industry. One of his core arguments asserts that an average woman's temperament, "neuroticism," and inherent aptitudes are biologically determined. Below, the following data points outline the gender and ethnic makeup for Google's workforce:

Table 1: Google Employee Gender and Ethnic Percentages

	Men	Women	White
Overall	69%	31%	56%
In tech positions	80%	20%	53%
In non-tech positions	52%	48%	61%
In leadership positions	75%	25%	68%

The engineer doubles down by attributing a woman's biology to explain why women are more suited to work in people-focused tech positions rather than systems and coding intensive positions (Conger). Men, he claims, are biologically tempered to endure extreme stress, to pursue high social status, and to excel in jobs like coding due to their preference for systemizing. The author rounds out his manifesto by refuting Google's

programs and initiatives for minorities, claiming that these programs are discriminatory in practice (Conger). The timing of this leaked memo ricocheted off the Department of Labor's investigation into the "systemic disparities against women pretty much across the entire workforce" within Google ("Google Accused of 'Extreme' Gender Pay Discrimination by US Labor Department"). Despite the "virality" and shock-value of the memo, such conversations around gender, innovation, and technology have been ongoing for decades. The memo is a symptom of a larger issue.

This dissertation stems from the hypothesis that innovation, as a concept and practice, is imbricated with gender biases (Harding 6; Frize 155; Fox-Keller 39; Schiebinger 4). Specifically, this project examines how dominant conceptualizations of innovation affectively shape tech environments in ways that ultimately (dis)place women and their contributions from these spaces. Compounding these popularized conceptualizations of innovation are the silent, yet paradoxically loud, rhetorics of innovation where marginalized communities are invisibilized, innovative making practices designed and undertaken by women are underrepresented, and ideologically-invested portrayals (such as the "non-bias" understandings of innovation illustrated in the "Anti-Diversity Memo") illuminate subordinated features of innovation. This project pays particular attention to these thresholds and limitations of innovation or, in other words, the *shadow* rhetorics that are always already present in prominent discourses surrounding innovation. In this context, the shadow rhetorics of innovation disrupt common assumptions that undermine the alluring features of innovation (more on this in Chapter Two).

Before delving into the shadow rhetorics of innovation, a fundamental question is answered first: what are the rhetorics of innovation? This project performs a rhetorical analysis on prominent discourses of innovation. In this context, rhetoric is defined as a framework to understand what makes innovation conceptually remarkably compelling and persuasive. To examine the rhetorics of innovation is to investigate how dominant conceptualizations of innovation shape attitudes, beliefs, behaviors, and expectations around who innovates, where innovation takes place, and how and with what innovation occurs (Isaacson 10; Govindarajan; Rogers 26; Schiebinger 6). As I examine the dominant traits of innovation, I also recognize that a lesser visible, discernable rhetoric of innovation is simultaneously co-extended.

Later in this project, I investigate the often omitted, but just as vital, shadow rhetorics of innovation. I demonstrate that innovation is not magical or rooted in 'eureka' moments, but is controlled and predictable. In particular, I apply critical making and affect theories to investigate the popularization of Silicon Valley as a premiere site for innovation. The chapters in this project examine innovation as a persuasive mechanism that shapes behaviors and expectations of women-identified makers as they participate in innovation events (*e.g.* hackathons) and environments (*e.g.* makerspaces). Bodies, objects, and spaces are three dimensions of innovation that are identified as project variables for analysis. From this purview, a new vantage point is established to envision the relationship between the rhetorics of innovation and the gendered narratives that comprise them. In sum, the overarching argument of this project is that innovation-centric environments (*e.g.* hackathons and Makerspaces) are imbricated with gender biases that negatively shape the socio-technical relationships women-identified users develop within

these environments. The driving argument of this dissertation will advance by: (1) outlining how the more and less dominant rhetorics that affectively fortify the underrepresentation of women (especially women of color) in innovation spaces and digital humanities fields; (2) applying affect and critical making theories to generate a multi-faceted analysis of innovation as contextualized within maker culture; and (3) facilitating an Institutional Review Board approved observational study that I conducted which examines gender identity and the interactions that take place between a maker and the bodies, objects, and spaces in close proximity to her.

The import of this work traverses disciplines and extends beyond the university. Primarily, it is a theoretical and practical undertaking that engages conversations in the private sector, government, local community spaces and organizations looking to mitigate issues regarding the inclusion of women in innovation spaces. Several macro concerns stemming from the underrepresentation of women in innovation environments include the following:

- The underrepresentation of women is indicative of a lack of divergent thoughts, ideas, and tech-solutions that drive and shape the future.
- Labor analysts predict that an increasing number of jobs in the near future will become available in tech domains such as cyber security, information technologies, and engineering ("Computer and Information Technology Occupations").
- Innovation is an exclusionary discourse that highlights and rewards demographics of a particular skin color, class, and gender. This is problematical since innovation

> continues to serve as a benchmark and/or metric to drive success in many institutions.

Moreover, on a micro level, the import of this subject extends to women-identified makers concerned with the inequalities, issues, and points of contention that arise upon their arrival in (and many times departure from) these spaces.

I. Innovation[1]: Object, Caster, Shadow

Innovation's often invisibilized features will be centralized and depicted in this project as shadows. By extension, the dominant and widely-accepted conceptualizations of innovation are conceived as the caster. The caster (*i.e*. innovation) is centered, highlighted, and is illuminated whereas the shadow is relegated to obfuscation. The term "shadow," however, maintains various denotations and connotative attributes. Schilperoord and Weelden note the wide-ranging symbolism attributed to the shadow:

> One can 'be frightened of one's own shadow,' 'take the shadow for the substance,' 'be only a shadow of one's former self,' or 'be unworthy of standing in someone else's shadow'… And in Plato's illustrious Allegory of the Cave the shadow appears as an imposter to symbolize human ignorance as the mental state of detainees in a cave who take the shadows cast by events happening outside their prison for reality. In all these (and many more) examples the shadow represents meanings that none of the laws of optics can predict.

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[1] Cristina Ramîrez reminded me of Carl Jung's psychological portrayal of the shadow as it relates to a person's conscious and subconscious. Jungian illustrations of the shadow are frequently cited in scholarship, and offer interesting enrodes for further research on innovation. Jung conceptualized the shadow as residing in the subconscious, and is characterized as "inferior, primitive, unadapted, and awkward" (78). It would be interesting to further examine innovation as it is conceived by, for instance, women-identified technologists in US colleges and how their confrontation with their own shadows relating to innovation could have the potential to spark or inhibit different ways of thinking about themselves and their participation within innovation fields.

While the concept of the shadow has a rich interdisciplinary history, in this project, I will be employing a more focused conceptualization of the shadow that engages the metaphor of the shadow to examine the various facets of innovation. Similarly to Toni Morrison's approach in *Playing the Dark: Whiteness and the Literary Imagination,* I examine the rhetorics of innovation that are simultaneously co-extended. Morrison, for example, offers a critical analysis of the way the African American presence, although dominantly ignored, was always already present in white American literature (3). That is, although Whiteness is centered in American Literature, African American presence is simultaneously presented. In a comparable approach, I examine the prominent features of innovation (the caster) in terms of the shadow discourses it projects: "the term *shadow discourse* [describes] ways of understanding psychic formations, as well as their relation to political struggle that dominant epistemological paradigms fail to recognize" (Kucich 90). The concept of the shadow in this analysis is inspired by Morrison, and is furthered aligned with thinkers who engage the shadow as a communicative artifact (Schilperoord and Weelden).

Schilperoord and Weelden conceptualize what they call 'rhetorical shadows' as fundamental communicative tools for persuasion and analysis. With a particular focus on the caster and the shadow, Schilperoord and Weelden outline various rhetorical forms of the shadow. In particular, this project aligns with the "type II incongruity" rhetorical shadow that the authors depict: [this rhetorical shadow] differs from the first type in that the caster and shadow are the same object but they represent that object in different 'qualities,' 'roles,' or 'manifestations." Within this framework, the caster is innovation and maintains remarkably different features than the shadow it produces. While the

dominant and subordinated features are casted from the same object, innovation, they offer distinctly different renderings and semblances of the object. In the following analyses, I highlight the shadow by emphasizing how innovation "stresses the dormancy of a shadow discourse, its failure to generate interpretation, and its subsumption with conceptual frameworks that obscure it" (89). However, before delving into the liminality and shadows of the rhetorics of innovation, a benchmark is needed: what are the prominent features of innovation?

II. Methods, Chapter Outline, and Project Trajectory

In order to carry out this project, I have chosen three methods to advance the aforementioned line of inquiry: What are the (shadow) rhetorics of innovation? The methods, detailed below, aim to reveal the dissuasive rhetorical mechanisms embedded in prominent conceptualizations of innovation that, in turn, undermine women-identified makers from participating within innovation environment. Each method performs an examination of innovation across time. That is, the following methods are coupled with timeframes to highlight how the rhetorics of innovation manifest in the past (Chapter Two), in the future (Chapter Three), and in real-time (Chapter Four). Such time frames act as referents for comparisons and examinations of innovation's multiple features and embodiments throughout the project.

To discover and document the widespread discouragement of women-identified makers in the past timeframe, I will carry out a topic modeling study of a small corpus comprised of scraped verbiage from twenty websites on innovation. Specifically, I will analyze the data generated from a series of topic models to make sense of the dominant ideologies undergirding innovation. This corpus study—the subject of Chapter Two—

will contribute to my larger project by documenting gender biases in innovation literature that are, in effect, inherent and ubiquitous. From the outset, l argue that the rhetorics of innovation work on a rhetorical level *from the past* to discourage women-identified users from participating within innovation environments. Such innovation environments are the sites for analysis in the two subsequent chapters.

In Chapter Three, I will report on a comprehensive survey of registrants at the largest women's hackathon in the Southwest. This study represents the *future* timeframe of innovation by examining participants' perceptions of innovation from the viewpoint of their future anterior. This perspective of "What could be?" provides insight into how the rhetorics of innovation shape the future imaginaries of women participating in an innovation-centric event. Before the event began, I distributed a survey to capture participants' perceptions. This timing, regarding the administration of the survey, is critical in that it aimed to capture possible anxieties, assumptions, and associations that attendees attributed to themselves. This focus on the rhetorics of innovation in this timeframe lends itself for a more focused analysis of innovation as it transpires in real-time.

Lastly, I study the physical and affective mapping of students as they collaborate on a maker project in a makerspace (the subject of Chapter Four). I will conduct nine observations that investigate how innovation unfolds among a group of women-identified makers, men-identified makers, and within groups comprised of various gender identities. The observations are a part of a pilot study that takes place in a makerspace; the pilot study has received institutional review board approval. This method provides new data on

how objects, bodies, and spaces inform the way bodies affectively navigate making processes in real time (*i.e*., the *present* timeframe).

The mixed-method approach I employ in this project emerges from my background and training within two knowledge domains: critical making and digital humanities. Particularly, I have selected these three methods because they function well independently to generate data about the shadow rhetorics of innovation as a persuasive mechanism that continues to shape digital humanities and innovation spaces alike. Importantly, however, they also function integrally, the results of each study inform the analyses of the others. It is from this holistic context that I aim to derive a comprehensive understanding of the extent to which sexist rhetorics of innovation actively and passively discourage women-identified makers from participating in innovation spaces. From these three chapter analyses, foundational concepts are developed which advance the analysis by giving name to the limitations of the shadow rhetorics of innovation. Concepts that are developed in each chapter concretize the affective impact that the rhetorics of innovation deploy on the mobility that women-identified makers embody in tech-rich spaces.

For example, I remember watching a woman-identified student tinkering with a 3D printer for the first time. As she was looking for a 3D model in *Thingiverse.com*, she was talking about how excited she was to see and 3D print something in person. I showed her how to change out the filament spools, and left her to print while I sat at a nearby table. She was changing out the spool, when a male student walked in and immediately asked her if she was going to be done soon because he needed to print something. I saw her put the blue filament back into the cabinet, heard her apologize to the male student, and watched as she walked towards me to sit down. I told the male student that he could

queue up his print job after hers; she then said aloud: “Oh, I wasn’t really interested in what I was doing anyway.” As a maker, teacher, and feminist, I’m interested in moments like this wherein feelings of excitement morph into feelings of shame—she held in her hands a spool of blue filament that affectively broke down from being an object of intrigue to that of humiliation. I assert that this concept is integral to understanding innovation because it highlights the interference that women-identified makers experience in relationship to bodies, space, and objects within innovation spaces. The second idea, object oriented bodies, continues this line of inquiry.

In this project, object orientation takes on similar qualities to its computer science namesake, as it explores the object-centric bonds that women-identified makers attach to objects in innovation spaces. This concept is further developed to show how women-identified makers are actively discouraged when interacting with objects that evoke specific affective reactions. Like all makers, women-identified makers form attachments to objects. In this project, objects are both tangible (*e.g.* using HTML5/CSS to code a website) and metaphysical (such as an “object of desire”).

III. Critical Analysis of Silicon Valley As the Premiere Site for Innovation

The following literature review generatively entangles conversations across various knowledge domains such as business, science, rhetoric, technology studies, gender studies, critical maker culture, popular culture, and digital humanities. Together, I synthesize these knowledge domains into a robust definition of innovation. This context will provide the framework for a deeper analysis of innovation in subsequent chapters as the “shadow rhetoric” of innovation is further unpacked and examined. Innovation has

developed a protean likeness because it has been defined and re-defined across various discourse communities.

For example, innovation could be envisioned in various forms: as the development of a lean business canvas that favors quick iteration, as the act of making or creating for survival, *jugaad*, or even as a simple, yet clever "life hack" that one performs at home (Vita).[2] In this regard, innovation has achieved a buzzword status. The word is frequently invoked during business meetings, is scripted across gym murals, and often makes its way into the mission and vision statements of companies and universities alike. While there are various domains to contextualize and understand innovation conceptually, this project will narrow its focus extensively on the conceptualization of innovation as it is framed and situated within Silicon Valley.

Dating back to 1540, innovation etymologically stems from the Latin word *innovationem* which means to "renew or change" ("Innovate"). Generally speaking, innovation is the act of re-presenting newness—it is modifying, hacking, or altering an existing thing (*e.g.* an idea, product, or solution) (Govindarajan); it also emerges from need. That is, innovation can be derived from an existing need, and thus acts as a bridging mechanism to close the chasm between the present and an anticipated future (Kelley and Littman 6). In terms of its popular qualities, innovation is conventionally outfitted as compelling, alluring, and is often reductively attributed to stories of great breakthroughs such as the apple falling on Isaac Newton's head to Steve Jobs' unveiling of the *iPod*. The lure of the garage continues to captivate people with idealized visions of Steve Jobs and Steve Wozniak working in a dimly lit garage amid wires and hardware as

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[2] *Jugaad* can be defined as innovation that is driven by lack or necessity (Vita 2012).

they gingerly pieced together the Apple One in 1979 (Kātz 77). However, there are other representations of innovation and innovators. Lesser-sung associations illustrate innovation as myth-like, narrowly focused on progressing modernist narratives, and implicated with issues of acclaimed objectivity (Harding 6; Schiebinger 15).

In sum, at the core of innovation are two basic features: (a) the ability to take something already in existence, modify it, and then re-present it as new, and (b) the ability to have an individual or population accept or receive the innovation and deem it valuable (Isaacson 10; Govindarajan; Rogers 26; Schiebinger 6). After reading across numerous texts on innovation, these two characteristics are consistently present. That is, innovation isn't simply a new or changed object, but is also attributed to possessing a level of social responsibility. Re-presenting newness comes with a level of social responsibility and the need for ethical consideration because innovation has the potential to change or alter normative behaviors and understandings of the world. Everett Rogers, in *Diffusions of Innovation,* cites Edward H. Spicer to describe the ethics involved in the implementation and reception of innovation saying: "Changing people's customs is an even more delicate responsibility than surgery." For example, a recent innovation in single-serving coffee brewing illustrates the social responsibility element that is part and parcel with innovation.

John Sylvan invented the single serving, customized coffee experience with the Keurig Cup or the "KCup." The Keurig Brewing system modified coffee brewing technologies and transformed the way many people brew their coffee. While KCup sales skyrocketed, so too did the concern with the environmental impact the non biodegradable KCups presented. Sylvan since then regrets creating the KCup, and has advocated against

KCup usage by championing petitions such as "Kill the KCup" to bring awareness to the environmental waste KCups generate. In terms of magnitude, as of 2015, there are enough discarded KCups that can circle the earth's equator 10-12 times (Petri). The implications of innovation are often not addressed when defining innovation, yet material social, political, and environmental are often at risk. Such oversight explains how Silicon Valley continues to receive much attention and appeal as an innovation hub—the ability to renew existing technologies and their adaptability of new versions of technology are prominent and consistent.

While innovation is a hallmark of our species that cannot be isolated into a specific discipline or population, innovation has for the past few decades been framed pretty stringently around science and technology fields. In fact, innovation theorists interchangeably use technology and innovation as synonyms (Rogers 12-13). Much of the attribution of innovation to technology, and vice versa, could be drawn from the popularization of startup and the do-it-yourself (DIY) movements that began in the Silicon Valley in the early 1980s and that continue to thrive today. A succinct historical trace showing the relationship between innovation and technology will be outlined in the next section. This trace will contextualize current illustrations of innovation and will situate the impending analysis on gender identity and mobility within innovation environments.

Technology and entrepreneurship has shaped the current identity of Silicon Valley. Before Silicon Valley became home to the 2nd highest per capita per income (PCPI) region of the United States, it became home to thousands of startups and to millions of high tech workers ("Personal Income for San Francisco"). The centrality of

innovation to the Bay Area's identity can be largely attributed to the technologies and companies that flourished there in the early 1970s—the decade initiating the rise of the PC wars (Cringley; Levy 5) This region of California, nicknamed Silicon Valley, derived its namesake from the innovations made from silicon chips (Finn 9). Major computer companies, such as IBM, worked towards developing a computer model available for a mass market. The relationship between innovation and the rise of the mainframe computer stems from Silicon Valley. The development of computers changed how people worked, engaged, and experienced the world. Innovation of this kind, the Silicon Valley brand, is and continues to be extremely alluring and persuasive.[3]

IV. Innovation and the 'Maker Movement'

The Maker Movement is the site of inquiry for this project's multi-valent analysis on the rhetorics of innovation. In the mid-2000s, Dale Dougherty of *O'Reilly Media* coined the term "Maker Movement" to demarcate a tech-extension of the DIY movement: a representation of the garage culture of tinkering, programming, and hacking that took place within private residences in Silicon Valley. Dougherty envisioned bringing tech and programming enthusiasts out of their garages, and into their local communities to share expertise, excitement, and technologies with one another. With the launch of *Make:* magazine, the accessibility of cheaper tech (*e.g.*, Arduinos), and the social media infrastructure to share and teach (*e.g.*, *YouTube* and *Instructables*), the excitement around maker culture sprawled beyond the Bay Area and into local communities, colleges, and universities around the world. Popularized conceptions of

[3] While Silicon Valley continues to be a regionally compelling and alluring region for innovation, I am reminded by Adela Licona of how unkind this locale continues to be toward those living with and experiencing poverty. Silicon Valley is not only populated by the wealthy, but in fact is also made up of thousands of residents who rely on public or private assistance to survive (Weller).

innovation, as conceptualized from Silicon Valley, sustained the emergence of the Maker Movement phenomenon.

Maker culture was viewed as an open invitation to anyone interested in making with tech regardless of their subjectivity or expertise. Many readily accepted this invitation, especially as cheaper hardware and software became more accessible, and as prosumer-based websites such as *Instructables, YouTube,* and *Pinterest* were increasingly popular (Gauntlett 83). The social phenomenon was further fortified as maker communities began organizing from the movement. Events and spaces dedicated to cultivating innovation such as hackathons and make-a-thons were increasing in prominence, while innovation spaces, makerspaces, and hackerspaces continued to crop up in universities and communities ("By the Numbers: The Rise of the Makerspace").

