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MAKE, FIX ALMOST ANYTHING –

HOW MAKERSPACES FOSTER CONSUMER EMPOWERMENT

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Master's dissertation project presented to the Instituto Coppead de Administração, Universidade Federal do Rio de Janeiro, as part of the mandatory requirements in order to obtain the degree of Master in Business Administration (M.Sc.).

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ABSTRACT

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Makerspaces are generally defined as collaborative places for tinkering, creating, experimenting, and sharing knowledge and experiences using various tools and technologies. This is a relatively nascent topic and most research on Makerspaces has focused on aspects of learning, innovation, economic development, and sustainability. The extant literature does not explicitly address the role makerspaces play in empowering consumers to consume differently. This research is guided by the theories of prosumption and sociomateriality. Prosumption is an emerging practice in which consumers become producers and make some of their own products (Ritzer et al. 2012). People enter makerspaces as consumers and have the potential to leave as prosumers, capable of producing some of their own goods. Sociomateriality recognizes that the social and material are entangled in everyday life (Orlikowski 2007) and that objects have different properties in different contexts. Makerspaces are places where materials and tools are center stage, and consumers can build practical skills and put them into practice via materials. A case study approach is used to collect data through participant observation and in-depth interviews, based on the analysis of two different makerspaces. Case study findings suggest that consumers are empowered through their interaction with materials and with other makers in a collaborative environment. A prosumer empowerment model is conceptualized, which delineates how consumers are empowered to become prosumers in makerspaces. Enabling mechanisms that foster consumer empowerment in makerspaces are proposed, as are social benefits that keep consumers coming back to these spaces. On a macro level, it is suggested that the Maker Movement and makerspaces empower consumers by encouraging them to make the world they want to see through material action - by providing materials, knowledge, and an enabling environment - as opposed to empowering consumers in a politicized, proselytizing manner as is more common in social movements.

Keywords: Consumer empowerment, makerspaces, prosumption, sociomateriality

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List of Abbreviations

DIY – Do it Yourself

DIWO – Do it with Others

STEM – Science, Technology, Engineering, Mathematics

STEAM – Science, Technology, Art, Engineering, Mathematics

Summary

1. Introduction

The Maker Movement is loosely defined by an enthusiasm for making, tinkering, and hacking, often centered around collaborative environments that provide various tools and technologies. It is a community of hobbyists, engineers, computer programmers, and artists who creatively design and build projects for both playful and useful ends (Martin 2015). It blurs the lines between crafts and technology (Posch 2017) and is seen by some as an iteration of the DIY culture (Papavlasopoulou et al. 2016). The Movement facilitates and commends the use of new digital tools, such as 3D-printers, laser cutters or even biotechnology, and at the same time, it celebrates and is inspired by the lost arts of traditional handicraft skills (Anderson 2012; Lang 2013).

Maker Culture is a philosophy in which individuals or groups of individuals create artifacts that are recreated and assembled using software and/or physical objects. This culture builds on an individual's ability to create things, to be a "Maker." It embraces the ideas of (almost) everyone designing, creating, producing and distributing renewed, new and improved products, machines, things or artefacts (Nascimento & Polvora 2016). The ethos of the Maker Culture is closely related to the hacker ethic of sharing, collaboration, and learning through deconstruction and reconstruction (Levy 2001).

This physical manifestation of the Maker Movement and Maker Culture happens in Makerspaces, which are open communities where people gather to make, tinker, and socialize with shared tools and knowledge (Halbinger 2018). In recent years, these spaces have rapidly emerged and there are an estimated 1,000 Makerspaces globally (Makezine.com). Makerspaces exist on a continuum of various dimensions – formal to informal, nonprofits to for-profits, highly structured to very little structure, private space to public space, high proficiency to low proficiency of makers, varying levels of participant control, high tech to low tech, etc.

The Movement has evolved from a fringe, grassroots movement to a lifestyle with implications (van Holm 2015) and has gained widespread attention across the globe. From studies of China's makerspaces (Lindtner 2015) to the new emergence of DIY

synthetic biology, the movement has evolved from hobbyist culture into a global force (Hatch 2014).

Other commentary has framed the movement as inaugurating a new age of sustainable consumption and participatory design. Popular discussion of the Maker Movement has been enthusiastic: former President Barack Obama inaugurated a National Week of Making with the promise that making would ensure “our Nation’s progress (Davies 2018) and former Wired editor Chris Anderson (2012) wrote of a “new industrial revolution that happens when the web generation turns to the real world” (Anderson 2012: 42).

The Movement has been co-opted by a variety of companies and brands. Martha Stewart started “American Made” annual awards for American Makers in 2012 (https://www.marthastewart.com/americanmade). In 2013, Stewart commissioned a “State of the Maker Report”, on the impact of the Maker Movement in the American economy. In 2017, Black and Decker opened a Makerspace for all its employees to “bring ideas to life” in Towson, Maryland (http://www.sbdmakerspace.com/). Autodesk also recently opened a series of Makerspaces (https://www.autodesk.com/sustainability/sustainable-design-education). Similar corporate concepts to Makerspaces are framed as Innovation Labs or Hubs but have many of the same principles. For example, Microsoft has the “Garage”, a place for employees to work on experimental projects (https://www.microsoft.com/en-us/garage/) and Capital One has Innovation Labs (https://www.capitalonelabs.com) Many companies also have “Hack Days,” in which challenges are presented and cross functional teams set out to solve them.