As more innovation-centric events and spaces materialized across the US, a repertoire of technologies began to emerge as maker movement essentials. In subsequent chapters, these maker-culture-branded technologies serve as sites to analyze how innovation affectively shapes makers' behaviors amid these objects. Several computers and computerized technologies have gained popularity in this tech-extension of the DIY movement: Raspberry Pi, Arduino, 3D printers, and other small electronics. Raspberry Pi are credit-card sized computers that have been used in applications ranging from home sprinkler systems, to retro-gaming, and even robotics. The Maker Movement invigorated makers with the allure of limitless possibility. It has now surpassed its ten year mark, and many communities and universities alike are sustaining the movement with the addition of hackathons and the building of makerspaces; however, despite the resounding

excitement surrounding the maker movement, it is and has been in need of critical examination as it pertains to several communities and demographics.

This section provided a brief synopsis of the conversations around innovation, and more specifically the relationship between innovation and technology, and provides a general overview of the Maker Movement as the site of inquiry to further examine the shadow rhetorics of innovation. The aforementioned portrayal of innovation is linear, contained, and in many ways erases ideas and voices of past innovators. It does not speak to the maker cultures that preceded the mid-2000s; it does not account for the diverse communities, practices, and voices of makers outside of Silicon Valley; it does not, especially pertinent to this work, account for the contributions that women workers in the Santa Clara Valley (a considerable percentage were immigrants) had in shaping the prominence Silicon Valley currently stands on (Matthews 160). Rather, ”innovation” here has been outlined in such a way as to provide definitional work around one very particular concept, the Silicon Valley variety, thus defining the scope and threshold of this project and its focus on a unique form of innovation.[4] This analysis will continue to speak to and against frameworks highlighting the way women-identified makers are constrained in the Maker Movement. Innovation is now carved out in terms of this project's scope, and will next be placed in conversation with the last piece of this literature view: the underrepresentation of women in innovation environments.

[4] The baseline definition of innovation is outlined in a linear manner and although I advocate against this narrow illustration, it serves a purpose in this project. The conveyance offers this project a starting point to identify the limitations of this popularized portrayal. The shadow rhetoric of innovation is unlike the popular concept of innovation. It isn't linear, but instead it's diffused. It isn't male-centric, but instead it's focused on underrepresented gender identities. The shadow rhetorics of innovation are introduced in this project to counteract this linear outline.

V. More than a Pipeline Problem: Wrapping Our Arms Around these 'Women Issues' in Tech

In this last section, the conversations and debates informing the lack of gender diversity in tech spaces will serve as the final feature of innovation that will be woven into this literature review. The underrepresentation of women in STEM and innovation fields continues to be a resounding issue that many organizations and universities are striving to mitigate.[5] This section provides an overview of the issue, and the limitations of current solutions meant to mitigate the gender gap. But, first, why? Why is it problematical that there is a primarily homogeneous demographic comprising STEM and innovation fields in the US? The importance of diverse viewpoints, perspectives, and a thoughtful consideration of the end user are critical—especially when it comes to user design and experience. For example, the latter is exemplified through the narrow design processes that went into the creation of seatbelts. The consequences of a homogenous design could be fatal.

The seatbelt is a modern-day innovation that continues to save lives and reduce the injury of drivers and passengers alike. The lesser-known narratives associated with seat belts, however, are the high levels of fatalities of women and children as a result of seatbelt use (Reynolds, *et al.*). Initially, the majority of lives saved by seatbelts were men. When the seatbelt was first designed, and in many respects this remains true today, the crash dummies were designed in the likeness of the average male body from the design team (Reynolds, *et. al.*). The dimensions of the seatbelts were engineered without careful

[5] Compounding the gender gap in tech and innovation environments are the racial disparities amid the population of women that are represented therein. Throughout this project, I use the words “woman” and “women” to signify individuals who self-identify as women (this includes white and women of color). I do, however, emphasize and call out instances where women of color are inflicted with a higher degree of precarity than white women.

consideration of the bodies of other passengers (*i.e.* women and children) using this "life saving" mechanism (Reynolds, *et. al.*). The seatbelt is an innovative breakthrough in safety technology without a doubt; however, one wonders how many fatalities could have been prevented with the inclusion of different perspectives shaping the design and understanding of seatbelt users.

The issue of the representation of women is a recent phenomenon—this was not an issue several decades back (Kanny *et. al.*). While tech fields in general are dealing with gender disparity, some fields specifically are dealing with an even wider gap; specifically, the representation of women in computer science and engineering fields has steadily decreased since 1990 (Hill). Research to determine the decrease has yielded numerous diagnoses as well as solutions to close the metaphorical gap. Before delving into the influence of the shadow rhetorics of innovation (*i.e.* how language continues to be a key factor fortifying the gender gap), here are the current conversations in dialogue with the issue. In "Investigating Forty Years of STEM Research: How Explanations for the Gender Gap Have Evolved Over Time," Kanny *et. al.* discuss three meta-narratives undergirding the underrepresentation of women within innovation fields. Prominent issues include: a pipeline issue, the gendered socio-behavioral associations between low confidence and women, and a lack of mentorship and women leaders. The article further dials into gender disparity by highlighting these following pain points as major influences: the psychological factors, values, and preferences of women (138), family influences and expectations (139), individual background characteristics, and K-12 structural barriers (137). Numerous literatures identify these sites of complication as

prominent areas in need of mitigation, and often identify these issues as key factors in the "pipeline" issue.

The first conversation centers on the metaphor of a pipeline. That is, there are not enough women entering into innovation and STEM fields which is impacting the lack of women professionals entering the workforce. In essence, it's an issue of supply and demand. Compounding the pipeline concern is that while women are earning degrees in innovation fields, they are opting out of choosing a professional career in these fields. While the numerical value of women entering the innovation workforce is declining, some argue that this is a limited understanding of the larger issue:

> Past decades have shown that simply trying to recruit girls and women into existing engineering and computing educational programs and workplaces has had limited success. Changing the environment in college and the workplace appears to be a prerequisite for fully integrating women into these fields. The report argues for changes in the workplace and college environments as a necessary preamble to women's full participation in engineering and computing (Hill).

In response to this pipeline problem, business and educational initiatives have honed their focus on providing technical training for women and girls by using platforms such as *Codeacademy, Udacity*, and *Udemy.* While open-source coding websites and targeted coding camps for women can be formidable ways to introduce newcomers to the field, they fall short of preparing women for the precarities in the workplace that specifically work against women (micro-aggressions, harassment, gender biases for example). Thus

researchers and gender parity advocates are arguing for a people-centric and not a pipeline-centric approach to getting more women in STEM fields (Martin).

While Kanny *et. al.* focused on gender disparity before a woman enters the workplace, other researchers examine workplace culture which is often perceived as 'remote' or goes unaccounted for (Hill). Workplace culture could be defined as the hiring/firing protocols, promotion process, programs, policies, mission, vision, values, physical workspace that comprises an organization ("Workplace Culture: What is it, Why it Matters, and How to Define it"). The design of these entities contributes to the cultivation of inclusivity or exclusivity in work environments. Despite a woman's qualifications and skillsets for a professional position, many are confronted with gender biases that stymie the workplace environment and one's ability to excel. For example, "stereotype threat" is defined as one's self-consciousness and/or anxiety with confirming a negative stereotype about a group with which they identify (Steele; Aronson; Gorlick; Gupta; Bhawe; Fryberg *et al.*). Stereotype threat impacts performance, productivity, and one's self-perception of ability to excel or succeed in spaces where they are not commonly a part. In *Athena Unbound,* the authors illustrate the social isolation and invisibility felt by a woman-identified student:

> In some instances women are devalued by not being included in unprofessional events. A female graduate student reported that invisibility was imposed when you have a visitor to the lab. The professor introduces the male students, but does not introduce you. Another reported self-imposed invisibility in reaction to expectations that her contributions would not be valued (Etzkowitz, *et. al.* 84-85).

While many point to explicit forms of workplace wrongdoing like sexual harassment, these subtle but also incredibly hindering behaviors can push any person, regardless of gender, to leave a workplace. Feelings of invisibility, frequent encounters with micro-aggressions, and navigating gender biases within a lab, classroom, or workplace accumulate and eventually compel women to leave.[6] In response to this disparity in treatment, many companies have turned to diversity and emotional intelligence training initiatives in hopes that this will change the workplace culture; however, some argue that these very trainings have adverse effects (Dobbin and Kalev). The argument for this is that such trainings reinforce stereotypes, making persons hyper-aware of stereotypes and biases that they were unaware of and potentially recreate them (Dobbin and Kalev). The pipeline problem and workplace culture serve as ongoing topics of discussion. There are prominent variables in the innovation gender gap that inform the last variable in the gender gap: women's self-efficacy and confidence within innovation spaces.

The third topic, self-efficacy and confidence, is an issue that has been frequently discussed with a longstanding history dating back to the Scientific Revolution in the 18th century. Labor and ability have been historically gendered; skillsets, jobs, tasks and thus technologies took on rigid categorizations of being either masculine or feminine (Keller 155; Wajcman 144). Technology, computing, and the sciences (STEM) had been ascribed as masculine (Harding 6; Frize 155; Fox-Keller 39; Schiebinger 4). Most prominent in Western society are the associations of technical ability and power to masculinity (Wajcman 145). In extreme contexts, Shivani Gupta recounts the belief that a woman's physical touch can destroy technology. The gendering of technologies reflects decades of

[6] The cliché, "death by a 1,000 cuts" is accurate in this scenario in that these seemingly inconsequential interactions have real consequences.

beliefs, rhetorics, and attitudes that have shaped the roles that women have with masculine- ascribed tools.[7] The rhetorics of innovation have historically constructed the way women have oriented and have disoriented themselves within innovation and STEM spaces. Technologies like programming, 3D printing, or virtual reality are steeped with histories where women's involvement are sidelined or unacknowledged—these technologies will act as sites for further inquiry in the coming chapters. These histories and ideologies around gendered technologies have manifested themselves in many girls and women's perceptions of their ability to solve problems and succeed in these environments.

Alongside stereotype threat and exclusionary workplace culture, low self-confidence and self-efficacy compound the already difficult navigation through innovation fields. In "Gender Differences in University Students' Perceptions of Confidence in Problem-Solving Abilities," Maggie Zhong and Shelly Wismath conducted a study to chart perceived confidence and ability that both male and female students possessed throughout a problem solving and puzzles course. In the pre-test, female students ranked themselves much lower in their confidence and abilities than the males in the class, with only 27% females citing confidence in problem solving; however, post-test, Zhong and Wismath observed a significant increase in self-perception:

> On the pre-test, female responses regarding the problem-solving skills were distributed across the 'Disagree' (14%), 'Neutral' (59%), and 'Agree' (27%) categories. However, on the post-test, no female respondents selected the

[7] This, too, offers insight regarding the hesitation and reluctance that persons may have when asked to work with a tool or technology that does not align with their self-identified gender.

> ‘Disagree’ option, and the ‘Neutral’ group shrank to 9%. Fully 91% of female students selected ‘Agree’ or ‘Strongly Agree (4).

While these pre-tests and post-tests are excellent in terms of fostering a better perception of females ability to problem solve, they also highlights a major issue within the STEM and innovation space. Many women enter the space with these preconceived notions and self-doubt that ultimately informs how they interact with the space, bodies, and objects in that environment. They, unfortunately, do not go through a confidence or problem-solving course, nor are they prepared for the gendered dynamics that often put women at a disadvantage when positioned to innovate, make, and to thrive in these creative technical spaces.

VI. Framing the Analysis—The Shadow Rhetorics of Innovation

This chapter has woven together the foundational context for the upcoming analysis of the shadow rhetorics of innovation. The multi-valent dimensions of the rhetorics of innovation will be examined in the coming chapters as they are explored in innovation-centric events (hackathons) and spaces (makerspaces). This chapter established the contextual background to frame subsequent chapters. While situating conversations surrounding the underrepresentation of women in tech and the rhetorics of innovation, this chapter has also indexed several key terms and concepts that will be later revisited in subsequent chapters.

Ultimately, this project performs an analysis of the dominant and shadow **rhetorics** of innovation. It centers on three omnipresent elements of innovation—objects, bodies, and spaces—and particularly examines how these elements exclusively and collectively establish an ideological discourse that purports many narrowly-focused

modernist conceptualizations of innovation (Ahmed 122). "Rhetorics," in this context, refers to the ways that the language around and supporting the concept of innovation, shapes attitudes, beliefs, behaviors, and expectations of people as innovators, where they innovate, and how they innovate (Isaacson 10; Govindarajan; Rogers 26; Schiebinger 6). **Innovation** could be defined across contexts, but is specifically deployed here in the terse sense as containing two main features: (a) the act of taking something (such as a product, solution, idea) that already in existing, and re-presenting it as new; and (b) the thing's ability to hold value for a person and/or population (Isaacson 10; Govindarajan; Rogers 26; Schiebinger 6). Since innovation is a nebulous concept often taking different shapes and meanings across various contexts, this project focuses on how innovation has been shaped by and through the privileged discourses of Silicon Valley, and most notably by the social phenomenon known as the Maker Movement. **Affect** is defined in this project as "visceral forces beneath, alongside, or generally *other than* conscious knowing that can serve to drive us toward, movement, thought, and ever-changing forms of relation" (Seigworth and Gregg 1). Affect theory, which will be further elucidated in chapter two, frames innovation in a way that represents some of the challenges facing spaces of innovation and events, while also contributing to the larger conversation on the underrepresentation of women in science, technology, engineering, and mathematics (STEM) fields. In the next chapter, I will perform a closer analysis of innovation by examining a textual corpus comprised of innovation website verbiage. I will conduct the text mine in order to determine a set of recurring themes and patterns that are often attributed to discourses surrounding innovation.

Chapter Two

'AFFECT REALITY': UNDERSTANDING THE LIMITATIONS OF INNOVATION THROUGH AUGMENTED REALITY & AFFECT THEORY

My colleague opened the door, and invited me into the empty room: "This is the room for the new makerspace we're launching!" My involvement with the iSpace, the University of Arizona's makerspace, began at the space's early stages. I remember one of our first meetings I was in. We, myself and several student colleagues, sat on the floor to pull together a technology purchase list. We envisioned a conventional university makerspace that would feature a series of cutting-edge technologies for students to learn and to create with (Lee 2017). Aloud, we brainstormed tech purchases as one person jotted the ideas down into an *Excel* spreadsheet: "*Oculus Rift SDK*, 3D printer, cardboard virtual reality viewers, microphones, speakers, laser cutter…." The list grew rapidly, and soon my colleagues began to point to different regions of the room: "We'll put the 3D printer against the wall by the door; the video wall will be centered on this wall…." They

began mapping the soon-to-be-purchased tech in the empty room.

At that time, I had little experience or knowledge of the majority of items on the purchase list. I was also the sole woman in the planning group. I cast a suggestion into the stream of ideas: "How about a sewing machine?" The typing stopped. My colleagues looked at each other and then at me. Quiet. I felt like an outsider. I felt hyper aware of myself at that moment. I watched as my colleague who was compiling the spreadsheet look earnestly to the group for a signal—should he add sewing machine to the list? I laughed nervously into the silence. Finally, another colleague leaned towards me and softly asked, "But wouldn't having a sewing machine in the space make male students feel excluded?" The question, as I perceived it, wasn't hostile or patronizing. His inquiry seemed to be rooted in a genuine concern for the male student population in this up-and-coming makerspace. As a rhetorician and digital humanist by training, this question was incredibly telling and troublesome. Alongside hearing his concerns for the ramifications of a having a sewing machine in the makerspace, I also identified these assumptions from what my colleague stated:

- The addition of a historically feminized technology (*i.e*. the sewing machine) subtracts from the male experience in the makerspace (Gordon 2004). We must be thoughtful and deliberate about tech purchases because that in turn will determine who will inhabit and who will be comfortable within the makerspace.
- The skin of the makerspace is decisively male. Specifically, my colleague's question affirms Sara Ahmed's notion that "spaces extend the mobility of some bodies; their freedom to move shapes the surface of spaces, while spaces surface as spaces through the mobility of such bodies" (70). Although openness and

accessibility to all students and community members are fundamental features of the makerspace, the makerspace must prioritize the needs of the male demographic.

- Tech equipment and tools are not standalone, neutral artifacts but have their own social lives, histories, and are affectively influential (Ahmed 33; Appadurai 15). That is, a concern for a sewing machine isn't its physical hardware and software components, but the people it invokes, women.

As a researcher and as a woman in tech, I wanted to trace the assumptions governing my colleague's question and gender bias back to the discourses fortifying them. That is, what makes technologies such as virtual reality and 3D printers readily accepted into a tech-centric maker community, whereas a sewing machine raises concerns? Even more so, how could maker culture, esteemed to be an inclusive and welcoming concept, fall short to arguably half of the population: to women-identified makers?

This chapter moves beyond identifying the issue of the gender gap in technology, and instead offers a theoretical outlining of how the shadow rhetorics of innovation operate as a divisive wedge in the gender gap in tech. Centering this analysis on the shadow dimension of innovation is tricky—it is a slippery concept that is not tangible, yet is influential and powerful. The socio-technical relationships that women-identified makers cultivate are deeply rooted in spaces, objects, and also in symbols and language (Wajcman 144). To perform an analysis on the shadow rhetorics of innovation, in the first half of the chapter, I first map out the dominant features of innovation through the analysis of topic model results. The second half of the chapter investigates the "shadows" cast from the popularized conveyances of innovation. To do so, I will leverage a familiar

makerspace technology to outline and elucidate the shadow theory of innovation: augmented reality (AR). This theory of innovation examines, at a physiological level, key variables within environments (bodies, objects, and space) that converge to affectively (dis)place women from innovation spaces. Specifically, these variables act as what Teresa Brennan in *The Transmission of Affect* denotes as points of transmission—things that affectively alter the "atmosphere" of an environment.

Augmented reality, as both a concept and an extended metaphor, will be further unpacked in the second half of this chapter. When I invoke the word "augment," I am nodding to its etymological origin to "make more severe" and to "increase" one's awareness of the surroundings ("Augment," *Online Etymology Dictionary*). Fundamentally, AR is a digital intervention used to tangibly and concretely alter a user's environment through the deliberate imposition of digital objects to achieve a certain physiological response (Carmingniani). Objects to incite joy, fear, and anger, for example, are superimposed in order to heighten a user's experience (Tomkins 88). AR is a mimetic technology that digitally recreates affective instances that people experience in their physical environments sans headsets and smart device. That is, similar to wireless frequencies, bodies, objects, and spaces signals information to persons in close proximity within an environment. AR exists on a daily basis without the digital mediation brought forth by the AR technologies—people are (and have been) consistently *affected* by their environment.

AR is an appropriate critical lens to outfit the otherwise protean underbelly of innovation. Although the shadow rhetorics of innovation are often unseen, its potency is commanding: its limitations are felt and press upon the bodies it does not privilege or

serve (Morrison 36). The rhetorics of innovation are a discursive mechanism meant to "augment" women-identified makers' experiences and, in coming chapters, these exclusionary rhetorics will be visibilized through an analysis of two innovation-centric spaces: a hackathon and a makerspace. In using AR as an extended metaphor for innovation, I demonstrate from the topic model analysis that innovation is not magical, epiphanic, rooted in 'eureka' moments, but is instead rigid, mechanized, controlled, and in many ways, predictable. Christopher Meyer succinctly undermines the mystique of innovation in the opening of his book *Relentless Growth: How Silicon Valley Innovation Strategies Can Work in Your Business*: "Innovation is not a mysterious black box" (XIX-XX). Dominant discourses work to shape ideas of who should be in a space, what they should do in a space, and with whom and what they should be engaging (Bazerman 1988; Farris 2002). In order to outline the defects of innovation, I will perform an analysis that will identify recurring themes and patterns within popular discourses on innovation.

I. Distant Analysis of 20 Innovation Blog Websites

Topic modeling is an increasingly popular research method in the humanities that allows researchers the ability to infer the dominant patterns and themes present within a textual corpus. Topic modeling is defined as a "form of text mining, a way of identifying patterns in a corpus" (Underwood). Specifically, a corpus is ran through a statistical model that uses a common digital humanities algorithm, Latent Dirichlet Allocation, to analyze the textual body for frequently co-occurring words.[8,9] The results serve as inferences for researchers to draw insight from. It is conventional for researchers to have

[8] Here are the topic model settings I had in place for MALLET: 500 iterations, .5 threshold for co-occurrence, added and revised stop words, 15 words per topic.

[9] Importantly, no matter how robust the algorithms, a topic model does not replace the analysis a researcher performs. A researcher's experiences, skills, and knowledges are an integral part of the topic model analysis.

a sense of the possible topics before the topic model is generated. To gain a fuller understanding of the underlying themes, words, and ideas surrounding innovation, I compiled a corpus of verbiage scraped from the top twenty innovation website blogs (Moretti). Ultimately, the following analysis of the prominent rhetorics of innovation will serve as a starting point to make visibilize the shadow rhetorics of innovation.

I analyzed a collection of websites that were hailed the "Top 20 Most Influential Innovation Blogs from 2016" by the editors of *Innovation Management*, Nick Skillicorn, Amelia Johannsen, and Manuel Kaiser. There were sixty three websites vying for this recognition as top innovation websites. The following criteria determined which innovation websites were honored in the top 20 list:

- Quality
- Social influence
- Availability of diverse media (*i.e*. the website contained audio, visual, textual elements)
- Popularity
- Reputation (InnovationManagement.se.)

I deliberately chose to scrape these website blogs because of their accessibility and impact—I wanted to capture prominent bloggers' ideas on innovation because of their wide audience reach. Content-wise, the majority of the innovation websites were conventional blogging sites, while a few websites departed from convention by also offering articles, graphics, quick reference guides, and other documents/materials on innovation. In order to compile the corpus, I web scraped and crawled of all these blog sites.

a. Methods: Compiling the Textual Corpus for the Topic Model

The scraping and crawling processes were unique to each of the twenty innovation websites. Scraping occurs when a researcher identifies desired HTML tags to

extract. Web crawling, in contrast, focuses on collecting web content and indices (Massimino 2016; Devi *et. al*. 2015). Each website had a different design interface and accompanying HTML code, which meant that I recalibrated the scraping process twenty times over in order to gather data from each website. Understanding each website's HTML scaffolding was a critical step in the scraping process—it allowed me to pinpoint which tags to pull from the site. Once I was able to get an understanding of which parts I needed, I generated workable results through the use of a few additional tools: *Python*, the command line or terminal, and a few open source libraries including *Beautiful Soup*, *Scrapie*, *Requests*, and a web crawler called *80 Legs*. Ultimately, the raw data I collected included both text and HTML tags, attributes, and objects. I cleaned the raw data by removing the HTML tags and all other extraneous text that were returned. Once the corpus was collected, cleaned, and compiled, it was ready to be processed through the topic model.

Piecing together a composite of innovation helps to make preliminary sense of how women-identified makers are expected to behave under the auspices of these popularized rhetorics. The topic model offered an interesting starting point to identify concrete characteristics of innovation and inadvertently its breaking points. The way popular discourses on innovation have established behaviors, patterns of thinking, and success metrics for persons participating in these contexts helps me to extend a critical framework that can be used to outline the theoretical foundation supporting the second part of this chapter as well as the remainder of this project. The following rhetorical analysis centers on three features of innovation and spur a deeper examination of the way

the rhetorics of innovation negatively shape the socio-technical relationships women-identified users develop within tech-centric environments.

b. Analysis of Generated Topics

While the first chapter offered an description of Silicon Valley innovation from the framework of maker culture and from literature written on innovation, the analysis here offers a broader conceptualization of innovation across 20 websites dedicated to innovation. The three topics listed below returned a co-occurrence of words that I arranged into specific themes and patterns that each represent a distinctive feature of innovation. In this section, I provide a brief analysis of the top three (of ten) innovation topics. These topics act as springboards into the multi-dimensional analysis on innovation (as mentioned, these topic models do not reveal patterns without a researcher to perform the analysis).

Business, magic, and the militarization are salient themes from the topic model that spurred the analyses in this section. Together, these themes form an assemblage of the most compelling parts of this project: the themes that are silenced. The topics project dominant features of innovation, while also revealing the shadow of what is not being represented in these narratives of innovation. Overall, they suggest a lack of critical engagement with the implications these dominant rhetorics impose on the people it is uninterested in. Innovation's limitations, at this level, are not readily visible.

	Topics	**Theme**
1.	creative | work | people | time | money | creativity | great | good | mark | art | business | thinking | life | find	Business
2.	innovation | leadership | excellence | power | management | creativity | magic | culture | world | open | people | innovators | america | idea | development	Magic

3.	people | world | military | great | innovation | person | war | good | time | work | iraq | bin laden | man | best	Militarization

Topic #1: Business
creative | work | people | time | money | creativity | great | good | mark | art | business | thinking | life | find

This topic highlights a salient and very prominent feature of innovation in the United States: business. Half of the co-occurring words are business-related, such as "time," "people," "money," "business," and "work." The connections between innovation and business have a longstanding relationship in Silicon Valley as more companies and executives have historically turned to innovation as a driving concept to integrate into their corporate strategies and initiatives over the past 30+ years (Kelley and Littman 3). The words "creativity," "creative," and "time" round out the business theme by alluding to the creativity often associated with the marketing and branding that goes into shaping consumers' reception of a product. In a business sense, innovation focuses heavily on persuading consumers to *buy into* a product's innovativeness. As Everett Rogers argues in *Diffusion of Innovations*, when it comes to how ideas, practices, and objects are viewed by individuals and communities: "It matters little, so far as human behaviors concern, whether or not an idea is objectively new as measured by the lapse of time since its first use or discovery" (11). While the marketing aspect of innovation is not always highlighted, it is a major element of what diffuses innovative ideas and products to the masses. Some would argue that at the heart of innovation is not just technology or cutting-edge ideas, but smart public relations (Berkun 6).

Marketing for innovation is a skill that many corporations like *Apple* have capitalized on immensely. The substantive "innovativeness" of *Apple* phone models is

difficult to discern: “If someone told you the ‘next iPhone; looks exactly the same, is somewhat faster, but is a new color and you don’t have to type in your Apple ID if you don’t want to, would you wait in line all night for it? [I]t turns out that’s all it took to break a sales record by almost double” (Plafke 2013). The business of innovation centers on the synthesis of strategic creativity and timing to form consumers’ attitudes around innovation and their decision whether or not to adopt or reject a new technology (Rogers 20).

Topic #2: Magic
innovation | leadership | excellence | power | management | creativity | magic | culture | world | open | people | innovators | america | idea | development

Legendary science fiction writer, Arthur C. Clarke once remarked: “Any sufficiently new technology is indistinguishable from magic.” This section pointedly addresses the allure, mystique, and magical qualities often associated with innovation. The theme of magic and innovation emerges through this topic in words such as “creativity”, “magic,” “culture,” “america,” “idea,” and “power.’ Building from the intense marketing efforts that go into shaping consumer behaviors around a product, this “magic” theme explicitly draws connections to the sleight of hand that major innovative companies perform. In “Magic and Innovation,” Jim Euchner analyzes the seamless relationship between magic and innovation: “Innovation is a magical thing. It transforms dross into gold, puts nature at our command, creates something new where there was once nothing. Throughout history, magicians (and charlatans) have used new technology to create illusions for delight and profit.” Euchner further elaborates on the magic not of the artifact itself but in the aura and social life objects maintain (Appadurai 13).

The enchantment of innovation derives from the myth-like status that innovators and the innovation process both possess. "Aha" and *eureka* moments draw consumers into the magic of the epiphany with the innovation process; magic has religious roots with an early meaning denoting divine insight (Berkun 5). Innovation's magic is localized in the creative and discovery process, imagined in a product's unique narrative, and is materialized into a product. The innovative product inherits a delicious origin narrative that makes it difficult for consumers to resist: "When amazing innovations arise and change the world today, the first stories about them mirror the myths from the past. Putting accuracies aside in favor of echoing the epiphany myth, reporters and readers first moved to tales of magic moments" (Berkun 6).

Militarization

Topic #3: Militarization
people | world | military | great | innovation | person | war | good | time | work | iraq | bin laden | man | best

This topic, of all the other topics generated, was unmistakable when it came to identifying the pattern: militarization. Across the 20 innovation websites, the majority of authors wrote multiple blogs on the death of Osama Bin Laden. With in-depth accounts of the military strategies and weaponry involved in Bin Laden's death, the majority of the authors spent time analyzing the variables that came together to make this a historical United States of America feat. This topic reveals dimensions of innovation that are steeped in calculated forethought, war, and victory: "The goal was to optimize investment decisions so as to increase the chances of success in war" (Hill 85). Similar to large corporations, the American government consistently seeks new and improved methods, practices, and knowledges around innovative militarization and investment. Interestingly,

some of these methods include educational initiatives such as coding for all programs (Kelley and Littman 4). The militarization qualities inherent to innovation have historical precedence: “On this view technology tends to be thought of in terms of industrial machinery and military weapons, the tools of work and war, overlooking other technologies that affect most aspects of everyday life. The very definition of technology, in other words, is cast in terms of male activities” (Wajcman). A subcontext for the U.S’s push for more STEM-centered curricula could be traced to an investment in future militarization.

An example of militarization and innovation is evident in the way the Trump Administration frames STEM and computer science education. In this context, militarization operates under the guise of education and innovation in order shape a young workforce and military. In 2017, President Donald Trump signed a memorandum to expand access to innovation-centric education in STEM fields with an allocation of at least $200 million in grant funding (*The White House, Office of the Press Secretary*). Several times the President and his daughter, who championed this initiative, emphasized the utility of coding to build a competitive workforce. In the company of students and educators, Trump remarked in the Oval Office: “Greater access to STEM and computer science programs will ensure that our children can develop the skills they need to compete and to win in the workforce of tomorrow” (*The White House, Office of the Press Secretary*). As the children left the Oval Office, Trump called them the future “innovators” and “programmers” of tomorrow.

Topics in Dialogue

While these major themes of militarization, business, and magic are dominant characteristics, they are but a small representation of voices. Of the twenty blog sites, seventeen were authored by men, two of them were authored by men and women, and one was authored by a woman.[10] Alongside the homogenous yet distinct concepts of innovation, another concern is the way search engines are developed to yield these websites as top results. That is, the search and understanding of innovation on the internet yields gendered results. The patriarchy is baked into the algorithms.

Safiya Umoja Noble's presentation, "Challenging the Algorithms of Oppression" highlighted the social issue of data discrimination in terms of the discoverability of specific portrayals of gender and racism (2016). Noble furthers her argument by discussing the multiple issues with obtaining information on the web: there are limited search engines to choose from, the manipulation of results through search engine optimization, and the way persons retrieve their information is in many ways reflects the self-interests of companies that benefit from search engine optimization (2016). Search engines yield commercially viable and profitable results that continually misrepresent women and especially women of color in the results. What is innovation then? If themes such as business, magic, and militarization are representative of the dominant features of innovation, which features of innovation are invisiblized? In the next section, the dominant discourses of innovation will be extended through the metaphor of AR. AR will serve as a critical framework to illustrate innovation's defects and limitations as a rhetoric.

II. 'Affect Reality': Innovation's Defects and Augmented Reality

[10] Reading authors' names, viewing their images, and taking note of their preferred pronoun usage informed this tabulation.

Augmented reality operates twofold in this analysis: to index the technologies used to embed computer-generated overlays into a physical environment, and to frame how objects, spaces, and bodies act as transmitters in physical environments in order to heighten one's experience within a space. Through a careful analysis of AR functionality, I am offering a theory of innovation that engages the prominent themes of innovation to make sense of the in-betweenness, the affective shadows, and forces that shape the lived experiences for women participating in innovation spaces. The principles of AR, as outlined below, provide helpful indicators to predict patterns of behaviors and expectations set forth by the rhetorics of innovation as they unfold in a makerspace or hackathon. They also help provide some insight regarding behaviors, actions, and patterns occurring within the space—a way of understanding how certain bodies are restricted in their movement, while others are not (Ahmed 69).

AR has grown in popularity in the past decade with the release of consumer grade AR technologies and development kits. Augmented Reality technologies allow digital overlays to interact with users' physical environment/reality: "Augmented reality can be thought of as the blend, of the 'middle ground,' between the completely synthetic and the completely real" (Carmingniani). One of the earliest AR technologies include the "Cinema of the Future," *Sensorama,* which was conceptualized by Morton Heilig in the 1950s and brought to life in 1962. *Sensorama* sought to mimic the sensations conveyed on the film screen with the physical environment the viewer was sitting in. The idea was "to draw the viewer into the onscreen activity by taking in all the senses in an effective manner" (Carmingniani). Currently, sophisticated technologies in headwear such as Google Glass and Microsoft Hololens has allowed a consumer market to experience the

semantics of their physical reality with that of a digitally imposed one in a re-presented manner. While these headwear technologies are rife with high costs, AR has made its way onto the smart devices of millions of people. The popularization of AR entertainment such as *Pokémon Go* has introduced the possibilities and allure of AR for other applications beyond gaming (*Newstex*). Before examining the various components (hardware and software) that comprise AR and how they elucidate the shadow rhetorics of innovation, I want to delineate a key feature of AR that is not often discussed: affect.

Affect is a fundamental feature of augmented reality. To define affect, I will be drawing from several prominent affect theorists to offer a synthesized definition to frame this project further. The role of *feelings* is an apt starting point. Aristotle cites affect as "feelings that so change men as to affect their judgments, and that are also attended by pain or pleasure. Such their anger, pity, fear, and the like, with their opposites." Silvan Tomkins, in *Imagery, Consciousness, and Affect,* expands the concept of feelings by defining affect as a human's physiological response (*e.g.* shame, fear, disgust, or joy) that ultimately compels them to affix positive or negative values to persons or things (Tomkins 108; Ahmed 24). While Aristotle and Tomkins provide helpful starting points to conceptualize affect, I further build on their ideas by aligning affect with a number of affect theorists. In particular, I align the project with affect theorists, mainly Sara Ahmed, who conceive affect as a type of force: "as a way of talking about the margin of maneuverability. The 'where we might be able to go and what we might be able to do' in every present situation" (Massumi 4). With this definition of affect in mind, a differentiation between affect and emotions (which some theorists choose to use interchangeably) should be noted. Stanley Flatley in *Affective Mapping* discerns emotions

as sensations that happen internally and that tend toward expression, whereas affect indicates a force that is relational and transformative (12). Together, these evaluations help to make sense of how bodies gravitate towards objects, bodies, and spaces within an environment and how the shadow rhetorics of innovation operate (Ahmed 24).

The affective qualities of the rhetorics of innovation are propelled by forces to push and remove those that do not belong: "[Affects] involve the transformation of one's way of being in the world, in a way that determines what matters to one; affects require objects, and, in the moment of attaching to an object or happening in the object, also takes one's being outside of one's subjectivity" (Flatley 19). Popular discourses on innovation cultivate environments where women-identified makers experience a heightened awareness of themselves within tech environments. A type of out-of-body, third-person experience that reminds users of their out-of-placement (Ahmed). This hyper awareness of one's body in a space is a mechanism that is deployed to eventually push women out of the space: "An insecure person is like a weakened immune system, vulnerable to destruction from even a mild attack. If things are working out well, that initial lack of self-confidence is not too important: but if problems arise, the negative feelings come forth" (Etzkowitz, *et al.* 69).

Like AR that uses beacons as transmitters of information, so too does innovation have transmitters that push out information to women-identified users to both send messages to them about the environment and to affectively manipulate their navigation of their paths in an environment. Transmitters as Teresa Brennan notes in *Transmission of Affect* can take on the forms of bodies, spaces, and objects in a space. Technology affords a mediation of reality in a way that allows for distancing between oneself and their

subjectivity and positionality: “Virtual objects added to the real environment show information to the user that the user cannot directly detect with his senses” (Carmingniani, *et. al.* 2011). Particularly in the curious ways that Stanley Flatley cites Walter Benjamin, “experiences of affective attachments are interesting because they put us—precisely at those moments when we care most, we feel the value of something—‘outside of ourselves” (18). AR, unlike its kin virtual reality, allows users a foothold into their reality. The following sections focus on a functionality of AR and the shadow rhetorics of innovation respectively.

III. Mapping Innovation—Augmented Reality and Global Positioning Systems

This section outlines a critical component of innovation and augmented reality alike: global position system (GPS). In doing so, I will continue to fortify the relationship between AR as an extended metaphor of innovation and affect as a fundamental characteristic of innovation. A map is conventionally understood as a mechanism for a person to place themselves within a geographical landscape; a locative mechanism that provides perspective for persons to view and to navigate a region (more of this will be explored in Chapter Four). More so, a map allows users a way to see what is unseen or not experienced for them (*e.g.*, when I visit cities I haven’t been to, I rely on the spatial markings of a map for guidance): “That is, we develop our sense of our environments through purposive activity in the world, and we always bring with us a range of intentions, beliefs, desires, moods, and affect of attachments to this activity” (Flatley 78). Navigating through spaces occurs frequently throughout one’s day. Navigation is described in the spatial movement (*e.g.*, How do I get to work with this road detour?) and even in the emotional sense (*e.g.*, How do I plan for a difficult conversation with a

student?). Relating it back to women within technology spaces, affect guides decisioning in terms of how women choose to move in an environment. Like Ahmed mentions, affect allows a way for a woman to "feel her way" in her present world (12). It's a constant unfolding of world-making as she engages with the environment's bodies, space, and objects. While maps are static in the sense that a campus map itself doesn't change, the user and her lived experiences fundamentally alter the way the map is read. Mapping in this scenario may invoke the conventional features of a map, but aligns more accurately with Stanley Flatley's portrayal of maps[11]:

> I should perhaps reemphasize here that 'map' is meant in a particular, metaphorical sense, a metaphorics that I hope does not seriously limit the concept. The affective map, like Deleuze and Guattari's rhizomatic, is neither fixed or stable: 'the rhizome refers to a map that must be produced or constructed, is always attachable, connectable, reversible, and modifiable, with multiple entrances and exits, with its lines of flight. The tracings are what must be transferred onto the maps and not the reverse' (70).

Mapping is a prominent feature that AR and the shadow rhetorics of innovation both possess. The GPS component of AR is explained in Alan Craig's work "Understanding Augmented Reality: Concepts and Application" as: "[A] navigation system that utilizes a network of 24 satellites in outer space. The receiver can determine its location in X and Y if it can receive 3 satellites by measuring the amount of time it takes for the GPS signal to travel from the satellite to the receiver" (2013). It is a merging of both the physical and digital, that blends the user with the AR—a fluid relationship where the object with affect

[11] Flatley's conveyance of maps will further extend the theory of innovation in Chapter Four through analysis of the movements of students collaboratively creating in a makerspace.

producing the object become one (17). A map begets a level of trust by readers as it takes on the role as a reliable guide.

This project depicts how the shadow rhetorics of innovation influence the way women-identified users behave, act, and perceive themselves within collaborative learning environments. The mapping is gendered. Ahmed further notes this idea of mapping bodies as they are affectively manipulated in space:

> For bodies that are not extended by the skin of the social, bodily movement is not so easy. Such bodies are stopped, where the stopping is an action that creates its own impressions. Who are you? Why are you here? What are you doing? Each question, when asked, is a kind of stopping device: you are stopped by being asked the question, just as asking the question requires that you be stopped. A phenomenology of 'being stopped' might take us in a different direction than one that begins with motility, with a body that 'can do' by flowing into space (2007).

Innovation welcomes and privileges White, heteronormative, affluent men while, in turn, operating as an incessant stopping mechanism for women and especially women of color in tech-centric environments. Although it may seem benign, the act of being consistently stopped has material implications for women. In spaces that particularly value learning, collaborating, and intelligent risk taking, constantly being asked *who* and *why* you are in a space ultimately excludes and forces marginalized genders out of the environment.

IV. Affect Transmitters—The Use of AR to Make Gendered Realities Visible

Many AR applications use devices called "beacons" to push out or transmit information to users via their smart devices. According to *iBeaconInsider*, beacon technology "allows Mobile Apps to understand their position on a micro-local scale, and

deliver hyper-contextual content to users based on location. The underlying communication technology is Bluetooth Low Energy (BLE). [BLE] is a wireless personal area network technology used for transmitting data over short distances." The correlation between the transmission of data and/or affect to users is an apt corollary to understand how the shadow rhetorics of innovation operate for women participating in innovation spaces.