From both a grassroots and corporate perspective, the Maker Movement is trending and becoming increasingly mainstream. Makerspaces have been studied for potentializing entrepreneurship, innovation, diffusion, and local economic development that can contribute to the public good (van Holm 2015). They provide access to and lower the costs of those factors known to support innovation, e.g. resources (Halbinger 2018) and known to support diffusion i.e. collaborators (de Jong et al. 2015). Makerspaces have become popular in educational institutions, such as schools and libraries, mostly for STEM, and more recently, STEAM

education (Hsu et al. 2017). Despite this expansion, however, little is known about repercussions on consumers practices. Thus, the present research aims to investigate how participation in makerspaces has the potential to transform consumers' relationships with products and consumption. Makerspaces are touted with "giving the tools of production back to the people." In these spaces, people can make things for their own personal consumption – clothes, arts and crafts, technology, etc. In this sense, Makerspaces are fertile ground for studying prosumption, which is "value creation activities undertaken by the consumer that result in the production of products they eventually consume and that become their consumption experiences" (Xie et al. 2008: 110). From this definition, prosumption can be understood as a practice entailing the production of goods and services by consumers who consume them as alternatives to those available in the marketplace. This practice embodies an evolution of consumer roles and participation in the marketplace.

Consumer studies research offers a lens with which to study the Maker Movement, Maker Culture, and Makerspaces and their impact on consumption behavior. Scholars have called attention to the cultural and creative behavior of consumers in the marketplace (Holt 1995; Moreau & Dahl 2005) and makerspaces can be a rich environment to study this behavior. Makerspaces are based on making things and Holt (1995: 2) explains that consumers use material objects (e.g. goods, products) as "vessels of cultural and personal meanings". In this evolving conception of consumption, consumers are producers of diverse creative and cultural meanings (Arnould & Thompson 2005). Additionally, consumer researchers have sought to understand how consumers (i.e. prosumers) perceive empowerment through collective participation (Denegri-Knott et al. 2006) and makerspaces are places where consumers share resources in their consumption.

This present research on makerspaces has the potential to advance what is known about consumer empowerment via prosumption in a few ways. Firstly, most prosumption and consumer empowerment has been studied on an individual level through DIY activities (Wolf & McQuitty 2011; Frauenfelder 2011) and craft consumption (Campbell 2005). This research seeks to further understanding of

prosumption and consumer empowerment on a collective level through DIWO activities. Secondly, much prosumption research related to consumer empowerment has focused on digital communities (Tian et al. 2017). This research studies prosumption in a physical environment, which is a distinct context rich for other types of consumer empowerment potentialities.

More specifically, this research aims to understand how Makerspaces foster consumer empowerment. With this goal, the literature review delineates the following topics: Maker Movement, makerspaces, hackerspaces, prosumption, participatory culture, communities, and sociomateriality. The Methodology section explains the rationale for selecting and investigating the two cases. The Case Studies Context section provides details about each of the cases. Finally, the Analysis section focuses on: (i) contextualization of each case; (ii) consumer empowerment via interaction with things; (iii) consumer empowerment via acquiring skills in an enabling, fostering environment, including enabling mechanisms and social benefits.

2. Literature Review

2.1. The Maker Movement and Maker Culture

The Maker Movement is characterized by a passion for making, tinkering, and hacking, in collaborative environments that provide tools and technologies. The Movement includes a wide array of skill levels and backgrounds, such as hobbyists, engineers, computer programmers, and artists. These people design and build projects for both playful and functional means (Martin 2015).

The Movement is multidisciplinary, multifaceted, and highly diverse. It means different things to different people – it is a grassroots cultural movement, a remedy to political woes, a new pedagogical method, and at the same time a continuation and reinterpretation of age old phenomena. In this sense, the Maker Movement is touted as a spiritual, intellectual, emotional, social and educational activity that can benefit all. There is of course much overlap of these ideas, each of which emphasizes different

qualities or notions of the Maker Movement. The Movement has impacts on culture, manufacturing, and education (Dufva 2017).

The Movement brings online communities to physical spaces. In this same vein, it has been referred to as a new industrial revolution which happens “when the web generation turns to the real world” (Anderson 2012: 42). It bridges the online and physical worlds, and in this sense some practices in the Movement may have the abilities to create deep sense-making into our digitalized world. It is part of a major transformation in manufacturing, transitioning from a society reliant on mass production and consumption, towards a distributed digital fabrication model characterized by “mass customization” (Millard et al. 2016).

Maker Culture is a philosophy in which individuals or groups of individuals create artifacts that are recreated and assembled using software and/or physical objects. This culture builds on an individual’s ability to create things, to be a “Maker.” There is a continuum of people in this culture – ranging from professional engineers and artists to hobbyists, with diverse skills and interests (Papavlasopoulou et al. 2016). The many diverse subcultures give the Maker Movement a unique twist as well as distinct character.

Dale Doughterty is considered by many to be the Father of the Maker Movement. According to Dougherty, the Movement has come about in part due to people’s desire to engage with artefacts in ways that make them more than consumers. In his eyes, the movement brings together people that are enthusiasts – whether it be about science, arts and crafts, or engineering. These makers are united by their common passion. He also sees the Movement as a place companies can look to for insights into how to create an ecosystem of talent and learning that will lead to an innovative economy and society (Doughterty 2012).

The possible benefits of the Movement are manifold. From the constructivist perspective, the Maker Movement is seen as an educational tool. And from the economic view, as a new entrepreneurial possibility. It has been hyped to bring engineering and making by hand back to the western countries as well as to create new

possibilities in the developing countries (Anderson 2012; Lang 2013; Halverson & Sheridan, 2014; Lindtner 2015).

2.1.1. Makerspaces

Makerspaces are places where people can access a range of equipment and machines for personal making (Smith et al. 2016). These spaces provide access to technologies (such as additive and subtractive prototyping equipment, lathes, cutting machines) that allow people to make things, from beginning idea to final production (Fleischmann et al. 2016).

They are the physical manifestation of the Maker Movement and provide in-house training to guide “making” by participants. While making is not new, networking capabilities have made it accessible to locate materials, knowledge, procedures, and expertise. Makerspaces support consumer innovation as well as non-innovative creative activities (Halbinger 2018). Makerspaces can be funded through a range of different business models including being voluntarily run, government or institution supported, or commercial ventures. They exhibit a range of activities, governance structures, scope of ambitions, regularity of use and attendance, and exist in diverse local contexts.