The beacons, foundationally, are transmitters of affect in the way it directs people to engage with other bodies, spaces, and objects within an environment. AR much like other graphical interfaces, gives us the ability to bring usable information and meaning in real time: "AR can also be used to augment or substitute users' missing senses by sensory substitution, such as augmenting the sight of blind users or users with poor vision by the use of audio cues, or augmenting hearing for deaf users by the use of visual cues" (Carmingniani). The positioning of objects impacts the sensory experience of persons; that is, objects, too, enact functionality that beacons have to restrict or promote motility (Ahmed 25). Objects in this context, are not conceptually relegated to physical objects, but extend to "styles, capacities, aspirations, techniques, habits" (Ahmed 154). A focus on an environment's bodies, objects, and spaces will serve as loci for discussion in the fourth chapter of this project.

When I claim that the rhetorics of innovation are broken, I am noting the limitations and departures that dominant conceptualizations of innovation fall short for women participating within innovation environments. This chapter brought together the dominant features of innovation (business, magic, and militarization) that emerged to make sense of the absences, the in-betweenness, the liminal, and the shadows of

innovation that continue to shape the lived experiences of women-identified makers in tech. The use of AR provided a generative metaphor to make sense of how the shadow rhetorics operate generally; however, it does not provide an in-depth conceptualization of the impact the shadow rhetorics of innovation have in specific locales. The next two chapters further explore innovation's shadow and fissures through the analysis of two case studies where the limitations of innovation are documented. That is, the next two chapters explore how the defects of innovation manifest in innovation spaces (in hackathons and makerspaces) for women-identified makers.

Chapter Three

CRUEL OPTIMISM: THE PROMISE OF INNOVATION & ITS AFFORDANCES FOR WOMEN

"For me, it is important to be able to code and discuss nerd things in an all-female/ female-dominated setting… [It] is very relaxing and empowering to not have to navigate gender bias and that feeling of not having to prove yourself as equal to men. It feels good to connect with other female nerds and women with similar interests."

"The STEM fields are traditionally seen as male-dominated fields and this discourages a lot of women from participating in them. This is why having a women's hackathon is hardcore as hell."

—Women Techmaker Tucson Hackathon 2016 Registrants

The opening epigraph is comprised of responses from the 2016 Women Techmakers Tucson (WTT) Hackathon Pre-Event Survey. The inaugural WTT Hackathon took place in the fall of 2015, and continues to be the only hackathon in the Southwest exclusively designed by and for women. In the survey, registrants responded to questions regarding innovation, their relationship to technology, and the importance of the "women's-only" feature of the hackathon. This pair of quotes sets the tone for this chapter. While Chapter Two outlined the shadow rhetorics of innovation (vis-a-vis the extended metaphor of augmented reality), this chapter will examine how the shadow

rhetorics of innovation shape registrants' perceptions of innovation and its associated affordances. As such, this chapter explores how women-identified participants navigate the contention between what they desire and what is possible as they engage in a women's-only hackathon, where the shadow rhetorics of innovation are readily present. Moreover, this analysis continues to engage the overall argument of this project: the rhetorics of innovation foundationally shape the socio-technical relationships women-identified makers develop within tech-centric environments. Such socio-technical relationships are critical in terms of discerning how an innovation space facilitates the motility or displacement of women from tech-centric, innovation environments.

The "shadow" in the shadow rhetorics of innovation refers to the "ways of understanding psychic formations, as well as their relation to political struggle that dominant epistemological paradigms fail to recognize" (Kucich 90). While the rhetorics of innovation extend a set of dominant characteristics that are compelling and persuasive (*i.e.* innovation as business, magic, and militarization), simultaneously the same rhetorics co-extend a set of characteristics that are not as readily visible. In turn, the shadow rhetorics of innovation highlight the silences, omissions, and aphasic features of innovation that exist alongside the *louder* features of innovation. Those former traits are at the forefront of this analysis. The shadow rhetorics of innovation are discourses most visceral and understood by persons (*e.g.* women-identified persons) who are not served or represented under the current paradigm of innovation. In this analysis, themes and patterns characterizing the shadow rhetorics of innovation are traced through an examination of registrant responses to the 2016 Women Techmakers Tucson pre-event survey. I consider participants' conjectures to make sense of how the shadow rhetorics of

innovation shape the participants' relationship to innovation and its assumed promises. Theoretically, the analysis is informed by affect theory and attachment theory jointly.

In the context of this analysis, cruel optimism and affect theory help to reveal how conceptualizations of innovation *move* participants to reflect, world-build, and forecast innovation's impact onto their lives. This chapter engages Lauren Berlant's theories on attachment, in particular her notion of cruel optimism. Affect and cruel optimism interanimate the engagement between a space, the objects, and users within an environment; they help to discern the symbiotic, socio-technical relationships of the women-identified participants and the objects in proximity to them in the hackathon:

> [A]ffect is found in those intensities that pass body to body (human, nonhuman, part-body, and otherwise), in those resonances that circulate about, between, and sometimes sticks to bodies and worlds, *and* in the very passages or variations between these intensities and resonances themselves. Affect, at its most anthropomorphic, is the name we give to those forces—visceral forces beneath, alongside, or generally *other than* conscious knowing, vital forces insisting beyond emotion—that can serve to drive us toward movement, toward thought and extension, that can likely suspend us (as if in neutral) across a barely registering accretion of force-relations that can leave us overwhelmed by the world's apparent intractability (Seigworth and Greg 55).

Lastly, while Chapter Two centers on the rhetorics of innovation in the past time frame, this chapter will center on examining rhetorics of innovation as conceptualized in the future. Moving from a high level purview of the shadow rhetorics of innovation to a more concentrated analysis, Chapters 3 and 4 will examines two case studies where the

shadow of rhetorics of innovation are more readily visible. Specifically, this chapter builds from the prior chapter by shifting the analysis on innovation from the past into a future time frame: how do registrants for the 2016 WTT Hackathon forecast innovation, and what are innovation's promises? In this analysis, the 2016 WTT Hackathon pre-event survey prompted participants to think of themselves in the future; that is, participants envisioned their future selves (often characterized as transformed or improved) at the end of the hackathon. In this vein, the objective of the analysis is to gain a deeper understanding of how the shadow rhetorics of innovation shape participants' perceptions of themselves, their imagined possibilities, and their relationship to innovation. Before outlining the findings of the analysis, I will provide context around the hackathon.

I. Affective Interventions: Hacking the Gender Gap in Hackathons

With the growing enthusiasm behind the Maker Movement in the mid-2000s, hackathons became prevalent in communities and universities across the United States. In 2015 alone, there were more than 1,500 hackathon events (Jones). Komssi *et al.* describes the typical hackathon as:

> A highly engaging, continuous event in which people in small groups produce a working software prototype in a limited amount of time. Hackathons, a portmanteau of the two words hacking and marathon, vary wildly in their purpose and execution but generally have a common structure and characteristics (60).

Hackathons emerged from Silicon Valley and have inherited several defining characteristics of that region. During a hackathon, participants may encounter investors, corporate sponsors, tech company recruiters, and product development practices from rapid prototyping to lean startup methodologies. The hackathon readily embodies and

inherits the culture from Silicon Valley (Jones). To further elucidate the design of a hackathon, I will be outlining one well-known hackathon in the Southwest: *Hack AZ,* Arizona's largest hackathon.

Hack AZ capitalized on the possibilities that innovation and technology can afford ("10 Questions About #HackArizona"). From launching a startup, to meeting angel investors, to creating the "next big thing," *Hack AZ* participants were compelled to try their hand at building out their ideas and to win project prizes. *Hack AZ* started in 2014 and has attracted 500+ students from Northern Arizona University, Arizona State University, the University of Arizona, and from several universities in Mexico. In terms of participant demographics, the event was open to undergraduates and graduate students across disciplines. Students interested in the event submitted applications to participate in the event. The application was a critical procedure in that it elicited basic participant information such as name and major, while also asking participants to disclose their technical know-how. From participants' responses, organizers were able to determine a participant's fitness for the event. If a student was accepted into the hackathon, they were invited join to the three-day hackathon that took place in the University of Arizona's Science-Engineering Library.[12]

The excitement during *Hack AZ* is undeniable. Students shuffle into the library with pillows, hardware, energy drinks, and sleepwear tucked in their arms. Once in the library, participants scattered to different sections of the library to stake out spaces that they will use to work and to ultimately transform into makeshift sleeping areas. As a participant, I too, was in awe of the electricity and possibility that the event could afford.

[12] In order to accommodate the several hundred participants, the entire library was closed to the public and to students not attending the hackathon.

The sound of project teams forming, the flurry of sticky notes being pasted onto walls, the sound of markers hitting white boards with the scribbles of half-baked ideas, and the chatter between corporate sponsors/mentors and up-and-coming tech talent comprises the soundscape for a conventional hackathon. I remember being especially surprised when I witnessed several company sponsors conduct on-the-spot interviews with participants for openings in their company. While I was surprised by the hackathon happenings, I was also stunned by something that was discernibly missing.

I immediately became aware of the gender disparity among participants. Amidst the event chaos, I remember looking around the first floor of the library and thinking: where are the women? *Hack AZ* aimed to attract as many student innovators from the Southwest as possible, but unfortunately was lacking women. If participants were ostensibly involved in future world-building, what does it mean when women were not involved in that process? What does it mean to center an event around innovation and innovators with a small percentage of women-identified participants? What does it mean for budding women-identified participants to join a tech event where the organizers, speakers, sponsors, and participants are predominantly men? Moreover, not only were women underrepresented in an event centered around future world-building, but they were inadvertently missing out on opportunities emerging from the hackathon such as networking with other techies and community members, making tech projects, and even landing a job. My *Hack AZ* project idea clearly manifested at that moment: I was going to hack the hackathon.

I decided to radically change the model of the hackathon to create space to center the voices, knowledges, and lived-experiences of women in tech-centric making and

hacking processes. The inspiration behind the WTT Hackathon stemmed from my familiarity with *LadyHacks*, a Philadelphia-based organization that has been hosting women-only hackathons since 2013. Their rationale behind a women-only hackathon was to "Provide women who are new to software development a welcoming environment in which they can get their hackathon feet wet, understand that it isn't a scary place, and that, yes, they DO have the skills that are useful and necessary to participate in these types of events" (*Ladyhacks*). As the lead organiser for the women's hackathon, an avid hackathon goer, and as a scholar of critical maker culture, I pulled together these various knowledge and experiential domains to think through the intimacy of bodies, spaces, objects within a hackathon environment. The project was informed by my experiences, interests, and notably my frustration as a woman of color in tech environments. As a result, I wanted to affectively "hack" the hackathon.

II. Cruel Optimism and the Affective Transmission of Innovation's Promises

How do women-identified persons negotiate the possibilities and foreclosures of innovation? One key factor is optimism. Explicitly invoking attachment and affect theory, I draw from Lauren Berlant's theory of cruel optimism to identify the destructive attachments the women-identified registrants affix to objects and objects of desire associated with the 2016 WTT Hackathon. Cruel optimism serves as the theoretical thrust for this chapter's examination of innovation in the future time frame. Berlant defines these damaging attachments this way: "[a] relation of cruel optimism exists when something you desire is actually an obstacle in your flourishing. It might involve food, or a kind of love; it might be the fantasy of the good life, or a political project" (1). In the context of the hackathon, participants formed several attachments to the possibilities and

transformative potential of their potential selves post-event. Despite the conventional hackathon's routine demonstration of gender disparity and biases in tech, female participants often choose to attend them anyway because they are optimistic about the outcome, namely that the event will draw them closer to their desired future state (Berlant 23). The desire to learn how to code was a popular aspiration share among a majority of WTT 2016 registrants. Participants' hopes and desires for the hackathon, as undergirded by cruel optimism, will be further outlined in the forthcoming analysis that focuses how affect interanimates participants and the objects within the hackathon. There are two data points from the 2016 WTT Hackathon pre-event survey that contextualize the respondent population and their forecasting of the desired results they hoped to achieve.

In line with cruel optimism, I posed several questions in the 2016 WTT Hackathon pre-event survey that asked registrants to express their personal goals for the event. Specifically, below is a graph that speaks to a survey question that asks participants to think about some skills or competencies they hope to achieve. Participants

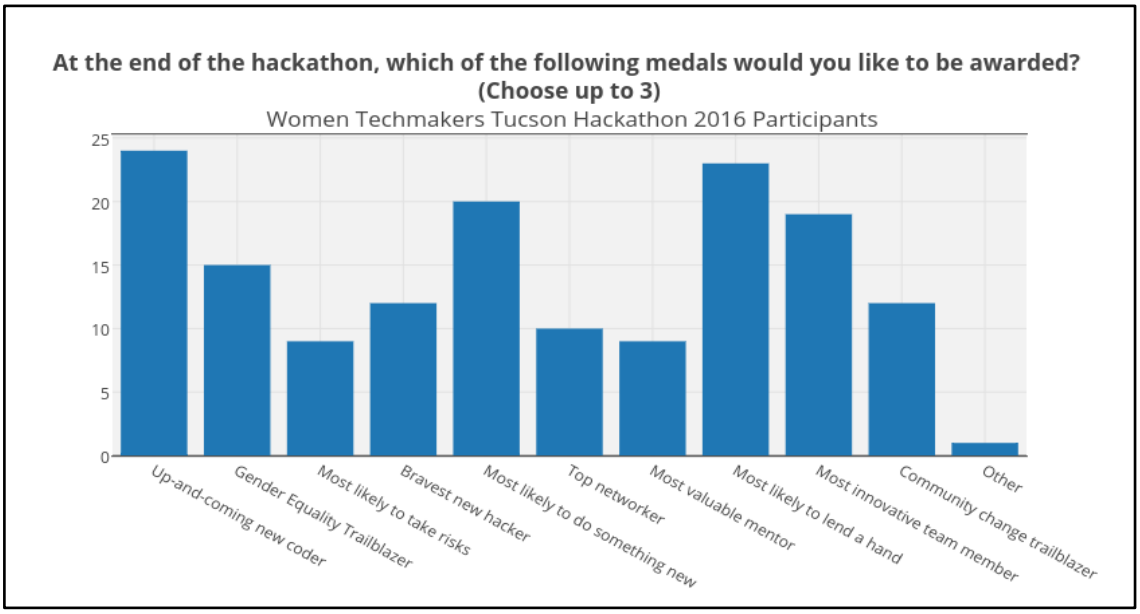

Figure 1- At the end of the hackathon, which of the following medals would you like to be awarded? (Survey Question 12); n = 64

were asked to identify three hypothetical medals they would like to earn after completing the hackathon. The data reveal three prominent aspirations projected by participants:

- To begin and/or continue learning how to code ("Up-and-coming new coder");
- To step out of one's comfort zone ("Most likely to do something new");
- To be a collaborative and productive team member ("Most likely to lend a hand" and "Most innovative team member").

Registrants' responses aligned with Berlant's notion on attachment and, in this context, participants are drawn to the affordances of innovation as framed by the hackathon. Registrants' desires represented both objects (*e.g.*, create a video game with *Unity 3D*) and objects of desires *(e.g.*, be a valuable team member on a project). A hackathon was perceived as a space where a participant's tech aspirations could be fulfilled. Participants bundled their desires and place them on top of the altar of possibility: "When we talk about an object of desire, we are really talking about a cluster of promises we want someone or something to make to us and make possible for us" (Berlant 23). It is difficult to form deep and meaningful collaborations or learn how to code over the short span of two days. However, despite these realities, participants' desires endured nonetheless. Berlant identifies this contention amid ineffectual realities and desired results: "irrational attachments to results are less about the futility of an outcome, and are more so about 'an explanation of our sense of endurance in the object" (27). Despite the clear shortcomings of the 2016 WTT Hackathon and the impracticability of many of the desired outcomes identified, registrants continued to endure in the concept of innovation and in the possibilities of the hackathon.

In addition to participants' desired outcomes of the hackathon, another generative data point that emerged from the survey responses were the self-perceptions registrants had of their relationships with technology. Registrants' self assessments offered a glimpse into their past interactions, whether positive and/or negative, with technologies. In particular, one question pointedly asked participants to choose which descriptors best described them pre-hackathon.

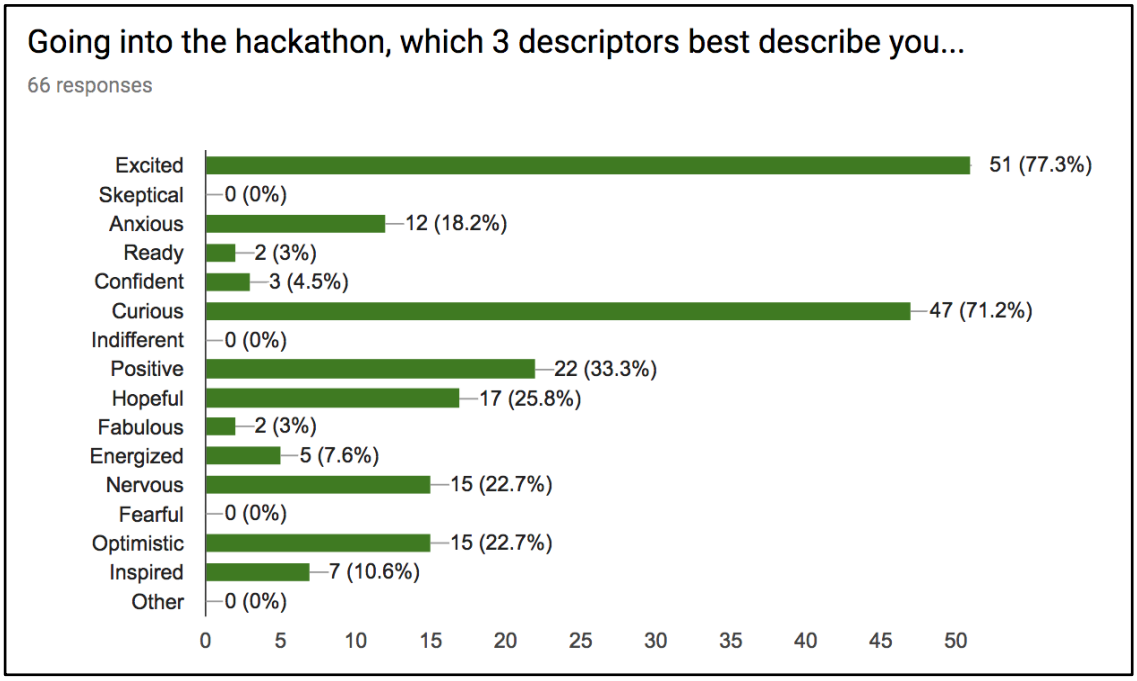

Figure 2- Going into the hackathon which 3 descriptors best describe you? (Survey Question 9); n = 64

The data shows that the two main characteristics were "Excited" (77%) and "Curious" (71%). The descriptor "excited" was not too surprising as many feel excitement and look forward to events they are interested in. "Curious," on the other hand, was a surprising descriptor that distinctively exemplified cruel optimism.

Researchers have defined "curiosity" as the desire to learn what is unknown, a desire that is both dangerous and helpful (Kang *et al*.). In the context of the 2016 WTT Hackathon, the event presented both a gap and bridge that could either bring participants

closer or farther away from their desired outcomes: "curiosity arises from an incongruity, or information gap—a discrepancy between what one knows and what one wants to know" (Kang *et al*.). I saw the hedging that came along with the high levels of curiosity.[13]

As the lead organizer for the event, I conversed with participants who were interested in attending the hackathon, but were unsure about their fitness for the event. I observed registrants trying to secure an escape if the hackathon did not meet their expectations. Returning to Berlant, it is evident that cruel optimism is at work in this context: "To understand cruel optimism, therefore, one must embark on an analysis of indirection, which provides a way to think about the strange temporalities of projection into an enabling object that is also disabling (25)." I received several emails and have engaged in several in-person conversations in which participants ask whether they (a) need to stay for the entire event, (b) could just 'check things out' and leave if need be, and/or (c) could participate without technical expertise. The self-description of curiosity, from my experience, offered participants a way to back out of the event without dispelling emotional or physical labor.