Makerspaces are fertile grounds for entrepreneurship, innovation, diffusion, and local economic development that can contribute to the public good. They provide access to and lower the costs of those factors known to support innovation, e.g. resources (Halbinger 2018) and known to support diffusion i.e. collaborators (de Jong et al. 2015). Makerspaces have become popular in educational institutions, such as schools and libraries, mostly for STEM, and more recently, STEAM education (Hsu et al. 2017).

There are various types of Makerspaces that fall under the Makerspace umbrella – Hackerspaces, HackLabs, FabLab, etc. While each of these spaces has its own history and unique characteristics, they ultimately have enough in common that the term Makerspace can be employed to describe them collectively (van Holm 2015). This variety of spaces under the umbrella of Makerspaces illustrates how these spaces are constantly being built and redefined, leading to a variety of terms to define themselves

(Moilanen 2012). The term Makerspace is relatively new, having become widespread only in the past 5-7 years. On the other hand, Hackerspaces were first empirically observed in Europe during the 1990s (Maxigas 2012) and FabLabs in the early 2000s.

2.1.1.1. Hackerspaces

As explained in the previous section, Hackerspaces have their own unique history from Makerspaces. However, the phenomena that occur at Hackerspaces and Makerspaces have converged into similar enough structures and uses that the term Makerspaces is employed to encompass Hackerspaces (van Holm 2015). A hackerspace is a physical location where the same ethics present on online “hacker” communities are manifested. Hackers congregate at these spaces to share their interest in tinkering with technology, meet and work on their projects, and learn from one another.

The word hacker is a controversial term that is only now entering the mainstream (Hunsinger and Schrock 2016; Smith et al. 2015; Kostakis et al. 2015). How the word is used and connotated depends on the context, but in general it is still associated with doing something wrong and/or illegal. There are many types of hackers: the benevolent, white-hat hacker who experiments, tinkers, modifies, creates and/or participates in collaborative projects. There also is the mean, black-hat hacker (also known as cracker) who can causes damage and carry out criminal acts. Then there is the grey-hat hacker who tends to be more morally ambiguous (Kostakis et al. 2015).

In this research, we understand the work hacking as a creative process, embedded in the hacker ethic of problem-solving (Erickson 2008) as well as of producing novel artifacts (Söderberg 2007; Wark 2004). Fundamental aspects of the hacker ethic include: (i) sharing, solidarity and cooperation; (ii) distrust of authority, opposing the traditional, industrial top-down style of organization; (iii) freedom, in the sense of autonomy as well as of free access and flow of information; and (iv) embracing the concept of learning by doing and peer-to-peer learning processes, as opposed to formal modes of learning (Kostakis et al. 2015).

The hacker subculture is traced back to the 1960s. This subculture gained momentum in the 1970s at the MIT Artificial Intelligence Laboratory and other research institutes in the US (Maxigas 2012). The hacker ethic is also considered to share some common characteristics with the hippie culture, as it started around the same period, and has since evolved over the decades through different generations (Hogge 2011; Levy, 2001) and socio-economic transformations (Benkler 2006). In the 1980s, hackers started to form online and offline communities - sharing knowledge, tools and ideas. There was a need to organize these hacker communities in physical spaces, which led to the creation of communities or the first hackerspaces, as we know them today, in Berlin (C-base) and Cologne (C4) in the mid-1990s (Niaros et al. 2017).

During the last two decades, the wide distribution of technology and the dropping costs of local manufacturing technologies have allowed groups with the hacker ethic, as described above, to build community-run physical places to pursue their shared interests. In this sense, hackerspaces are also makerspaces, as makerspaces are used as a local, physical location for the sharing of resources and local manufacturing technologies that are not yet as distributed as widely or freely as computers or Internet connectivity (Kostakis et al. 2015).

Recent research on hackerspaces focuses on hacking as a lifestyle and identity, hacking as leisure activity, and hacking to form a sense of community (Davies 2018). There is also research on countercultural elements and subversive nature present at hackerspaces, as a critique of neoliberalism (Coleman 2013), an alternative to globalized production (Anderson 2012), means of opting out of mainstream consumption (Davies 2018) or the opportunity, although one that is constantly frustrated, to intervene in capitalism (Soderberg and Delfanti 2015).

The popularization of the term ‘Maker’ x ‘Hacker’ can be traced back to the father of the Maker Movement - Dale Dougherty. Dougherty founded MAKE magazine in 2005 and he tells the story of how the magazine was originally going to be called Hacks – a term he associated with “non-obvious or clever solutions to interesting problems” – but decided that “‘making’ was a more positive framing for customizing and changing the world” (Dougherty 2012). Other hackers and makers have tended to take a middle path

between using the safer language of making and using the term hacking (for example in naming spaces) while seeking to reeducate the wider public as to its positive connotations (Lindtner 2015).

2.2. Prosumption

Makerspaces gather people, tools, and knowledge with the intention of making things. In these spaces, a consumer can learn the skills necessary and have access to tools to make his/her own products. The concept of “prosumption” can help to understand this process and explain what happens inside Makerspaces in terms of consumption.

The terms “prosumption” and “prosumer” are used to describe blurred lines between producers and consumers brought on by the societal transition from the Industrial Age to the Information Age (Toffler 1981). Prosumption according to Toffler describes, firstly, that consumers take over, or are made to take over, activities traditionally performed by commercial producers and, secondly, that consumers produce their own products and services as opposed to buying them. In this sense, a prosumer is both a producer and consumer. Common examples include people making their own clothes, furniture, houses, etc. (Ritzer et al. 2012).

Prosumption has also been defined as “value creation activities undertaken by the consumer that result in the production of products they eventually consume and that become their consumption experiences” (Xie et al. 2008: 110). In this light, prosumption can be understood as a practice entailing the production of goods and services by consumers who consume them as alternatives to those available in the marketplace. This practice embodies an evolution of consumer roles and participation in the marketplace.

The prosumption concept was popularized by Kotler (1986) in marketing studies, to urge business scholars to consider prosumers as a new market segment. For the next few decades prosumption as a research topic was widely neglected (Dusi 2017). Ritzer and Jurgenson (2010) published a seminal paper that theorized prosumption from a sociological lens, with the objective of moving beyond traditional debates

regarding production and consumption. This paper sparked renewed interest in prosumption in the social sciences. Around this same time, scholarly interest in concepts closely related to prosumption increased, such as do-it-yourself (DIY) (Watson & Shove 2008); craft consumption (Campbell 2005); and the “complete collapse of consumption into production” (Ritzer et al. 2012). Building upon these concepts and prosumption, researchers began to use terms such as co-creation, coproduction and collaborative consumption to describe situations where consumers collaborate with companies or with other consumers to produce things of value (Humpherys & Grayson 2008).

The significance of prosumption is becoming evident research beyond consumer studies. Researchers have contextualized their works on prosumption in arts (Nakajima 2011), consumer psychology (Denegri-Knott & Molesworth 2010), politics, and sociology (Fuchs 2011). This breadth of research areas in which prosumption is gaining attention points to an emerging prosumer society. In this line, marketing researchers suggest that prosumption is on the verge of shaping a new face of marketing (Cova & Cova 2012; Ritzer et al. 2012).

In our postindustrial society, the return to prosumption is largely attributed to readily available and diffused technologies. Postindustrial technologies enable individuals to engage increasingly in the production of goods and services that they consume, and therefore reduce the distance between producer and consumer (Toffler & Toffler 2006). The expanding accessibility of these technologies, which were previously available only to professionals, allow greater possibilities for consumers to perform tasks usually carried out for them by traditional producers. This has led to the transformation of consumers' roles and agency (Dusi 2017). If one looks at Makerspaces, a similar phenomenon – of greater access to technologies, such as 3D printers, laser cutters, and even sewing machines – is allowing consumers inside these spaces to made things, such as cellphone cases, that before were made by traditional producers. Aside from the increasing accessibility of technology, other social changes have accelerated and magnified prosumption.

There are several elements that contribute to and facilitate the recent proliferation of the prosumer phenomenon. Firstly, the rise of the internet has allowed consumers to exchange knowledge and information. In the case of the Makerspaces observed, many consumers found out about the events from the internet. Secondly, production is also becoming less and less material, and is happening throughout society, rather than in exclusive, traditional spaces such as factories. Again, Makerspaces could be representative of spaces where decentralized production on a small scale is happening throughout the country. Lastly, we live increasingly experience economy (Pine & Gilmore 2011), which means that rather than material goods, it is the largely immaterial experiences involved in various aspects of our lives, especially as they relate to the economy (and including consumption), that are of great and increasing importance (Ritzer et al. 2012). Makerspaces also have this element – of making in a common space, which for many consumers is just as much about the experience of making as it is about making itself.

Tapscott and Williams (2006) describe prosumption as a powerful engine for change and innovation and highlighted the emergence of “prosumer communities,” namely, spaces where “customers participate in the creation of products in an active and ongoing way.” Through prosumer communities, consumers co-innovate and coproduce the products they consume. Makerspaces present many of the elements of prosumer communities – consumers that produce some of their own goods, and a place for change making and innovation. These spaces are also fertile grounds for observing the process of how a consumer becomes a prosumer, as addressed in the following section.

The next section addresses research around consumers gaining skills via prosumption practices.

2.2.1. Prosumption as Means of Acquiring Skills

Some research helps us to understand prosumption as a practice by which consumers use their skills to become producers of some of their goods and services. Campbell (2005) refers to ‘craft consumption’ as a skill which enable consumers to make homemade products for their consumption. According to Campbell (2005), a craft consumer is a skillful buyer who chooses to become responsible for the design of the products he consumes or the selection of the materials he would need for the production of a homemade product. This enables us to view craft consumers more consistent with prosumers who often use various skills including weaving, carving, making and similar skillful activities to turn raw materials into a product. Wolf and McQuitty (2011), similar to Campbell (2005) also advance our understanding of prosumption as DIY consumption by which individual prosumers use their skills for the production of goods and services they eventually consume.

Hartmann (2015) also explores the consumption practices of craft consumers in relationship to skills. He theorizes that craft consumption goes beyond consuming tools, raw materials and energy, by involving consumption relating to skill and knowledge (expertise and know-how), judgement (consciousness of materials used in the production process) and commitment (dedication to high-quality outcomes). These three elements – skill and knowledge, judgement, and commitment are the pillars of craftsmanship (Sennett 2008).

It can be argued that the more skills consumers gain through their prosumption practices, the more ability they have to function outside of the traditional marketplace. This is to say, for certain product categories, Makers have the choice of buying something new or making it themselves. Of course, very few people can be characterized as ‘arch prosumers’, dedicating all their time and resources to making objects to achieve self-sufficient living (Kotler 1986), however these self-sufficiency skills are key to consumers buying less from the marketplace, in both the form of goods and services. The next section addresses this topic – of how self-sufficient consumers use prosumption as an alternative form of consumption and how Makerspaces can potentialize to this form of consumer empowerment.

2.2.2. Prosumption as Potential for Consumer Empowerment

There is research connecting prosumption with a potential for consumer empowerment (Cova & Dalli 2009; Wolf et al., 2015; Wolf & McQuitty 2011). Empowerment takes on a myriad of definitions and is very dependent on context. For the purposes of this research, we consider empowerment to be how people expand their skills or abilities, and is a positive and productive force, rather than the negative and dominating influence of power in society.

Wolf and McQuitty (2011) refer to the empowering potential of prosumption at an individual level via DIY activities. Frauenfelder (2011) explains that DIY can be empowering by lending a more comprehensive awareness of the environment and consequently consumers' the sense of control over that. However, these works are not focused on consumer empowerment through the marketplace or the empowering potential of prosumption at a collective level. Little is known about how individual prosumers experience empowerment through their participation in collective prosumption in physical spaces. It is in this light that the present research contributes a unique perspective – by studying the empowerment process of collective prosumption in Makerspaces.