Curiosity, by the same token, also asks for a certain type of invitation to be treated in a certain way: I don't have to be an expert level of something, but I could be swayed either in a way that I could be encouraged to learn more, or, in another vein could be dissuaded from pursuing this unknown terrain. George Lowenstein, a prominent scholar on curiosity studies, notes the decisioning processes stemming from curiosity: "Curiosity poses an anomaly for rational-choice analyses of behavior that assume that the value of

[13] Compounding curious was "Hopeful," a characteristic that resounded with 25% of respondents. "Hopeful" holds both interest and caution simultaneously—an explicit acknowledgement of the possibilities for growth but also for self-degeneration.

information stems solely from its ability to promote goals more basic than the satisfaction of curiosity" (Lowenstein 1994). The following paragraphs will explicitly outline participants' responses to the hackathon in conjunction with the affective interventions integrated into the WTT Hackathon; however, some context relevant to the analysis (*e.g.*. a list of all of the survey questions) and data contextualization are outlined first. The next section in this chapter will outline the data collection and analysis processes of the surveys from the WTT Hackathon. Moreover, it will continue to participate in the larger argument of this project: to make sense of how the dominant conceptualizations of innovation shape the socio-technical relationships of women-identified participants in tech-centric environments.

III. Data Collection: 2016 WTT Hackathon Pre-event Surveys

2016 WTT Hackathon participants were asked to fill out a pre-event survey as part of the registration process. The survey allowed me, as both the lead organizer and researcher, to obtain data on participants' perception of themselves, innovation events like hackathons, and on the possibilities and fortifying discourses surrounding innovation.[14] The timing of the survey's distribution was critical. The survey aimed to capture participants' perceptions and forecastings of innovation pre-event. For many participants, 77% to be precise, this was their first hackathon—a detail that made the data especially important considering that they were basing their perceptions on what they know (or don't know) about hackathons and assumptions. The majors, for those enrolled in an undergraduate or graduate program, spanned 20 different disciplines including journalism, computer science, retail and fashion sciences, and English.

[14] While the pre-event data offers interesting insight regarding participants' lived experiences and how such experiences are illuminated by discourses of innovation, post-event data weren't captured to measure whether the event had fulfilled the expectations of the participants.

Participants either completed the surveys before they arrived at the event, or at the registration table the day of the hackathon. Several weeks before the event, a Google *Form* survey was circulated to all participants. Participants were encouraged to fill out the form prior to the event in order to reduce the time it took to register on site, and to allow enough time for them to consider and form responses to the questionnaire.[15] If participants didn't fill out the form, they were asked to complete it the day of the event (we had a row of laptops available on a nearby table for participants to use). Of the 113 participants who attended the event, 66 completed the pre-registration survey—64 respondents allowed me to analyze their responses and write about them. Below are the pre-event survey questions. Asterisks indicate that the question had a required response.

- *Name (text field)
- *E-mail address (text field)
- *Current sex and gender identification: (checkbox)
    - Female
    - Male
    - Feminine
    - Masculine
    - Gender non-conforming
    - Option(s) not listed
- *If you selected "Option not listed" please specify here. (Text field)
- *Classification: (checkbox)
    - High school student
    - Undergraduate
    - Graduate
    - Faculty and/or staff
    - Professional
    - Member of the community

[15] This is an important note to consider—since participants may have been in a rush to begin the event, some of the responses may not be as well articulated or thought out. Some responses, in fact, answered in a terse manner.

- *Major and/or department (please type “N/A” if this question doesn’t apply) (text field)

- *Have you participated in a hackathon before? (checkbox)
    - Yes
    - No

- *What do you personally hope to get out of this hackathon? (text field)

- *Going into the hackathon, which 3 descriptors best describe you? (checkbox; up to three descriptors can be chosen):
    - Excited
    - Skeptical
    - Anxious
    - Ready
    - Confident
    - Curious
    - Indifferent
    - Positive
    - Hopeful
    - Fabulous
    - Energized
    - Nervous
    - Fearful
    - Optimistic
    - Inspired

- *Hackathons are typically dominated by men. In your opinion, why don't more women attend hackathons? (text field)

- Which of the following descriptors best describe your relationship working with technologies and technical skills? (check all that apply)
    - Early adopter
    - Fearful
    - Curious
    - Under confident
    - Expert
    - Confident
    - Anxious
    - Educated
    - Tinkerer
    - I avoid technology at all costs
    - Fascinated
    - Confused
    - Reluctant
    - Willing to learn something new

- *At the end of the hackathon, which of the following medals would you like to be awarded? (Choose up to 3) (checkbox)
    - "Up-and-coming New Coder"
    - "Gender Equality Trailblazer"
    - "Most Likely to Take Risks"
    - "Bravest New Hacker"
    - "Most Likely to Do Something New"
    - "Top Networker"
    - "Most Valuable Mentor"
    - "Most Likely to Lend a Hand"
    - "Most Innovative Team Member"
    - "Community Trailblazer"

- *Rate the importance that technical skills (*e.g.*, knowing how to code) play in a woman's ability to lead a successful life. (1-5; 1 = not important at all, 5 =incredibly important)

- *Please comment on your chosen rating above? (text field)

- *To what extent is having this a women's-only hackathon important? (text field)

- *I authorize the organizers of the Women Techmakers Tucson Hackathon to use my comments/answers anonymously in reports and research. (checkbox)
    - Yes
    - No

The verbiage on the event website is important to note because it communicated the logistics of the event and inadvertently shaped participants' expectations. In many ways, especially for the 77% of participants who never attended a hackathon before, their responses to the pre-event survey emerged from their past experiences working with tech, their understandings of hackathons, and what they had learned about the 2016 WTT on the Hackathon website. In terms of the "messaging" of the event and how it was marketed, all promotional materials pointed back to the website that outlined the following: the event code of conduct, event schedule and workshops, frequently asked questions, organizing team, past event photos, and a contact form. On the landing page of the website, the following verbiage welcomed participants:

> Google *Developer Groups, Code for Tucson*, and *UAZ Libraries* are proud to present the 2nd annual Women Techmakers Tucson Hackathon from October 22 - October 23 at the University of Arizona's Science-Engineering Library. Join us for a weekend of food, fun, learning, and hacking! We are proud to offer a diverse set of workshops and childcare for participants during workshop hours. This free event provides an opportunity for participants of all levels of technical expertise to collaboratively develop tech-driven projects over the course of two days. *All are encouraged to attend — no computer programming experience required.* Projects are never built by ones and zeros alone — designers, product managers, community organizers, writers, and YOU are very much welcome!

As noted, the pre-event survey was crafted with a keen focus on registrants' forecasting of innovation in relationship to the intimacy of bodies and objects evident in the hackathon. In the forthcoming sections, an analysis of innovation's promises will be situated within the "shadows" of innovation. The 'affect reality' of the hackathon, signifiers comprising the hackathon (bodies and objects), were examined as interanimate catalysts that disrupted ideas and expectations of a conventional, male-dominated tech event. The implications of the women's-only design feature of the event (in terms of participants' perception of innovation) will also be further outlined.

IV. Innovation Beacons: Affectively Augmenting the Hackathon

Augmented reality, as previously outlined in Chapter Two, affords a framework to visibilize the shadow rhetorics of innovation, and a way to analyze how the presence of certain bodies (*i.e.*, assumed-to-be male bodies) may become a signal and source of information for users (*i.e.,* othered genders) in proximity. Users' navigation of AR-

enhanced environments is configured by a host of agents including beacons that transmit information to users in real time. Like the United Kingdom's Gatwick Airport that uses beacons to transmit information to users in order to direct them to their terminals with digitally imposed arrows and notification on their smart devices, bodies, too, are persuasive mechanisms that work to shape users' paths and (dis)engagements within a space (Owen); the WTT Hackathon aimed to superimpose, and explicitly direct how participants viewed and navigated the event. This section explores the displacement of male-assumed bodies from the hackathon space to engage affective possibility. What are the affective possibilities in a tech event where male-assumed bodies are not present? Focusing on who was welcomed to the event was a way for event organizers to affectively and deliberately intervene in the gendered politics of hackathons and the domination of the White heteronormative constituencies who often organize such events. Foundationally, the WTT 2016 Hackathon organizers intervened with the affective design of the traditional hackathon: "Censuring affect is a discursive technology of power that depends expressly on whether different inflections of affect (or lack of affect) are used to promote, negotiate, and challenge conditions of dominance" (Tomlinson 57). In other words, the body, in some ways, functions as a beacon.

By framing the body as a beacon of information, the messaging of the WTT Hackathon aimed to send a clear signal with the absence of male-assumed bodies: the event was for women-identified attendees to collaborate with women-identified participants using tech in a space where hostility, harassment, and discrimination are not tolerated (Melo). For some folks, the "women-identified" phrasing was unclear or

unfamiliar. In response, the event organizers added the following verbiage to the event webpage that was crafted by one of the co-organizers, Maria Steinrueck:

> We welcome anyone who identifies as female or feminine of center, including cis and transgender, intersex, non-binary, and genderqueer people. Any skill level. We want you to focus on hacking, coding, learning, and having fun! Therefore we aim to provide an inclusive space for female and feminine-of-center folks across lines of race, disability, class, and skill level. If you have any concerns, questions, or need special accommodations, please don't hesitate to contact us. While we do welcome our younger hackers to attend, anyone under the age of 16 must be accompanied by an adult.

The subtext of this messaging is made explicit in participants' responses in the pre-event survey. A few questions were crafted specifically to inquire about the impact of bodies and how that would change environments, and spoke to the impact men have instilled in these environments.

"Hackathons are typically dominated by men.
In your opinion, why don't more women attend hackathons?"

The presence of a male body in an innovation environment signals pain. While this question inquired about the underrepresentation of women in hackathons, it also prompted participants to reflect on and explain why they thought this was the case. The male body was front and center in their responses. Sara Ahmed notes the affective qualities certain bodies possess and trigger in others: "Of course, within feminism, some bodies more than others can be attributed as the cause of unhappiness" (67). For these reasons, this hackathon welcomed participants who identified as women because for a population of women, male bodies were the sources of unhappiness and discomfort.

Upon analyzing the responses to this question, participants noted the exclusionary behaviors they experienced in tech events such as "getting shouted down by boys," or being "pushed aside by men," or, because as one participant notes, "in my view, many men are not that welcoming and inclusive towards women." These responses should not be taken lightly. These women have learned about tech environments and experiences not only through the transmission of information (*e.g.*, how to navigate a space), but also from pain.

The male body interanimates sensations of pain in innovation environments: "[P]ain sensations might rearrange bodies…. So the experience of pain does not cut off the body in the present, but attaches this body to the world of other bodies, and attachment that is contingent on elements that are absent in the lived experience of pain" (Ahmed 28). Participants' responses make it clear why having a space for women-identified participants would be critical and attractive for the learning and collaborative environment. It is an appealing environment that is both physical and psychological. The phrasing "safe space" or "comfortable space" came up multiple times in response to the importance of women-only events question on the pre-event survey. Of the 64 responses to the question surrounding bodies, moreover, there were two related themes that emerged in response to the underrepresentation of women in hackathons: deficiency and socialization. Yet where do these preconceptions of the abilities of certain genders stem from?

Bodies come with histories, including scientific ones that are infused in the rhetorics of innovation roots, and that seek to divide and control what male-assumed persons and female-assumed persons are expected to do with innovation events:

> Gender differences: real, imagined or created? All the arguments or assertions seen so far involve the claim that women are different from men. The difference, it is claimed, is grounded in "nature," whether interpreted in terms of biology (Aristotle), environmental abilities (Hume, Kant, and James), or brain size (craniologist). Such natural differences were used to define what women could and could not do, and what they should or should not do. (Frize *et al.* 47).

23 of the 64 responses pointed to a "lacking" stemming from women. Women lacked a familiarity of tech events, or fell short with the needed confidence, or could not contribute to a project because they had little technical expertise. Bodies of knowledges possess epistemologies that have shaped how participants navigated the women's hackathon: "As pain sensations demand that I attend to my embodied existence, then I come to inhabit the services of the world in particular way. The tingles, pricks and then cramps return me to my body by giving me a sense of the edge or the border, a sense that it's an experience of intensification and a departure from what is lived as ordinary" (Ahmed 27). Participants noted varying "bodies" of influence that carry rhetorics of innovation that dictate how they've come to understand or interact with technology (Schiebinger 14). The following responses seen below speak to the socialization and how it engages the gendered expectations of female-assumed and male-assumed hackathon participants. Even more important, is the outline the affective dis-ease that male-assumed bodies have impressed and interanimate into innovation environments like hackathons. Below are response entries from registrants that speak directly to socialization as framed by the dominant rhetorics of innovation:

- Socialization; women hesitate to go into male-dominated spaces (>80% men); fear of being judged; negative experiences (harassment/fear of being objectified/reduced to your gender identity); as a woman in tech you first have to prove yourself in order to be accepted.
- Technological fields are often dominated by men/men are encouraged to participate through socialization. Women are less so. It doesn't always feel like a space that's welcoming and/or for learning.
- [A women's-only hackathon] creates more of a welcoming environment! I have nothing against men being in hackathons, but there has been so many generations of intellectual oppression that I think I kind of subconsciously default to the technical opinion of a male because it's been ingrained in my head that "boys are better at mechanical things." Even though I know that's not true, I have heard it so many times throughout my life that it's hard to erase that from my psyche. I want to see women be at the forefront of the hacker world, because I think that we have a lot to offer. I want for women who are technically-inclined to feel that they can succeed in STEM fields because they are smart and capable, not because a manager was impressed by her womanly presence in an office or lab full of males.

These responses suggest that the male body is received as a painful signal to many of the WTTH's participants. The presence of male-assumed bodies evokes a clear message: you do not belong in this space; stay and subject yourself to pain and the perceived recognition of your shortcomings. This serves as a reminder of their assumed deficiency, subordination and, importantly, that their bodies do not belong in the space.

While one may think that a women's-only hackathon would be free from the affective dis-ease that comes with the historical and gendered oppression in tech, however there are other variables of unbelonging that comprise the hackathon space. A women's-only hackathon means that women could become productive and confident participants, correct? By removing male-assumed bodies, ostensibly the idea is that these anxieties and negativity would be removed as well; however, it is more complicated. It is neither the tool nor the person, but the socio-technical dynamic that comprises the affective relationship between the two that could ultimately liberate an innovation environment (and its users) from its inherently oppressive structures.

V. Advice for Future Women Techmaker Tucson Hackathon Participants

The shadow rhetorics of innovation in several ways represent the invisibility and underrepresentation of women in innovation environments. Women have been eclipsed in the histories of innovation breakthroughs, in their technical competencies, and in the dominant rhetorics of innovation that shape the very social and technical relationships that shape tech spaces (Schiebinger; Hicks). In this analysis, the shadow rhetorics of innovation reveal the silences, omissions, and aphasic features of innovation that exist alongside the dominant conceptualizations of innovation. These shadow traits were emphasized in this analysis, as registrants for the 2016 WTT Hackathon described and responded to their relationships to technology and innovation. And while a post-event survey wasn't administered, I want to end this analysis with the advice that participants offered to 2017 WTT Hackathon participants.

At the end of the Women Techmakers Tucson Hackathon 2016, participants were invited to share a piece of advice for first-time participants for the next hackathon in

2017. Participants had experienced an array of experiences over a period of 48 hours that ranged from attending workshops on 3D or building drones, to collaboratively coding and hacking alongside other women, to sharing a meal or watching their kids or grandkids play with other participants' children. The notes were written on individual sticky notes, and were gathered at the end of the event:

Table 2: Advice for Future Women Techmakers Tucson Hackathon Participants
"Put yourself out there and try something new! You won't believe what you'll learn! < ♥ >"
"Stay for the hackathon, even if you don't think you have skills, experience, etc., to share."
"Don't be afraid to raise your hand and participate!!!" (Has an image of a woman stick figure flying a drone with the words "fly a drone!" underneath the image)
"Don't be afraid to try something out. Just do it!"
"Don't be scared to try new things that you don't know anything about"
"Don't be intimidated. You will be useful somewhere!!"
"[N]o one knows everything, so this is a cool opportunity to trade knowledge w/ fellow strong women! <3"
"Try something even if it seems impossible"
"Definitely try to execute plans as soon as possible."
"Make sure you pre-install any program needed and make sure they run, so you can get the most out of the workshops."
"Come in w/ open mind & open expectations"
"Just give you a chance, from anywhere you are, your age, your gender, your… anything. Just give you a chance and you will be a witness about how great you are! PLEASE!"
"BE WILLING TO LEARN." (Has a light bulb drawn on it)
"Bring a laptop, or check one out from the library before the event starts."
"Find a team to collaborate with. Find people from different backgrounds and passions."

“Spend 95% planning, 5% executing. Having a clear practical plan is important, best of luck ♥□”
“Come with an idea in mind—but don’t be too set on it!”
“Don’t be scared to pitch an ambitious idea, even if you don’t have much/ any coding/programming experience—people will join you & the organizers will help!”
“1. Have a clear and common goal. 2. Know how much time and energy [each] person is willing to dedicate. 3. Create an outline, ✓list & stick to it.”
“Never give up. Keep trying! Keep pushing yourself one step further!”
“Be flexible—be willing to reduce size of the project to get it done.”
“If your team is too big, it will be hard to focus on a project”
“No idea is too big and no idea is too small”

The sticky notes are interesting not only because of the advice written on them, but also because it visibilizes their preconceptions of innovation as it is coupled with their past lived experience engaging in an event centered around innovation. That is, many of these pieces of advice encourage participants to refute conceptions, their own assumptions of the hackathon. While the previous chapters discussed past conceptualizations of innovation of the Silicon Valley stripe, this chapter makes visible the contention between what’s expected and the outcome.

These pieces of advice build from past popularizations of innovation, to an examination of innovation as it is visualized or forecasted in the future: “The very existence of fears and anxiety become a sign of the time, characterized as they are by rapid transformations and innovations, which have not only eroded old structures and values, but have also led to feelings of loss of control and loss of certainty about the future” (Ahmed 72). The previous chapter outlined popularized and current conceptualizations of innovation and how they, in turn, impact the way discourses of

innovation have set the expectations and representation of who innovates, what's considered innovation, and how one behaves in an innovation space. This chapter gathered further insight on conceptualizations and perceived affordances of innovation through the way it is envisioned from the perspective of a group of women participating in an innovation event. Together innovation is talked about, with, and against, allowing for a clearer grasp of the way innovation shapes the confidence and expertise of women-identified makers and the bodies, objects, and spaces in proximity to them. While the women's hackathon continued to meaningfully shape women-identified participants' interactions with technology, having it a women's-only event is arguably limiting in terms of striving for achieving technical confidence and expertise in current socio-political tech environments where the White, heteronormative, and affluent status quo is highlighted.

Chapter Four

AFFECTIVE & SPATIAL MAPPING OF INNOVATION IN A MAKERSPACE

"*The biography of a person is intimately bound up with objects.*" -Sara Ahmed

While spatial maps illustrate the layout of an environment, they do very little in terms of predicting how people will navigate a given space. Specifically, for a collaborative learning space, the spatial layout of the environment (*i.e*., where technologies and furniture are arranged) does not forecast a complete picture of how participants will interact within the space, with its technologies, and with other makers in the environment. Even more telling than spatial maps are the maps that people create unwittingly within a collaborative learning space. While the spatial layout of a room remains relatively static, I'm reminded of the social and very much personal and dynamic dimensions that a person brings to a space. Teresa Brennan in *The Transmission of Affect* makes a claim regarding the "atmosphere" of a room by noting that "the affect in [a] room is a profoundly social thing" (68). Simultaneously informing the physical map are the affective maps that makers chart in the collaborative learning space—each person brings with them their own subjectivities, experiences, and beliefs that inform their decisions around how they engage (or do not) with the space. In *Affective Mapping,* Stanley Flatley notes: "In the context of geography and environmental psychology, the term affective mapping has been used to indicate the affective aspects of the maps that guide us, in conjunction with our cognitive maps, through our spatial environment" (77).

Together, the spatial and affective maps will be placed in dialogue around conversations on collaborative learning spaces and gender identity.