Hunter and Garnefeld (2008) view consumer empowerment as a positive subjective state which results from a mental comparison of a consumer's abilities relative to existing or previous abilities. Denegri-Knott et al. (2006) view consumers as empowered when they can (i) manipulate and even produce special spaces within the market in which they can construct their cultural (consumer) identity. Similarly, Holt (2002) speaks of consumer empowerment as seeking out social spaces that make it possible to produce a culture that is different from that forced upon consumers by the market. In turn, these spaces allow consumers to constantly reconfigure their identities, as opposed to letting the market dictate identity for them (Holt 2002). Makerspaces could be an example of this type of social space where a culture is produced that is an alternative to those forced upon consumers by the market.

Human Computer Interaction (HCI) discourse has theorized Makers in terms of an empowered consumer. In this discourse, the maker is constituted as (i) an empowered subject (i.e., an individual *subjected* to certain material and social conditions, who is also the *subject* of, or agent of, skilled and purposeful action within those material and social conditions) and (ii) the maker as a materially empowered subject and the maker as a socially progressive subject. Within this context, it was found that makers are materially empowered in the following ways: (i) makers see "finished products" as "unfinished", and they are able to adapt products to suit their needs and purposes; (ii) makers repair and repurpose what would most consider to be "consumer waste"; and (iii) acts of making can enhance an object's personal meaning, leading to greater attachment and fostering an ethic of long-term care (Bardzell et al. 2015).

Denegri-Knott (2006: 964) implies that consumer empowerment is most effectively manifested by a maker and not an adapter of the material world:

> *A truly powerful consumer would be a **maker**, and not adapter of spaces and goods*.

This is a key insight for how Makerspaces could contribute to empowering consumers – by physically making goods. Another differentiating element of Makerspaces is the person to person interaction between consumers. Denegri-Knott (2006) have found that consumer power will be amplified when consumers combines their resources and skills with those of other sovereign agents. In this sense, Makerspaces could potentialize consumer empowerment through collective prosumption and resource sharing.

This present research on makerspaces can contribute to what has been studied in terms of consumer empowerment via prosumption in two main ways. The first way is studying prosumption in a collective space. Most prosumption has been studied on an individual level through DIY activities (McQuitty 2011; Frauenfelder 2011) and craft consumption (Campbell 2005). The second way is by studying prosumption in a

physical environment, since most prosumption has been studied in digital communities (Tian et al. 2017).

The next section will address a closely related topic to collective prosumption – participatory culture.

2.3. Participatory Culture

Participatory culture is relevant to this research because it can offer insight into how the rise of digital culture has changed consumption to a more collaborative form. It also offers background for understanding how technologies can empower consumers to be more active in their consumption decisions.

American media scholar Henry Jenkins theorizes that the constant evolution of the digital landscape has restructured the relationship between producers and consumers, signaling a shift towards more collaborative, social cultural forms (Jenkins 2006). He coined the term Participatory Culture to describe this concept. The key elements of a participatory culture include low barriers to expression and engagement, strong support for creating and sharing one's creations with others, and some type of informal mentorship whereby what is known by the most experienced is passed along to novices. These participatory cultures reevaluate the passive role of consumers as mere users of content from traditional channels to a much more active role – where they can access content through dispersed channels, discuss, resignify, create, and share it.

Jenkin's theory of participatory culture is similar to Toffler's prosumption in the sense that both attribute the constant evolution of technology and the digital landscape as contributing to a changing relationship between producers and consumers. This is to say that the internet and other digital tools give consumers' access to information and other consumers at an increasing rate. Both Jenkins and Toffler also speak to consumers taking a more active role in the market. The context in which many consumers access and share information are communities. The next section addresses the essential aspects of a community and different types of consumption communities.

2.4. Communities

Communities are relevant to this research because makerspace are generally considered to be loose-knit communities. A differentiator that makerspaces have, in comparison to digital communities for example, is that they are physical. This physical encounter of people and things in the same space time continuum could offer a rich context for consumer empowerment potentialities distinct from other communities.

Communities are a fundamental component in the study and understanding of human behavior. The concept of community in consumer studies and other fields of research has evolved over time, in accordance with societal shifts. Modernism caused significant changes in how communities function, at the expense of local, traditional communities. As a result, consumers began to search for their new place in the world in the form of “markers of identity” (Beverland et al. 2010: 699) based on common consumption interests. This phenomenon is similar to a community-like behavior and is now referred to as consumption communities.

Consumption communities are formed by consumers who share a commitment to a product class, brand, activity, or consumption ideology (Cova & Cova 2002; Muñiz & O’Guinn 2001; Schouten & McAlexander 1995). These communities are characterized by voluntary interaction among members, a shared sense of identity, and lasting social relationships built around a common consumption interest. They are constituted of consumers, producers, and resources.

2.4.1. Heterogeneous Communities

Heterogenous communities have three distinct attributes. The first speaks to the members’ varying levels of commitment and engagement (Muñiz & O’Guinn 2001; Schouten & McAlexander 1995). The second is that members are not necessarily from the same sociodemographic group (Cova & Cova 2002). The third is that these communities consist of an assemblage of diverse actors, including consumers, producers, and social and economic resources. These actors differ in how they position themselves in the community, in how they enact their community roles, and in the meanings, they construct in relation to the community (Thomas et al. 2012).

This view of community is built on the key tenet of actor-network theory: social entities are “patterned networks of heterogeneous materials” (Law 1992), which include human and nonhuman actors (i.e., individuals, institutions, and resources). Beyond consumers and producers, social and economic resources have more recently been found to be relevant actors in the community framework. The community relations among actors are represented by multi-connections, reminiscent of a web.

Thomas et al. (2013) found that heterogeneity in a community is a destabilizing force that can create constraints. Nonetheless, communities are still considered relatively stable forms of association, as such constraints can be mitigated by “collaborative practices that reinforce collective and individual belonging” (p. 1024), termed frame alignment practices.

2.4.2. Communities of Practice

Communities of Practice are formed by individuals who share a common interest, engage in collective learning around this topic, and interact on a regular basis (Wenger et al. 2002). While the term is relatively new, the phenomenon itself has been taking place for centuries. Not any community is a community of practice, however. The central component of a community of practice is learning, regardless if this is intentional or an outcome of interaction among the individuals. There are three specific characteristics that differentiate communities of practice from other communities: (i) a domain, which refers to the common interest members commit to; (ii) the community formed around this domain, which allows members to build relationships, help one another, and share information; and (iii) a shared practice, which involves shared resources, such as stories, tools, ways of addressing persistent issues.

All communities of practice are therefore defined by this unique combination of the three elements – domain, community, and shared practice. Communities of practice come in all shapes and sizes – big, small, local, global, in-person, virtual, etc. Some members are core to the community, other peripheral, and still others are outsiders. These communities offer members the opportunity to share explicit knowledge, as well as tacit knowledge, by providing space for learning through conversation, storytelling,

etc. The practice of a community is dynamic and involves learning from all members. In terms of structure, leadership is necessary and so long as it is distributed the community should stay healthy (Wenger et al. 2002).

Much of the consumer studies research around consumption communities focuses on the digital space (Kozinets et al. 2017). It is within consumption communities that Makerspaces exist. These spaces are distinct from other types of consumption communities in the sense that they are physical spaces where consumers gather. Another unique aspect about Makerspaces is the interaction consumers have with materials and tools. This interaction is different from the interaction they have with materials at home because they are in a community, a space with other people. The next section addresses how this interaction between people and materials in Makerspaces is unique and how meaning can be constructed through our interaction with materials.

2.5. Sociomateriality

Sociomateriality is defined as ‘the constitutive entanglement of the social and the material in everyday organizational life’ (Orlikowski, 2007). Due to this mutual composition, sociomateriality is often simply called ‘materiality’, since ‘social’ is so implicitly entwined with the material that distinctions between the two are superficial (Leonardi et al., 2013). Sociomateriality goes beyond a mere fascination with the ‘things’ that shape or are positioned within human action, as seen in research into artifacts and boundary objects (Cacciatori 2012). Sociomateriality research acknowledges that actors, objects and intentions are entangled in a complex bundle of practices (Leonardi, 2011; Orlikowski 2007). However, management scholars often have difficulties in integrating actor and object within emerging practice and many studies still separate material and human agency (Jarzabkowski et al. 2013). In terms of the issue of agency, research highlights the role of materials in identity work and sensemaking (Stigliani & Ravasi 2012).

Affordances are a term for understanding how humans interact with the material world. This concept of affordances is fundamental for understanding the prosumption

process at Makerspaces, as much of the process involves how consumers engage with materials. Gibson (1986) developed an ecological approach for affordances, suggesting that certain objects - tables, chairs, and surfaces - have affordances that go beyond their purely physical properties. These additional properties—affordances—emerge in relation to the activities of those actors using the objects. For example, a card table may afford support for a mouse to sit on it, but not an elephant, although the physical properties of the table are unaltered in either situation. In this sense, material affordances are relative to the situation and context in which they are used. Norman (1990) has applied this concept in the field of technology studies by suggesting that the affordances of an object are often designed into the object. The user of the object may also recognize these design properties and hence both the affordances and inbuilt limitations of design (Jarzabkowski et al., 2013). In this sense, the affordances of technological objects cannot be boiled down to their material constitution, but are inextricably entangled with specific, historically situated modes of engagement and ways of life (Bloomfield et al., 2010).

Makerspaces provide the tools, materials, and human knowledge for consumers to design, create, and repair products. Considering that affordances are relative to the situation and context they are used, it can be argued Makerspaces potentialize the possibility that consumers see materials differently, as they are in a different context. Consumers in these spaces may have not noticed the inbuilt limitations of design (Jarzabkowski et al. 2013) of some products until they are faced with that reality in a Makerspace. For example, another consumer could recognize that a cellphone cannot be fixed as it was not manufactured for disassembly, but rather only to be fixed at an Apple certified store, and this knowledge is then passed onto other consumers in a Makerspace.

The next section explores how sociomateriality – the interaction between people, objects and intention – has materialized in the Maker Movement.

2.5.1. Maker Ethos via Material Action

The Maker Movement has political undertones and ethos, which is manifested differently in each Makerspace. Research has been done on how hackers demonstrate their ethos via material action, as opposed to talk about politics, by being producers of free and open source software. It is through material action that hackers demonstrate the right to express themselves, learn, and create technology over the right to privatize the fruits of their labor (Coleman 2013). This is directly related to sociomateriality in the sense that Makers make a statement through their interaction with the material, as opposed to the discursive, world.

Other authors have suggested that these “material actions” of the Maker Movement are inherently political, as material engagement with the physical world offers as a distinctive means of intervening in broader sociopolitical worlds. An example is issue-oriented hackathons, where a specific problem is given to be solved in a short amount of time. These are sites of “material participation” in the sense that they stimulate the unpacking of real-life, pressing issues through concrete development and consideration of technological prototypes and products designed to solve those issues (Lodato et al., 2016). In a similar vein, Delgado and Callen (2016), in a discussion of biohacking and e-waste modification, argue that “[h]acks are tangible demonstrations that realities could hold together differently”. The research around material actions in the Maker Movement demonstrates how some Makers communicate their political views and make an impact on the world through materials.

The next section will explore the relationship Makers develop with materials and some of the implications this can have.

2.5.2. Making and Human Interactions with Materials

There is much hope and positivity surrounding the societal benefits of the Maker Movement. In this light, the Maker Culture tends to focus on overstating solutions and understating critiques. To balance this, there is research focused on material attachment and sustainability implications in makerspaces (Maldini 2016), questions of identity as mediated through materials (e.g. Toombs et al. 2014) and the more interventional critical making (Ratto 2011). Whether studies explicitly use the term

"sociomaterial" or not, they generally acknowledge the bundling, entanglement (Barad 2007) or assemblage (Law 2002). of the social and material.