In this chapter, I explore the tension between cultivating inclusive Makerspaces and the inherent gender biases rooted in the configuration and conceptualization of the Makerspace.[16] In doing so, I will be investigating how the shadow rhetorics of innovation become pronounced in tech-environments that are often male-dominated. In order to contextualize the analysis, I outline an institutional review board (IRB) approved pilot study that I conducted. The pilot study took place in the iSpace, where I observed the real-time making processes of twenty-nine participants. The pilot study examined the relationship between gender identity and the decisions participants made in terms of how and why they navigated a Makerspace in a specific way. The guiding question for the pilot study centered on gender and technology: "How does gender identity impact the way students engage with the technologies in the Makerspace?"[17] Doreen Massey in *Space, Place, and Gender* highlights the contention amid space and gender: "The limitation of women's mobility, in terms of both identity and space, has been in some cultural contexts a crucial means of subordination. Moreover the two things—have been crucially related" (179). The spatial map of the affective maps (charted by the participants) of the collaborative learning space are jointly analyzed to gain insight on how the various technologies in the space affectively signaled whether and which particular genders are welcomed and encouraged to use the space. The study had two parts: the actual observation of collaborative making and a post-observation survey.

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[16] Makerspace with a capital "M" signifies a branded collaborative learning space that is heavily inspired by the technologies and maker ethos of *Make:*.

[17] This pilot study served as a generative site to think through the possibilities for a future project that has a significantly larger sample size and a more precise survey instrument.

Throughout the analysis, this argument is centralized: the desire for inclusive Makerspaces is not substantial enough to drive material changes in such environments; in order to cultivate more diverse and equitable Makerspaces, critical and affective interventions need to occur on a systemic level.[18]

This chapter continues to explore the shadow rhetorics of innovation with a focus on the ways a Makerspace orients bodies within its space through an examination of the intentional arrangement of technologies and objects. Such ideologies informing the Makerspace shape not only the configuration of technologies in the space, but also how bodies are oriented in the space. I explore the rise of the Makerspace as a prevalent innovation environment, with a close examination on the impact that the integration of Makerspaces have on re-defining the assumptions, beliefs, and values around understandings of making. In particular, there are two theories that serve as the foundational frameworks advancing my analysis.

Sara Ahmed's notion of how bodies are oriented within a space will be placed in conversation with Stanley Flatley's conceptualization of affective mapping. Together, these two theories help to make sense of how participants in the pilot study "feel [their] way" through and within a makerspace (Ahmed 12). Ahmed's work enriches Flatley's ideas of affective mapping through her consideration of how affect both *makes* and *shapes* bodies as "forms of action, which also involved orientations towards others" (4). Flatley, in turn, homes in on values and beliefs that people carry and embody within environments, that in turn influence how they orient themselves in a space: "[W]e develop our sense of environments through purposive activity in the world, and we

[18] The primary focus of this chapter is to critique and to examine the gender biases ingrained within the Makerspace.

always bring with us a range of intentions, beliefs, desires, moods, and affective attachments to this activity" (77). Before outlining the study, its components, and the preliminary findings, I offer context around the exclusive configuration of the Makerspace.

I. Exclusive by Design: Critical Innovation and the Rise of the Makerspace

Over the past few years, I have collaborated with several academic units to help them design and launch their collaborative learning spaces. One of their immediate design concerns is legibility: how do they design their space so that it reads as a Makerspace? On numerous occasions, I have been asked a question to this effect: "If I have a 3D printer in a room, is that room a makerspace?" As an inveterate maker, I respond by affirming that any space where any type of making, creating, or ideation occurs *is* a makerspace. I also note that their idea of a collaborative learning space, too, aligns with Dale Dougherty's goal to create collaborative tech-centric learning communities.

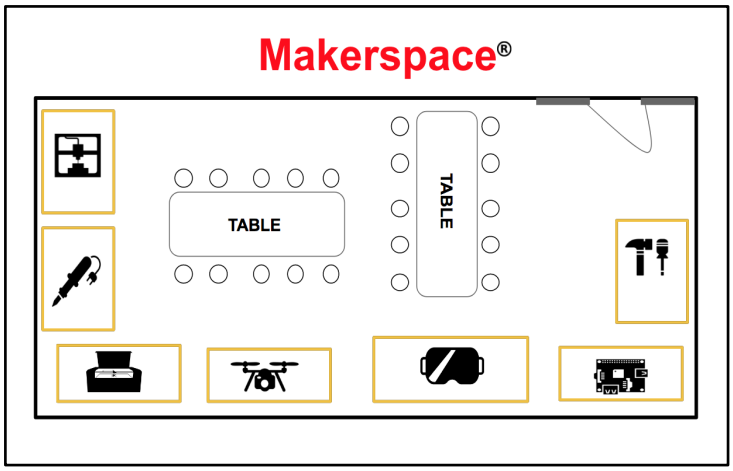

Figure 3- A sample layout of a Makerspace and its accompanying tech stations

However, and as I explain to colleagues, a room with a 3D printer (or any technology for that matter) is not a Makerspace as conceptualized and advertised by *Make:*. The Makerspace is a particular configuration that emerged from the Maker Movement. A Makerspace emerges from the collective arrangement of these specific technologies within a space.

This section will focus on the Makerspace as a configuration of these technologies, but more so will address the ideological implications, shadow rhetorics of innovation, that Makerspaces advance by design. Moreover, the physical entities within a Makerspace do more than just offer "Makerspace" legibility in an environment; they also inadvertently extend a set of beliefs, values, and assumptions around who can make, why making occurs, and what counts as making in the Makerspace. Over the course of a decade, *Make:* has featured a set of recurring technologies that now operate as markers of a Makerspace environment: fabrication machines (3D printer and laser cutters), robots, drones, virtual reality devices, and open-platform microcomputers. These are Makerspace staples. Individually these technologies do not mark an environment as a Makerspace. Such ramifications will be placed in conversation with a central concern numerous Makerspace managers, librarians, faculty, and administrators are grappling with: the underrepresentation of student communities, most notably women, in their collaborative learning spaces.

The design of the Makerspace is not neutral. The spatial design of the Makerspace continues to exacerbate the underrepresentation of women in Makerspaces (Bean 61). The popularization of Makerspaces raises concerns around the set of beliefs, assumptions, and values that are inadvertently embedded into the physical Makerspace

environments across the United States. According to *Popular Science,* as of 2016 there are about 1,400 Makerspaces globally—each of them bearing an exclusive strand of making ideologies that stem from Silicon Valley. Notably, there have been concerns around equity and gender representation in Makerspaces. While many scholars and advocates have called for more women in the spaces, for more technical training for women, or to fix the 'pipeline' issue, I call for a close examination (and later disruption) of the way the Makerspace is affectively and materially designed (Kanny, *et al*.). My research points to the Makerspace as a site comprised of specific technologies that signals and facilitates and/or inhibits the mobility of women in the environment. The spatial mapping of a Makerspace conceptualizes only a narrow illustration of making and the maker. The spatial map invokes the idea of the maker identity: technologically savvy and able to ideate and create easily within a Makerspace.

The organization (both affective and spatial organization) of the Makerspace is a critical variable to envision the subdued, and often overshadowed rhetorics of innovation. An examination of a Makerspace's organization reveals the extent to which women-identified makers are encouraged and welcomed into a Makerspace. Particularly, Susan Faulkner explores gender disparity in Makerspaces in her article "Women Who Make: Undercounted as Makers and Underwhelmed by Makerspaces" by stating: "Women are undercounted because of the type of making they do, and many of them avoid collaborative learning spaces, the community-operated workspaces that tend to be dominated by men." She further supports her argument by noting a study that was conducted by *Make:* magazine that revealed that the Maker community was 81% male. Building from the extended metaphor of augmented reality (AR) from chapters two and

three to conceptualize the shadow rhetorics of innovation, the "Analysis" section of this chapter further extends the framework of AR to outline how objects signal who is welcome to the Makerspace. As an entry point to analyze why women are underrepresented in Makerspaces, I examined all of the covers of *Make:* to glean a sense of the publication's underlying beliefs, assumptions, and representations of making and the maker.

The analysis of *Make:* covers reveals the dormancy of a shadow discourse of innovation at play. A defining feature of the shadow rhetorics of innovation is rooted in exclusion and the under representation of makers who are women and people of color. While *Make:* purports open and inviting maker communities, the covers extend a subtext on making that is contradictory. The covers of *Make:* explicitly depict narrow illustrations of a Maker, his tools, and his making environment. I was curious how their conceptualization of the "maker" influenced how women-identified students charted their affective paths in the iSpace. Collectively, the covers of *Make* offered a cogent argument for the editors' and Maker Movement's limited portrayal of both making and the maker. *Make:*'s publication content and history are described on the website:

> *Make*: is the magazine for Makers, which was first published in 2005 and used the word 'Maker' to name the community. Now in its 13th year, *Make:* is published bi-monthly in print and features dozens of DIY technology projects. Called the "bible" for makers, *Make:* and its companion website, Makezine.com, cover makers, their projects and technologies as well as the communities that grow up around them ("Join Us in Our Mission to Empower Makers Around the World").

Currently, there are 60 covers issues of *Make:*, and of those 60 covers, 33 feature people on them. Of the 33 covers with people, 85% of the people were male and 12% of the people total (including females) were people of color.

Figure 4 - Cover of Make:'s 42nd issue entitled "3D Print Your Car"

The findings of this analysis are troubling. Together, these covers extend arguments that conceptualize what Maker identity is comprised of: white, middle-aged men, of middle to upper class socio-economic standing, and with clear know-how of technologies (Faulkner).[19]

To gain a more robust understanding of the emergence of the shadow rhetorics at play, I shifted my analysis from an examination of *Make:*'s covers to an analysis of its editorial staff. Like the demographic breakdown from the *Make:* covers, the editorial staff was predominantly comprised of white, tech-savvy males ("Our Team"). The finding is a disconcerting realization because this handful of editors are extremely influential in the way they are managing popular narratives about making, innovation, and even gender in

[19] *Maker Media* also publishes a "sister publication" called *Craft*. The conceptualization of the crafter is remarkably different in terms of who and what is represented on the covers—predominantly white women and textile making are featured on the covers. The distinction between *Make:* and *Craft* further divides not only ideas of making, but also the gendering of tools, spaces, and making processes.

Makerspaces across the United States. The control over this narrow conceptualization of making has material consequences for the academic institutions and community spaces that have developed both a Makerspace and, subsequently, the ideological baggage that comes with it.[20] To further unpack defining features of the shadow rhetorics of innovation and the implications of the maker and making as put forward by *Make:*, I will be detailing the pilot study I conducted on collaborative making and gender in a Makerspace.

II. Pilot Study: Gender Identity and Affective Mobility in a Makerspace

For this case study, I captured whether specific technologies encourage or welcome the movement of women-identified participants in a Makerspace. The pilot study advanced this research question: "How does gender identity potentially impact the creation processes and behaviors of students in tech-centric environments such as a Makerspace?" I received institutional review board approval to conduct observations of University of Arizona students collaboratively making in the iSpace.

The study had two major components made up of various elements: the observations of students' collaborative making in the iSpace and a post-observation survey reflection. I designed three observation groups for study that included groups of all men-identified students, all women-identified students, and both men-identified and women-identified students. I observed three groupings within each category, giving a total number of nine observations that were conducted. During the observation, participants (UA undergraduate and graduate students) were asked to collaboratively

[20] The gender disparity in Makerspaces has been especially problematic in public and academic libraries. The contention between the library (as a space open to the community) and the Makerspace (an environment inherently exclusive by design) is palpable.

create an object. In this section, I outline the approaches and methods used during the study and offer an analysis of the findings for this pilot study.

a. Call for Participants: The Pre-Observation Survey

I used a couple of approaches to recruit participants for the pilot study. I sent out a *Google Form* to the UA Writing Program, UA Journalism, UA School of Information, and the UA College of Humanities to solicit participation for the study; students indicated their interest by filling out the Google Form entitled "Participant Registration for Study on Making: Pre-observation Form." The form contained the following questions:

Table 3: Participant Registration for Study on Making: Pre-observation Form

- Name
- E-mail address
- Academic year
- Major
- Current gender and sex identity[21]
- Have you visited, worked in, or participated in a collaborative learning space before?
- If you answered "Yes" to the previous question, please respond: Describe what you did in the makerspace (*i.e.,* the projects you worked on, the tech you used, etc.).
- Please check which observation dates/times you're available.[22]

I crafted these particular questions for scheduling purposes. Once I received the completed forms, I grouped participants according to availability and gender identity.[23] The second method I used to solicit participation was visiting classrooms, with the instructor's permission, to personally ask students to join the study. In this scenario, I

[21] As mentioned in Chapter Three, we defined gender on the event's website as: "We welcome anyone who identifies as female or feminine of center, including cis and transgender, intersex, non-binary, and genderqueer people. Any skill level. We want you to focus on hacking, coding, learning, and having fun! Therefore we aim to provide an inclusive space for female and feminine-of-center folks across lines of race, disability, class, and skill level. "

[22] The observations were conducted from October 30, 2017 - November 12, 2017.

[23] Participants self-identified their current gender identity.

distributed hard copies of the registration form for the students to complete. Moreover, to help further incentivize students, I informed them that each participant would receive a $15.00 Visa Gift Card for their participation. Notably, some students were more interested in signing up for the study if they were given extra credit, which some instructors offered to provide.

b. Participants

After sending out numerous email invitations and after conducting several class visits, I invited 65+ UA undergraduate and graduate students to participate in the study. In total, 29 students joined. A participant's gender identity was the driving characteristic that informed the way I organized the observation groups; a relatively small number of interested participants identified as men, which made it tricky to arrange equally sized gender-exclusive observation groups. In terms of gender identity, 21 of the 29 participants identified as women, while the remaining eight participants identified as men. The following chart offers more detail about the participants including their majors, academic years, and whether they had been to a Makerspace prior to the study.

Table 4: Participant Demographics

Majors represented	● Studio Arts ● Illustration ● Biology ● Computer Science ● Chemistry ● Communication ● French ● Finance ● Photography ● Material Sciences and Engineering ● Mechanical Engineering ● Music Education ● Neuroscience ● Cognitive Science

	● Molecular and Cellular Biology ● Optical Sciences ● Rhetoric, Composition, and the Teaching of English ● Nursing ● Physiology ● Public Policy and Management ● Teaching, Learning, and Socio-cultural Studies ● Biochemistry ● Undecided
Academic year	● Freshman - 20 participants ● Sophomore - 0 ● Junior - 1 ● Senior -3 ● Graduate - 5
Have you been to a makerspace?	● Yes - 7 ● No - 21 ● Unsure - 1

There were a couple of unique features distinguishing the participant pool. Overall, the group dynamics of the collaborations were overwhelmingly collegial. This was the case, I believe, because so many students signed up to do their observations on the same dates as their colleagues from class. Moreover, an important note to add: of the seven participants that had been to a collaborative learning space, three of them worked at the iSpace and two of them were regulars who visited the iSpace at least twice a week over the course of the semester.

c. Procedure

Before beginning the observation, I oriented each participant group to the iSpace. After signing acknowledgement forms, each student group was given a ten-minute tour of the Makerspace. During the tour, I discussed the available technologies, tools, and equipment that participants could use during the study, and informed them that I would be available for any questions that might arise during the session. Some technologies,

such as the 3D printers and laser cutters, were not made available due to the time constraints of the activity; however, participants were encouraged to use failed 3D prints and laser cutter materials (*e.g.*, acrylic, plywood, or medium density fiberboard) for their projects. I ended the tour by answering any questions participants had, reminding the group of the post-observation survey to take place after the observation, and guiding their attention to the activity they were going to do as a group. The activity, an ideation activity the iSpace staff routinely facilitates, was called "Half Baked."

Half Baked is an activity where students collaboratively create a made-up product/idea inspired by the selection of two random words. In the sessions, I presented each student group with two cups. In one cup were paper strips with single adjectives listed on them. In the other cup were paper strips with nouns on them. The group chose one random slip from each cup, and from those two words emerged the product or idea they were to build out for the next 20-30 minutes as a group. As soon as a group drew a product idea, I informed them that their project was going to culminate in an informal share-out. I asked participants to take a sheet of chart paper to summarize the description and function of their product, why they thought it was innovative, and to describe their product's target audience. I also asked them to use their responses from their chart paper for their informal presentation. Once I had completed the tour, run through the instructions, and reminded participants about the post-study survey, I started a 30-minute timer.

Over the course of 30 minutes, and as the students were collaboratively making, I was recording their interactions via web, laptop, and tablet cameras. In order to ensure that I captured each participant's path and interactions in the iSpace, I rigged cameras

throughout the Makerspace to achieve the vantage point of three perspectives. I began recording on all three cameras before the observation groups entered the room. I recorded the observations with keen attention to participants' engagement and interactions with technologies in the space. Once an observation group finished delivering their informal share out, I stopped the recording on all three cameras. I also took a moment to photograph all of the products created and the notes and sketches on the whiteboards.

The Half-Baked activity culminated with a brief presentation centered on what the group made. Students provided some context for the project (which was often spurred by what they had written on their chart paper) and with a demonstration of how their product worked. For example, one student group drew the two words "Intelligent Container" for their product idea. The product was comprised of five glass panels that were glued together, and then fortified with brown satin ribbon. The inside of the box included a row of LEDs and light sensor (these were prefabricated circuits from a *Littlebits* kit) to illuminate the contents in the box. The group also placed a dry erase marker inside of the container so that users could use it to write notes and reminders onto the glass surface.

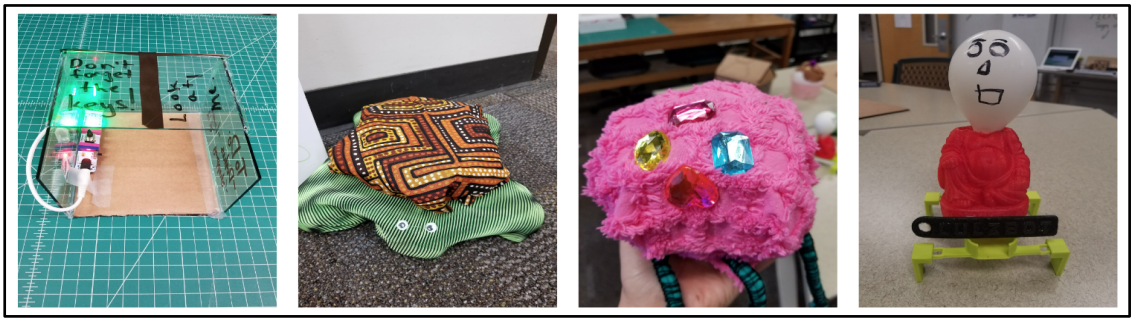

Figure 5 - Completed "Half Baked" Projects

The second part of the observation, the post-observation survey, rounded out the study. Each participant was asked to complete the survey on one of the computers on the iSpace and was encouraged to ask any questions they might have about their experience

during the survey. I informed participants that the survey was not an exam, and that their honest responses were greatly appreciated. Particularly, I devised the survey questions with the extended AR metaphor in mind: the technologies in the space (*i.e.*, the 3D printing station, craft supplies, laser cutting room, etc.) were beacons that influenced the way participants navigated the Makerspace. I crafted survey questions that aimed to reveal the "signals" or "push notifications" that a participant received from these technologies: I wanted to develop a preliminary understanding of how socio-technical relationships may be cultivated (or not) for women in Makerspaces. The survey was comprised of a total of nine questions, not including basic demographic questions such as name, date, major, and academic year:

Table 5: Post-observation Survey	
Questions about the iSpace	
1.	What did the iSpace "feel" like? What was your first impression of the iSpace when you walked in?
2.	To what extent does the iSpace foster creativity and innovation? What would you add to and/or remove from the space to heighten creativity and innovation?
3.	The following is a list of iSpace stations that are available to the UA campus community. Which gender identity do you feel predominantly uses each station? (Participants were asked to choose one of the following options for each station entry: Men | Women | Gender Nonconforming Persons | This Station Is Used By All Gender Identities) ● 3D printing ● Virtual reality ● Electronic textiles ● Sewing ● Micro-computers (*Arduino* and *Raspberry Pi*) ● Laser cutter ● Computer Numerical Control (CNC) Router ● Pegboard with tools (*e.g.* hammers, screwdrivers, pliers) ● Craft supplies (*e.g.*, pom poms, popsicle sticks, glitter, rubber bands)
Questions about the group project	

4.	What materials/equipment did you use? Why did you choose those materials?
5.	If you worked with someone on your project, why did you choose to work with them?
6.	What was your individual contribution to the group project?
7.	How well did your group do? Successes? Areas for improvement?
8.	Describe the making experience if it were to be overwhelmingly attended/inhabited by one gender in particular. (*e.g.,* If your group had men and women in it, describe the experience if your group was instead all women or all men).
9.	Additional comments?