As stated above, there is research dealing with attachment to materials, identity mediated through materials and intervention via materials. All this research deals with the question of embedding meaning into the world through materials. It could be argued that Makers and Makerspaces potentialize this phenomenon in the sense that if someone makes something with his or her own hands, s/he is likely to associate more meaning with that object than something purchased commercially. This idea that it is through making things with our hands that we produce meaning is not a new concept. Ivan Illich (1973: 34) wrote about how humans produce meaning in their worlds through tools in action:

> *Tools are intrinsic to social relationships. An individual relates himself in action to his society through the use of tools that he actively masters or by which he is passively acted on. To the degree that he masters his tools, he can invest the world with his meaning.*

Critical making is a concept that is related to this idea of our relationship with materials, and can provide insights into sociomateriality, which is how humans interact with materials. Critical making is defined as "a desire to theoretically and pragmatically connect two modes of engagement with the world that are often held separate—critical thinking, typically understood as conceptually and linguistically based, and physical "making," goal-based material work" (Ratto 2011: 253). Ratto (2011) conceptualizes making in the context of Latour's (2005) "matters of fact" and "matters of concern." Matters of fact are things that we apparently have no control and matters of concern are elements of the world we should care about (Latour 2008). Ratto argues that deterministic social theories categorize technologies as matters of fact, and as such something we should not 'care about.' In more recent work, Latour has used the extension of design to more domains to argue that people are increasingly recognizing the "designed" rather than "discovered" quality of artefacts, a realization that reopens them:

> *When things are taken has having been well or badly designed then they no longer appear as matters of fact. So as their appearance as matters of fact weakens, their place among the many matters of concern that are at issue is strengthened* (Latour 2008).

Conceptually and ideally speaking, critical making aims to turning the relationship between technology and society from a “matter of fact” into a “matter of concern” (Ratto 2011). This research strives to understand this making and how Makerspaces contribute to turning matters of fact into matters of concern by engaging Makers to interact on a deeper level with materials. This interaction happens in a space of learning. Makerspaces are largely places where people gather to learn new skills and make things. In this learning process, there is potential for these matters of fact to turn into matters of concern.

3. Methodology

3.1. Context

For this research, the case study approach was applied. This approach can focus on single or multiple cases, and varying levels of analysis. Case studies normally combine data collection methods, such as interviews and observations. And case studies can be employed to achieve varying objectives – provide description, test theory, or generate theory (Eisenhardt 1989).

This research investigates two different case studies – HacDC and Arlington Central Library. They were chosen using theoretical sampling (Eisenhardt 1989) and convenience criteria. The first reason I selected the two cases was that they are extreme situations or polar types, which can be helpful to make the process of interest “transparently observable” (Eisenhardt 1989). Both HacDC and Arlington Central Library fall under the Maker umbrella, and have many commonalities, but they also have many distinctions. HacDC is located inside a church, in a very under the radar room, has a 10-year history, is run by volunteers, employs the use of high tech in the production of goods, and has an anarchistic, countercultural environment and ethos. In contrast, Arlington Central Library is in a very central location, and the Maker programming is extremely visible throughout the library, the Maker program is relatively new, is run by

paid government workers, employs low to mid-level tech, and has a very open, collaborative, calm environment, with no explicit political undertones.

The second reason I selected HacDC and Arlington Central Library was the convenience aspect, since they are both located in the geographic area where I was at the time. As an initial task to select cases for investigation, I found a few different Makerspaces using a simple Google search query and the website Meetups.com, which posts events happening in cities around the country. After this initial desk research, I selected two locations to visit and evaluate if they would be appropriate for the research. The names Both spaces are in the DMV (Washington DC, Maryland, Virginia metropolitan area). The DMV population is approximately 6,133, 552 people, as of the 2016 census estimate, which makes it the sixth largest metropolitan area in the United States, and 5th highest GDP. The first Makerspace - HacDC - was founded in 2008 as a Hackerspace and is in Washington, D.C. And the second Makerspace - Arlington Central Library - is a public library, located in Arlington, Virginia, that has had Maker programming since 2015. HacDC and Arlington Central Library are approximately an hour from one another by public transportation.

During exploratory research, both spaces demonstrated a genuine interest in Making and the Maker Movement. Both spaces also have a variety of Maker programming and publics that attend these events. Consumers in both spaces also produce goods during these events. Considering that this research aims to understand how Makerspaces stimulate consumer empowerment through examining prosumption, interaction with materials and acquiring skills in a collaborative environment, these spaces have many attributes that make them fitting to explore these phenomena.

3.2. Data Collection

The data for this study were collected using two primary research methods – field observation (Emerson 1995) and interviews (Spradley 1979). The use of multiple data collection methods allowed greater immersion in the context. Field observation took place from June 2018 – September 2018. I attended a variety of events and

programming at the two sites over this period. I observed the physical space, governance, structure, participants, and culture.

As displayed in the table below, 06 people volunteered to be interviewed. The primary criteria used to select the interviewees was their willingness to be interviewed. From that group of people, I selected a mixture of both organizers and participants, to gain more diverse perspectives. Among the interviewees, 03 were women and 03 were men, ages ranging from 29-58. Some interviews were conducted in-person, others virtually, depending on the preference of the interviewee. The interviews consisted of 10 open ended questions and lasted approximately one hour.

Pseudonym	Case	Age	Years at Makerspace	Affiliation
Stacy	Arlington Central Library	30	1.5	Adult Maker Libriarian
Dawn	Arlington Central Library	56	3.5	Teen Maker Librarian
Maria	Arlington Central Library	29	3	Library Associate
Frederick	HacDC	58	10	Member
Dave	HacDC	38	3	Member
Mike	Arlington Central Library	39	4	Volunteer

Table 1: Profile of Interviewees

3.3. Analytical Procedures

The first procedure applied to the data gathered was open coding (Saldaña 2015). The idea behind this procedure is to compare and contrast content from each interview and field observation. The codes used were based on my lens as a researcher, as well as emergent themes from the literature review.