Participants who completed the survey were encouraged to reach out to me if any other questions about the study experience arose. I then compensated participants by giving them their $15.00 Visa Gift Card and, when applicable, e-mailed their professors to confirm their attendance so that the student would receive extra credit. After completing all nine observations (three women-only groups, three men-only groups, and three mixed gender groups), I began to document each participant's movement within the iSpace by reviewing the camera footage.

I reviewed the paths that each of the 29 participants traversed in the iSpace by reviewing the camera footage. In order to document the affective maps consistently, I designated 14 areas of the iSpace, and denoted these areas as "touchpoints."

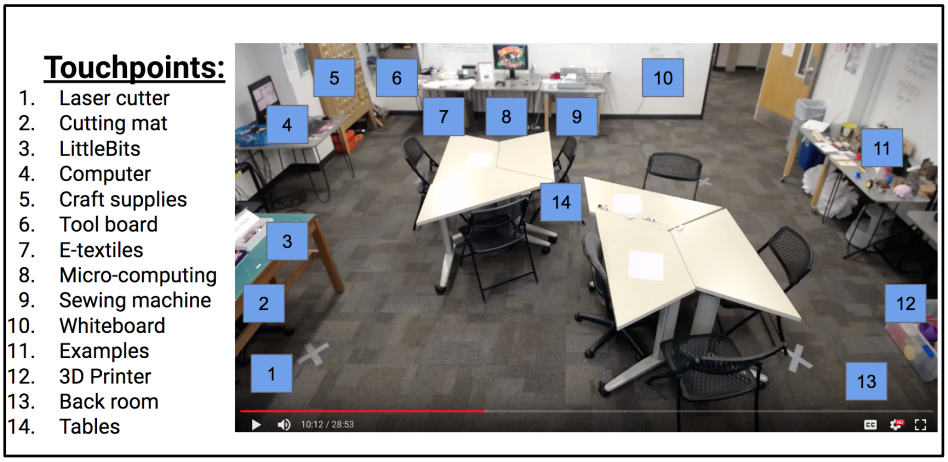

Figure 6 - Image of the iSpace with designated "Touchpoints"

For example, some touchpoints included the collaborative tables, craft supplies, microcomputers, and (unused) 3D printers. On a spreadsheet, I recorded the pathways each participant took in accordance to these touchpoints. After reviewing the footage for each individual, I had generated a collection of affective maps that detailed both collectively and individually the touchpoints each participant interacted with, the time each participant spent at any given touchpoint, their walking time to and from a touchpoint, and the number of unique touchpoints they amassed. Their unique mappings captured how the technologies interanimate a participant's individual and collective experience. Each participant had two maps that were in dialogue with one another: the spatial map of the iSpace where each participant was encouraged to interact with and their affective map that they charted in the space in real-time.

d. Results and Analysis

At the end of the observations, I had an affective map for each participant and a spreadsheet with all of the participants' survey responses to analyze. I approached my analysis with two aims: 1) to understand the extent to which the iSpace—a representative Makerspace—cultivates an equitable and inclusive learning environment for women, and

2) to gain an understanding of how the participants' paths and interactions pushed back against dominant conceptualizations of innovation that shaped the Makerspace. The observation allowed me to obtain a better sense of the emergence of the shadow discourses of innovation in the environment. My preliminary findings show that the Makerspace, with special attention to the technologies therein, impact the way men and women navigate the environment. In the pilot study, the Makerspace is not a neutral space. The environment plays an active role in the participants' collaborative making processes. The technologies in the Makerspace seem to influence the decision making and way-finding of participants in the iSpace. In this section, I will outline three preliminary findings from this study: the average touchpoints of men and women in the iSpace, the attribution of genders to technologies/stations in the iSpace, and how gender identity informs the collaborative making processes in a Makerspace.

Firstly, the average number of touchpoints each participant generated drew my attention to the level of engagement for men and women participants in the iSpace. While Makerspaces encourage collaboration through "doing" and making with tech, it was curious to note how the pilot study's men were significantly more active than its women. The observation footage shows that among people new to the iSpace, men were 22% more transitory than women. These data offered one perspective on engagement according to gender, but as a co-founder and researcher in the iSpace, I recognize that many students and faculty enter collaborative learning spaces, like the iSpace, with no previous experiences in such spaces; in this pilot study, such novices represented 72% of the participants. This is important to highlight since many collaborative learning spaces

will welcome first time users. Data points related to the number of touchpoints and movement of the participants (in accordance to gender identity) are as follows:

Table 6: Number of Touchpoints Based of Participants' Gender					
Average Touchpoints			Average Touchpoints		
With staff & regulars[24]			**Without** staff & regulars = 5 women[25]		
Men	18 (+22% more active)		**Men**	18 (+33% more active)	
Women	14		**Women**	12	

As mentioned, a handful of participants (all women-identified) worked at the iSpace or were users who visited the collaborative learning space on a regular basis. This group of women was highly familiar not only with the spatial layout of the Makerspace, but also brought with them a level of expertise and familiarity that other participants did not possess during the study. The regulars and staffers knew how each technology functioned, how to operate the technology, and were confident in troubleshooting or fixing any problems that came up. Each of them were leaders in this regard. Aware of the small population of staffers and regulars represented in the sample size, I wanted to get a sense of how the average of men and women would be impacted if this specific group was removed from the touchpoint averages.[26] Interestingly, while the men's activity stayed the same, there was a discernable difference in the women's average: the touchpoint average significantly decreased by 11%. According to that finding, men were more active/engaged in the Makerspace in comparison to the women. This preliminary

[24] This average is representative of the entire sample size for the study. There were 29 participants total.

[25] N = 5 indicates the number iSpace staff (3) and regular users of the iSpace (2). This average is representative of the sample size when the iSpace staff and regular users are factored out of the average.

[26] An interesting note: two women participants had one total touchpoint— they both sat at the table for the entire duration of the study.

finding offers a compelling argument around a participant's gender identity and their familiarity with the technologies in the space.

The socio-technical relationships formed in collaborative learning spaces emerge in part from a participant's past relationships with Makerspaces and the technologies therein. Participants' experiences align or depart with prominent ideas of innovation. The participants who were most familiar with Makerspaces and/or the staple technologies featured in *Make:*, exhibited a more comfortable relationship with the technologies that they experienced in the pilot study: "We are moved by things. In being moved, we make things. An object can be affected by virtue of its own location (object might be here, which is where I experienced this or that affect) and the timing of its appearance" (Ahmed 25-26). Affectively, for these groups, the technologies signaled a sense of familiarity that emerged from the past impressions the participants had of these technologies and vice versa: "But forming an impression also depends on how objects impress upon us…. *We need to remember the 'press' in impression.* It allows us to associate the experience of having an emotion with the very affect of one surface upon another, an affect that leaves its mark or trace" (Ahmed 6). Men and women staffers and regulars had a considerable advantage in terms of navigating and engaging the Makerspace. The impressions they have cultivated with technologies has equipped them with a degree of motility that other participants (predominantly women) did not exhibit. The next section focuses on the post-observation survey. In the survey, participants attributed gender identity(ies) to technologies/stations in the iSpace.

The post-observation survey was a chance for participants to reflect on their experience collaboratively making in the iSpace. Moreover, it presented me with an

opportunity to capture the participants' evaluation of their experiences engaging within the Makerspace configuration. The assessment provided insight regarding the affective dynamics amid the users and objects in the space: "To be affected by something is to evaluate that thing. Evaluations are expressed in how bodies turn towards things" (Ahmed 24). As such, the post-observation survey allowed participants to distill their making experience in a way that lends insight regarding affect and the decisions they made during the activity.

Each station in the iSpace operated as a beacon transmitting affective signals to each participant. To get a sense of how certain bodies turned or oriented themselves to a particular technology in the Makerspace, this section focuses on a finding that materialized from the responses to a question from the post-observation survey: "The following is a list of iSpace stations that are available to the UA campus community. Which gender identity do you *feel* predominantly uses each station?"

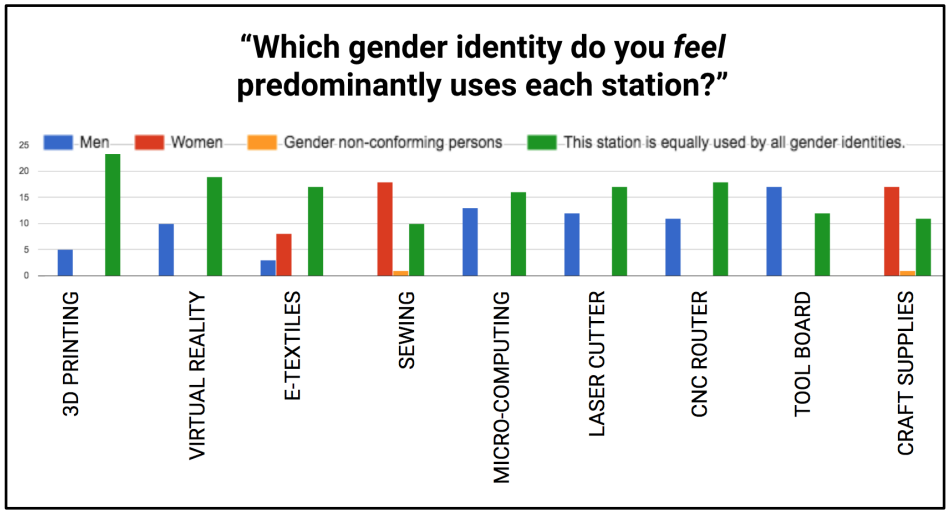

Figure 7- Which gender identity do you feel predominantly uses each station? (Survey Question 7; Section 2); n – 29

Across the x-axis on the graph are the iSpace stations; the y-axis indicates the number of participant responses per station. The color-coding of the bars in the graph are as follows:

- Blue: respondent believes the technology is primarily used by men;
- Red: respondent believes the technology is primarily used by women;
- Yellow: respondent believes the technology is primarily used by gender non-conforming persons;
- Green: respondent believes the technology is used equally by all gender identities.[27]

This graph reveals disquieting patterns around which stations are representative of and accessible to women.

According to participant responses, there were only three iSpace stations that were primarily used by women: the sewing machine, electronic textiles (embedding circuits in textiles), and craft supplies. In terms of the way these stations are represented in *Make:*, electronic textiles are infrequently featured in the magazine, while sewing and craft supplies are technologies that are not highlighted in *Make:* (whereas in *Craft* magazine they are prominently featured). This is a troubling preliminary finding. If bodies, spaces, and objects affectively interanimate an experience for users, what does it mean when only a small percentage of technologies in the space "welcome" women-identified makers?

In a previous chapter, I recalled a moment where a few colleagues were uneasy about purchasing a sewing machine for the iSpace for fear that it would "send the wrong signal." This finding does indeed suggest that the sewing machine helps to generate the

[27] While there were a significant number of participants who chose "this station is equally used by all gender identities," this result was not necessarily a positive finding. Despite the Maker Movement's promotion of diverse and equitable Makerspaces, maker communities continue to represent gender diversity poorly. In Miranda Joseph's *Against the Romance of Community*, the author characterizes the limitations of invoking 'community': "Fetishizing community only makes us blind to the ways we might intervene in the enactment of domination and exploitation" (9-10). This finding is unpacked further in the 'Limitations' section in this chapter.

affective signal "*for women*" in visitors: "[E]motions work to shape the surfaces of individual and collective bodies. Bodies take the shape of the very contact they have with objects and others" (Ahmed 2). In retrospect and with this finding in mind, it is evident that my colleagues' concerns with the sewing machine emerged from the misalignment a sewing machine had with *Make:*'s conception of Makerspaces and of the maker. Sewing machines and crafting supplies are not associated with Makerspaces, and doubly do not align with *Make:*'s conceptualization of the white, affluent, technophile, male maker. This misalignment further exacerbates understandings of who belongs in the space. This contention is further understood through the last finding, a post-observation survey where participants unpacked the iSpace in relationship to gender and the technologies they used.

The technologies in the space were possibly transmitting mixed (and gendered) signals to participants; more accurately, signaling who is welcomed to the Makerspace, women in comparison to men were receiving a weaker 'welcome' signal when taking into account the organization of the tech-environment and the technologies present therein. Building from the analysis on the post-observation survey responses, two participant answers will be detailed below. They both drew connections between technology and gender, and indicate how this association influenced the decisions they made in their group projects. The two responses below are representative of a larger set of responses that reveals how gender identity informs the two participants' rationale for working with specific technologies over others. Participants' decisioning is impacted by both the object and how it's environmentally contextualized: "To experience an object as may affect of her sensation all is to be directed not only toward an object but to what is around the object, which includes what is behind the object, the conditions of its arrival"

(Ahmed 25-26). The first response is from a woman-identified participant who was assigned to an all-women observation group, and the response theorizes the difference in team dynamics if their project team had been dominated by men:

> Our group was all women and we had a very collaborative environment where everyone contributed equally. I think if the group were to consist of both men and women, there would have been issues with establishing leadership. I think our project would have never been built in a group of men as well, as cupcakes are viewed as stereotypically feminine objects and many men would find building a project like that emasculating. Additionally, I think if men were involved the materials used would have been significantly different. Our group used mostly craft items and hardly any tools or stereotypically 'masculine' items. I think if men were involved, the project would have not been made entirely out of craft materials and would have had other objects incorporated into it.

The second response is similar to the previous one, but is more explicitly self-reflective of the "gendered stuff" that took place during the creation of the team's product, "Sophisticated Protection." Unlike the first respondent, the second respondent is reflecting on her experience collaborating with a group of both men and women:

> hm. i was fascinated by the gendered stuff that was happening in our session. i think if more men were involved, 'sophisticated' would have been interpreted differently. aesthetics wouldn't have been valued. which is bullshit because quality design (hello, Apple! hello, successful apps & social media interfaces!) are intuitively designed. i also found myself promoting gendered notions of tech

> when i said ‘we could use the sewing machine, but its less techy’ as we were brainstorming initially.

These two responses were among numerous comments that pinpointed moments of contention amid gender and technology in the Makerspace. Such contention does not unfold in real-time, but instead stems from past affective experiences that shape present and future engagements with technology like Flatley argues: “In an important sense, we never experience an affect for the first time; every affect contains within it an archive of previous objects” (81). Together, these two participant responses alongside the two other preliminary findings for this analysis (the gendering of technologies and the discernable activity men have compared to women in the iSpace) offer burgeoning evidence around the tendency for Makerspaces to be experienced as more comfortable by men than women. Moreover, it also adds a different perspective to the larger conversation: why is there an underrepresentation of women in Makerspaces? The preliminary findings reveal that simply promoting inclusive and equitable Makerspaces is not enough: at its core, the Makerspace is imbricated with gender biases. Affective and physical disruptions of the Makerspace configuration are critical to foster collaborative learning spaces that are more equitable and diverse.

e. Limitations and Next Steps

The pilot study has generated numerous preliminary findings that contribute to the larger conversation on gendered identity and technology within the Makerspace environment; however, and perhaps even more importantly, the pilot study has also helped to identify some of the thresholds, gaps, and limitations not only of my study in particular, but also of similar studies aiming to make sense of gender inequities in

collaborative learning spaces. In the next iteration of this study, where generalizable knowledge will be created, I will address the following research gaps discovered in the course of the pilot project.

i. Sample Size

While I invited the same number of men and women to participate in the study, I noticed that a significant number of men did not show up for the study, or they emailed me saying that they could not attend any longer. Despite efforts to recruit a comparable number of men and women, the sample size of the pilot was lopsided with 21 women and 8 men. This outcome prompted me to re-think my recruitment approaches for the next iteration of the study. Specifically, I am thinking through how I pitched and framed the study to participants.

ii. Survey Questions

Several participants had difficulty responding to some of the survey questions because they were afraid of appearing judgmental. For example, in response to the question "Describe the making experience if it were to be overwhelmingly attended/inhabited by one gender in particular (*e.g*., If your group had men and women in it, describe the experience if your group was instead all women or all men)," one participant stated his discomfort with responding to this query:

> [Our group] liked the robot aspect and it was fairly "manly", whatever that means in today's society! If it was more feminine or created by an all girl group it might've served a different purpose or physically looked more feminine (more colors, more decorations, etc.). It is hard to make these predictions without sounding rude, stereotypical, or judgmental.

I heard similar responses from participants as they were leaving: they did not want to respond honestly because they did not want to come off as judgmental and/or that they decided to respond to certain questions by illustrating how they *wish* the collaborative learning space was constructed. For example, some admitted to choosing "This station is equally used by all gender identities" because they felt this was the right answer.

iii. Camera Vantage Points

Some key engagements were not captured during the observation because they took place in the iSpace's back room. The back room is primarily a storage area for supplies for the iSpace, but does have a few computers and virtual reality equipment. I gave each observation group a tour of the iSpace's main room with the assumption that participants would work and use the materials solely in the main room area; however, I was surprised to find that a handful of participants (mostly iSpace staff and regulars) ventured into the back room for supplies and other tools. One of the limitations of this study was not knowing what happened in the back room since there was not a camera present in the room.

iv. Lack of Analysis: Gender Non-Conforming, Non-Binary Persons

In its current state, the study examines the engagement of students who currently identify as men or women. This leaves a critical gap in the research: a concerted consideration of how students with non-binary gender identities engage within the Makerspace. It is critical that this demographic is accounted for, especially in this line of work that seeks to promote equitable and gender inclusive Makerspaces. According to the pilot study, women were associated with only three stations in the Makerspace, yet gender non-conforming persons were only associated with two stations: sewing (1

respondent) and craft supplies (1 respondent). Moreover, the option "gender non-conforming persons" was selected significantly less than the other gender options. Below is a table with the number of attributes each gender category on the post-observation survey received:

Table 7: "The following is a list of iSpace stations that are available to the UA campus community. Which gender identity do you feel predominantly uses each station?"

Options	*Number of times selected by respondents*
This station is equally used by all genders	144
Men	71
Women	43
Gender non-conforming persons	2

Even more bleak and unequal than the representation of women in the collaborative learning space was how non-binary persons were not only underrepresented but discernibly absent in the conceptualization of the Makerspace.

In the second chapter of this project, I detailed an occurrence that took place in the early stages of the University of Arizona's first interdisciplinary collaborative learning space, the iSpace. The narrative was about the time that I suggested adding a sewing machine to the purchase list for the iSpace to a group of colleagues. What was most memorable about that interaction was my colleagues' response to my idea. My colleagues responded to my recommendation by asking: "Wouldn't a sewing machine in the space make men feel excluded?" Their question helped me re-envision the iSpace's layout: I was very familiar with the spatial mapping of the iSpace, but was uncertain of the iSpace's affective map—how women-identified students are affectively guided to move and to engage within the space (Flatley 78). As a co-founder for the iSpace, I am

very aware of the spatial mapping of the collaborative learning space; however, as a researcher, the question still remained: how does a collaborative learning space shape the way women-identified makers engage with the objects contained therein (*i.e.,* the technologies in that environment)? More pointedly from the narrative, I wondered: if a sewing machine "signals" to male students that they are not welcome to the space, what signals do the other technologies on the purchase list transmit to other student populations, more particularly, to women-identified makers?

Tracing and recording the affective maps of Makerspace users offer critical vantage points for understanding how innovation in the collaborative learning space emerges from a set of beliefs, assumptions, and values. Without an accompanying affective map to complement (and disrupt) the spatial mapping of the iSpace (or any collaborative learning space), it is difficult to devise action plans for creating collaborative learning spaces that are more equitable for and inclusive of women-identified makers. The creation of affective maps offers insight that a spatial map alone could not provide: "Just as the lack of a cognitive map of one's social space is crippling for effective political activity, so too is the lack of an affective map" (Flatley 78-79). While Makerspaces are founded on professed values of inclusion and diversity, the preliminary findings from my study show that certain genders are afforded motility in a Makerspace, while other(ed) genders are restricted: "Spaces extend the mobility of some bodies; their freedom to move shapes the surfaces of spaces…. It is the regulation of bodies in space through the uneven distribution of fear which allows space to become territories, claimed as rights by some bodies and not others" (Ahmed 70). In this chapter, Sara Ahmed's work on bodily orientations and Stanley Flatley's notion of affective maps

advanced the analyses in this chapter. The next and final chapter builds from this and prior ones by exploring applications for a theory of innovation in past, present, and future timeframes for librarians, faculty, and pedagogues to consider. The last chapter will also recap the project with a particular focus on the findings from each chapter and how they further reveal and define the shadow rhetorics of innovation.

Chapter Five

FROM CRITIQUE TO FUTURE APPLICATIONS: THE IMPLICATIONS OF THE SHADOW RHETORICS OF INNOVATION & EQUITABLE LEARNING SPACES

On November 5, 2017, the founder of *Make:,* Dale Dougherty, posted a controversial tweet questioning the veracity of a prominent YouTuber, Naomi Wu. Dougherty challenged Wu's legitimacy and identity as a maker: "I am questioning who she really is. Naomi is a persona, not a real person. She is several or many people" (Cho).[28] While Wu quintessentially possesses the skill sets of a maker, what ultimately sets her apart is her deviation from the image of a typical Maker. Wu is a Chinese woman who embraces her sexuality as a form of her gender expression (Andre). Born and raised in Shenzhen, China, the prominent YouTuber rose to fame due to her proficiency with fabrication tools and electronic circuitry. Aside from being a hardware engineer who happens to be a woman, she is also well known for her provocative clothing and the unique project ideas she builds. Self-proclaimed as the "Real Sexy Cyborg," Wu's third most popular video—"3D Printed Bikini Top - Yes It's Comfortable!"—has over 2.2 million views.[29] In the comment sections of the video, viewers cheekily jest that they were watching the video for the "science" and tutorial dimension behind her project builds. Despite Wu's massive following of over 763,000 YouTube subscribers and supporters, Dougherty's tweet spurred material consequences for Wu. She lost invitations

[28] Dougherty has since deleted the tweet.

[29] The first two videos featured Wu walking around with a 360-degree camera. These were not project-based videos, but nonetheless garnered 5.9 and 4.5 million views respectively.

to speak at events, sponsorship, and was suddenly being asked to perform demos of the technologies she had developed in order to prove her work and ability (Kobie).

The altercation between Dougherty and Wu succinctly captures what this dissertation project sought to visibilize: the influence of dominant conceptualizations of innovation (developed by a handful of influential thinkers from Silicon Valley) and to examine how these rhetorics shape perceptions of who can make, how one makes, why they make, and what counts as making. Similar to the contention illustrated in the aforementioned anecdote, the project outlined the inherent precarity that innovation environments present to women-identified makers, and the material consequences that can emerge for them. Dougherty's questioning of Wu's ability and legitimacy is consistent with how dominant conceptualizations of innovation shape ideas and police who can make (Chapter Two). Cruel optimism, when one's desire is potentially detrimental to one's well being, undergirded Wu's ability to thrive in a male-dominated, tech-centric environment. This is readily noticeable as Wu was observed navigating the contention between her passion for fabrication while also having to confront the damaging claims that were made against her competencies (Chapter Three). Wu's confidence in her sexuality and tech building abilities created a site generating cognitive dissonance among Dougherty and members of the Maker community (Chapter Four). The altercation seemingly resolved itself with two public apologies from Dougherty to Wu, an invitation from Dougherty to Wu to attend the Bay Area Maker Faire, and with a dedicated cover of *Make:* to feature Wu. However, as this project has shown, there still is much work to be done to close the gender (and perception) gap in innovation. In hopes to

move the proverbial needle, I have contributed to the conversation on gender disparity a critical examination on the rhetorics of innovation.

The major question guiding the project was "What are the rhetorics of innovation?" The question spurred analyses that collectively supported the main argument for this project: Innovation rhetorics embed and exacerbate mainstream gender biases into innovation-centric environments (*e.g.*, hackathons and Makerspaces). These biases reduce the likelihood that women-identified users will develop strong, independent, and creative socio-technical relationships with the tools and skills commonly associated with Makerspaces. Conventional innovation rhetorics, in other words, often function repressively, especially for girls and women. The project unfolded across four chapters that posed supporting questions, drew forward implications, and outlined the rhetorics of innovation. In the following section, I revisit each chapter, summarizing them with specific attention to the guiding questions of each and noting its implications for future research.

I. Chapter One Summary and Implications: Rhetorics of Innovation

The objectives of the first chapter were to reveal the difficulty in defining a protean concept like innovation, and then to categorically define the scope and type of innovation under examination. In order to define the rhetorics and shadow rhetorics of innovation, I first established the baseline definition of innovation. The rhetorics of innovation analyzed in this project originate in Silicon Valley, and are further analyzed as they manifest in the social phenomenon, the Maker Movement. It is in the defining work carried out in the first chapter that innovation is outlined and also called out in terms of other forms of innovation (*e.g.*, *jugaad*) and making that are left out. The definition work

around innovation was achieved through the outlining of a literature review on Silicon Valley innovation.

"Innovation," I illustrated, is used across different contexts and has a variety of meanings; however, I presented a baseline definition in this project that outlined innovation as possessing two fundamental features: (1) presenting an existing idea or object as new, and (2) an acknowledgement (by an individual or collective) of the object's novelty and value (Isaacson 10; Rogers 26; Schiebinger 6). I crafted a literature review that traced innovation from 1979 when Steve Jobs and Steve Wozniak designed the Apple One to the popularization of *Raspberry Pi's* in the mid-2000s during the start of the Maker Movement (Kātz 77). In the literature review, I outlined innovation by moving from a general definition of innovation, to geographically situating innovation as seen from Silicon Valley, to localizing it within the Maker Movement, and then ultimately positioning the analysis within the context of an ongoing conversation and issue prevalent within innovation environments: the underrepresentation of women in tech and innovation environments. The literature review was crafted in response to the central research question for this project.

The first chapter introduced the project's central research question and supporting questions. The overarching question for this project was "What are the rhetorics of innovation?" This research question spurred numerous supporting questions in the first chapter that shaped and advanced the main argument for the project through a collection of analyses. Below are lists of questions categorized in two columns. One column indicates the questions that were intentionally explored in the first chapter. The second

column represents a series of questions that were raised at the conclusion of the chapter—these questions have become focal points for future research.

Chapter One	
Questions Explored	Questions Raised
What is innovation? How is innovation conceived in Silicon Valley?	How do communities re-define innovation to meet the needs of their local contexts?
What role does the Maker Movement play in perpetuating the values, assumptions, and ideas of Silicon Valley's innovation?	What are the rhetorics of feminist innovation?
How do the rhetorics of innovation shape the socio-technical relationships of women-identified makers?	How is innovation measured? Capital? Patents? What insight does a feminist read of these metrics extend?

Although defining and situating innovation was difficult, the work was important because it established a baseline for the project's ongoing analysis on innovation. The definition work in the first chapter created space to ask more critically informed questions (as seen in the "Questions Raised" column). Moreover, creating a baseline carved out a defined framework to study how innovation informed the interanimation of relationships among people, objects, and spaces. A baseline definition of innovation emerged from the literature review in the first chapter. This common thread allowed the chapter's analysis (and subsequent chapters) to consistently trace innovation throughout—how the Silicon Valley stripe of innovation emerged, how it was cultivated through the Maker Movement, and ultimately how it was instilled in Makerspaces throughout the United States. The second chapter of this project furthered the analysis on innovation by investigating the hidden side of the dominant rhetorics of innovation.

II. Chapter Two Summary and Implications: Affect Reality: Understanding the Limitations of Innovation through Augmented Reality and Affect Theory

Chapter two established the theoretical frameworks to examine the shadow rhetorics of innovation as they unfold in innovation and tech environments such as makerspaces and hackathons. In particular, this chapter worked toward defining a rhetoric of innovation by both outlining the dominant features of innovation, and more importantly affectively situated the shadow rhetorics of innovation that are simultaneously co-extended with popularized features of innovation. In chapter two, I explored both the dominant and recessive features of innovation in three time frames: past, future, and present—the second chapter was dedicated to examining how innovation has been historically conceptualized.

In the first half of the chapter, an analysis of prominent patterns and themes of innovation were data mined from a textual corpus. The corpus was comprised of web content from twenty innovation blog sites. The authors of these sites were renowned thought leaders and influencers on the topic of innovation. A topic model revealed several topics on innovation from the corpus, but there were three topics that particularly advanced the analysis. I categorized each topic under the following headers: innovation as business, innovation as magic, and innovation as militarization. These features also emerged as three of the prominent traits of innovation.

The second half of Chapter Two examined the thresholds of innovation. In terms of responding to "What are the rhetorics of Innovation?" this chapter revealed the intimate and affectively contingent relationship women-identified makers embody in tech-centric environments like makerspaces. To further elaborate on how bodies, objects, and spaces interanimate interactions with tech, I deployed augmented reality (AR) as an

extended metaphor to outline the limitations of innovation especially as it implicates women-identified users of a space. Particularly, AR beacons served as a generative shell to conduct the analysis: innovation purports specific values, assumptions, and ideas around what making is, who can make, and how making occurs. Together this multi-valent examination of innovation's dominant and not-so-dominant features extended a robust representation of innovation that raised questions for further research.

Chapter Two	
Questions Explored	Questions Raised
What are the dominant features of innovation?	What other fitting metaphors could be leveraged to discuss the affective dimensions of innovation? How would the shadow rhetorics of innovation be analyzed without metaphor?
Who and what are underrepresented or invisibilized from dominant conceptualizations of innovation?	How could one visibilize and capture data around the interanimate relationships within innovation environments? How could one observe the affective interaction between users and objects in this regard?
How could the liminal, invisible, affective, and often oppressive aspects of innovation be analyzed?	What other sites of inquiry and/or corpora (textual, digital, ephemeral, etc.) on innovation could be analyzed and placed in conversation with the existing analysis?

Chapter Two signaled the beginning of a larger, multi-faceted analysis on the rhetorics of innovation. The site of analysis for Chapter Two was on innovation blogs—a textual corpus. For future research, other corpora will be explored and examined to develop an even deeper representation of the dominant conceptualizations of innovation. For example, image mining portrayals of innovation could extend visual arguments around what an innovator/maker looks like. Moreover, an audio analysis on top innovation speeches could also lend itself to an analysis revealing how innovation is

heard (*e.g.*, I'm thinking of specific factors such as pitch, register, intonation) across the United States. Innovation in the first and second chapters was examined at a high-level to provide framing for the deeper, more focused analyses on innovation that were carried out in the third and fourth chapters.

III. Chapter Three Summary and Implications: Cruel Optimism: The Promise of Innovation and its Affordances for Women

In outlining the shadow rhetorics of innovation, it becomes evident that one of their defining features is what Lauren Berlant calls cruel optimism. Theoretically, the chapter primarily draws from Lauren Berlant's attachment theory, cruel optimism, as a framework to understand how these perceptions of innovation move hackathon participants to world-build, self-reflect, and forecast the affordances of innovation. This is a key finding that further responds to the question "What are the rhetorics of innovation?" In Chapter Three, the analysis shifts from conceptualizing prevailing ideas of innovation to closely examining the shadows cast by popularized discourses surrounding innovation. I examined the 2016 Women Techmakers Tucson (WTT) Hackathon as the central case study for this chapter.

Specifically, the pre-event survey responses from women-identified registrants for the 2016 WTT Hackathon were examined. The pre-survey was particularly crafted to get a sense of participants' perceptions of the bodies, objects, and overall environment of the hackathon (an event exclusively for women-identified participants). This chapter considered innovation in the future time frame—how do women-identified registrants forecast the affordances of innovation? Chapter Three was further situated within a larger conversation around gender disparity and representation of women-identified participants in hackathons. Below are the questions explored and raised in this chapter.

Chapter Three	
Questions Explored	Questions Raised
How do women-identified participants envision the affordances of innovation?	Are participants of a women's-only hackathon more likely to participate in other hackathon and innovation events?
The rhetorics of innovation are defective for populations that it does not serve—especially women . How are these defects visibilized in specific contexts?	The paradox of inclusion: how does the exclusion of men make for a more diverse set of participants? (For example, 2016 participants were more diverse in terms of race, class, and age.)
How do the shadow rhetorics of innovation manifest in an event where the perceived limitations and underrepresentation of women are explicitly centered?	Hackathon participants attend, participate, and ultimately leave. What impact do hackathons have on participants' personally, professionally, and academically? How else is a hackathon's success measured aside from attendance count?

The questions raised and intentionally explored in this chapter align with the major findings from the case study. Three prominent themes emerged from participant responses. The first one dealt with the socialization of women: the idea that women did not want to attend innovation/tech events for fear of being judged, objectified, or having to deal with gender bias. The second theme centered around discomfort: a women's-only hackathon created a "safe," "welcoming," "comfortable" environment to collaborate and learn; many respondents pointed to the physical discomfort of working with tech around men. Specific phrases such as "being pushed around" or "getting shouted down by boys" were seen in responses. The third theme directly tied into Berlant's notion of cruel optimism. Participants aligned themselves to the hackathon, despite all of its flaws, in

hopes to learn, join a community, and to work more confidently with technologies. While the implications from this chapter are telling, they also fail to capture a fuller representation of the participant's experience before, during, and after the hackathon. The next iteration for this research will include a fuller examination of the participant experience through the facilitation of pre-event, event, and post-event surveys.

IV. Chapter Four: Affective and Spatial Mapping of Innovation in a Makerspace

What are the shadow rhetorics of innovation? The fourth chapter offers a focused analysis of how innovation informs collaboration in a Makerspace. Particular attention was dedicated to examining the affective relationship between users and objects of the space. In this chapter, I investigated the tension between creating inclusive collaborative learning spaces and the inherent gender biases baked into the configuration of the Makerspace model inspired by *Maker Media*. I conducted an institutional review board-approved pilot study in the iSpace to observe how 29 participants navigated the iSpace with keen attention to the participants' interactions with the people and technologies within the space. I placed two maps in conversation with one another for analysis: the actual physical layout of the iSpace, and the affective maps each user uniquely created during the observation. The pilot study sought to respond to this overarching question: "Does gender identity impact the way students engage with the technologies in a Makerspace?"

The findings for this chapter pointed to gender identity as having a material impact on participants' movement within the space. One finding spoke to student engagement in particular. The finding emerged from my analysis of each participant's charted path in the iSpace. In order to consistently document participants' paths in the

iSpace, I sectioned off areas in the room and designated them as touchpoints. Each time a participant moved from one touchpoint to another, I calculated their walking time and their time spent at each touchpoint. From this data, I then collectively calculated the average number of touchpoints according to gender identity. Notably, men accrued an average of eighteen touchpoints during the observation, while women averaged fourteen. This was a 22% difference in activity and engagement. This pilot study is still in its infancy, but its early findings are not surprising. I am interested to see how a more balanced sample set of participants will impact the findings in the study's next iteration. The following questions further advanced the analysis, while also carving out space to consider ideas for the study's next iteration.

Chapter Four	
Questions Explored	Questions Raised
How do the shadow rhetorics of innovation interanimate the relationship between women-identified makers and technologies within a Makerspace?	Are collaborative learning projects less appealing to a specific gender identity?
With which gender identities are specific Makerspace technologies commonly associated?	How does one measure for diversity and inclusion beyond headcount (*i.e.*, simply accounting for attendance)?
What gives a Makerspace its legibility? What technologies signal the space as a Makerspace?	How do academic libraries negotiate the tension between being read as innovative (in the Silicon Valley sense) and inclusive, but also disciplinarily agnostic?

The questions emerging from the fourth chapter are not exclusively inspired by this chapter alone. Instead, it is a cumulative representation of the ideas and thought processes that surfaced throughout the project. The first two chapters established the contours of this project: a definition of innovation, the theoretical frameworks guiding the

analyses, and sketched out the importance of examining the lesser known, often invisibilized, and overshadowed rhetorics of innovation. In response to "What are the rhetorics of innovation?" the third and fourth chapter offered two case studies that focused on the relationships that women-identified makers attributed to innovation and technologies. The findings reveal that the innovation-centric environments I studied are embedded and exacerbate mainstream gender biases into innovation-centric environments (*e.g.*, hackathons and Makerspaces). This project is the beginning of a larger research trajectory that will continue to be in dialogue with several knowledge domains; however, there is a particular site of inquiry that will continue to advance this research.

V. "Maker Culture is Dead, Long Live Maker Culture!"

The academic library has been the site for much of this project's research on innovation. The WTT 2016 Hackathon was hosted and co-organized with librarians and library staff, and the pilot study was facilitated at the iSpace in the Science and Engineering Library. In terms of my own scholarship and advocacy for gender parity in tech and innovation environments, the library served as a main point of contact to support tech and community building events that work toward closing the gender gap in technology. The academic library has become a powerful institution to impact material change across the university and community.[30] Academic librarians are the connective tissue amid local community organizations, campus offices, and departments which enables a level of impact that any single department alone couldn't achieve. In terms of helping to move the needle toward greater representation of women-identified makers and users of technology in tech and STEM fields, academic libraries have the opportunity

[30] The University of Arizona is a land-grant institution.

and networks to create considerable change: “Libraries have an opportunity to contribute to their campus-wide initiatives by partnering across units to improve female STEM retention, and by using their liaison relationships to engage with faculty to meet this common goal” (Palumbo). A focus area for academic libraries will need to be in the burgeoning tech-centric collaborative learning areas.

Makerspaces will continue to gain traction in university settings as non-STEM and STEM disciplines continue to leverage the creative possibilities of integrating various tech-driven research approaches. As a result, academic libraries are continuing to re-think the spaces and services in the library to ensure that prosumer-based research approaches are supported. As such, the spaces in libraries are consistently evolving to meet these prosumer tendencies: “Libraries are no longer simple repositories of books, journals, and items used in academic research and teaching. Academic libraries are becoming places of collaboration and knowledge creation” (Zaugg and War). Academic libraries are consistently re-envisioning their spaces to better support student and faculty learning: stacks are being replaced with more flexible learning environments, study rooms are being transformed into virtual reality or artificial intelligence studios, and librarians are now providing reference help on how to both find resources and how to create research projects. While the prospect of more hands-on, experiential, and fundamentally innovative research is exciting, the Makerspace model still needs to be closely observed and, in many instances, disrupted in order for more equitable and inclusive tech environments to emerge.

The Silicon Valley stripe of innovation is unsustainable: it has behaved as an invasive species sweeping and making landfall across libraries and communities

throughout the United States. Makerspace leaders are confronted with the challenges and issues that come with tech-environments that are inherently gendered and exclusive (Bean 61). Currently, the Makerspace is in a curious position where communities are both adopting and diverting away from the *Make:* model. Makerspace leaders are getting rid of the "Makerspace" attribution, are re-thinking the technologies in the space, and slowly collaborative learning environments are re-centering the human learning experience at the forefront of design. Instead of illustrating making as an act that exists outside of the human experience and identity, it will be reclaimed as an activity that is part and parcel of our human existence for learning. While I have been an enthusiastic proponent and advocate for the Maker Movement, I know that equitable, inclusive, and diverse spaces will continue to emerge with the dying off of the Maker Movement. It is both exciting and challenging work to envision a more supportive learning environment.

While each chapter of this project presented a specific set of implications and next steps for future work, I believe the most pressing issue is cultivating equitable collaborative learning spaces (*e.g.*, Makerspaces) that are situated within academic libraries. As epicenters for knowledge and information creation, consumption, and organization, academic libraries will continue to be frontrunners grappling with and leading the charge on collaborative learning spaces and tech-driven approaches for research. I believe that academic libraries ranging from liberal arts colleges to research-intensive universities will continue to work through approaches to support prosumer research in their institutions. As a pedagogue, researcher, feminist, and woman of color, I recognize the need to center my energy on working with academic libraries to cultivate

collaborative, tech-centric learning spaces that meet the needs of and are reflective of the communities they serve.

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