Throughout the research process, I also wrote memos of the preliminary analysis from field observation. As a next step, I wrote analytical memos (Saldaña 2015). Given the variety of Maker programming and publics in the case studies, these steps were helpful in documenting the varied information.

I will now analyze how the Makerspaces observed foster consumer empowerment. The specific issues addressed include: (i) contextualization of each case; (ii) consumer empowerment via interaction with things; (iii) consumer empowerment via acquiring skills in a fostering environment, including enabling mechanisms and benefits.

4. Case Studies Context

In this section I will provide details of each Makerspace observed. This section addresses the first research topic – (i) contextualization of each case study. This contextualization is intended to paint a clearer picture of each Makerspace, as well as their relation to relevant literature.

4.1. HacDC

The first Makerspace observed was HacDC. This Makerspace is classified under the Maker umbrella as a Hackerspace (van Holm 2015). This means that participants do make some physical artefacts as in other makerspaces, but the focus tends to be more on technology and software, rather than on hardware.

Background

HacDC was founded in 2008 by a diverse group of engineers, artists, and hobbyists. It is the second oldest hackerspace in the United States. This Hackerspace is located inside a church in the Columbia Heights neighborhood in Washington, D.C. This neighborhood is racially diverse, but it is also undergoing gentrification.

Funding and Governance

HacDC is a nonprofit and has a board of directors that is run by volunteer members. It has a $60 monthly membership fee and approximately 50 members. There are monthly meetings in which members decide upon programming and other pertinent issues to the Hackerspace.

Mission

HacDC's mission is to "improve the world by creatively rethinking technology," as seen below in a screenshot taken from HacDC's Meetups.com description. This ideology would classify HacDC in the white-hat hacker category, which includes benevolent hackers who experiment, tinker, modify, create and/or participate in collaborative projects (Kostakis et al. 2015). On their website, the organization cites the following as its specific purposes:

- Build and maintain spaces suitable for technical and social collaboration
- Collaborate on all forms of technology, culture, and craft in new and interesting ways
- Apply the results of its works to specific charitable, cultural, and scientific causes
- Freely share its research and discoveries, using what is learned to teach others
- Recruit and develop talented members to these purposes

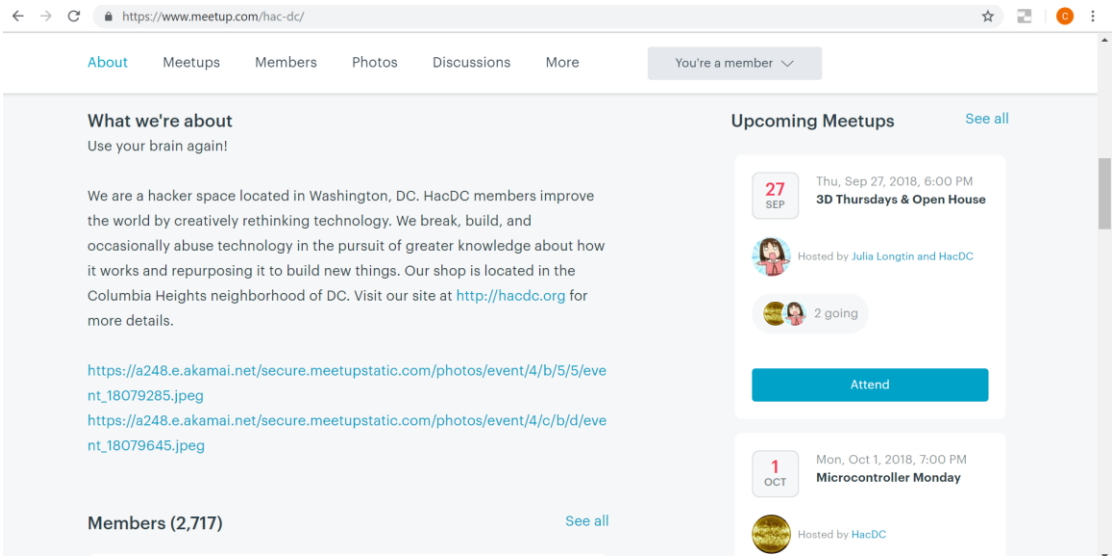

Image 1: HacDC's Meetup Page

Physical Space

The website also cites HacDC as part of a global movement of hackerspaces, "HacDC is part of a global trend in amateur engineering clubs that have come to be known as 'hackerspaces.' Centered on physical locations that function as shared workshops, these spaces support "makers" whose work bridges the realms of art and technology and who share a passion for putting old technology to new and creative purposes."

From this definition on the website, “hackerspaces” are places where “makers” gather. This reframing of the language – of using the word “maker” as opposed to “hacker” – demonstrates that even in the world of hackerspaces hacker can negative connotations and “maker” is preferred to use for the wider public (Doughterty 2012; Lindtner 2015). This also demonstrates how HacDC, although firstly a hackerspace, also recognizes itself as a makerspace and identifies with makers. As shown in the image, the space itself is relatively small; there is a table in the middle of the room that fits about 10-12 people comfortably. HacDC’s website describes the space as, “A combined meeting space and workshop is stocked with specialized tools and supplies useful for the collaborative development of technological and artistic projects”. Some members of HacDC use the Makerspace as a co-working space and spend 3-4 full workdays a week there.

Programming

HacDC hosts a variety of weekly events, including: Microcontroller Mondays, 3D Thursday and Open House, JavaScript Workshops, Amateur Radio, etc. Each of these events attracts a slightly different crowd of people. Each event is led and/or organized by a different member of the organization. Most of the events are announced on Meetup.com, as described above. This promotion of events outside HacDC’s website makes it possible to reach people that aren’t necessarily familiar with the space but use Meetup.com to find events in the area.

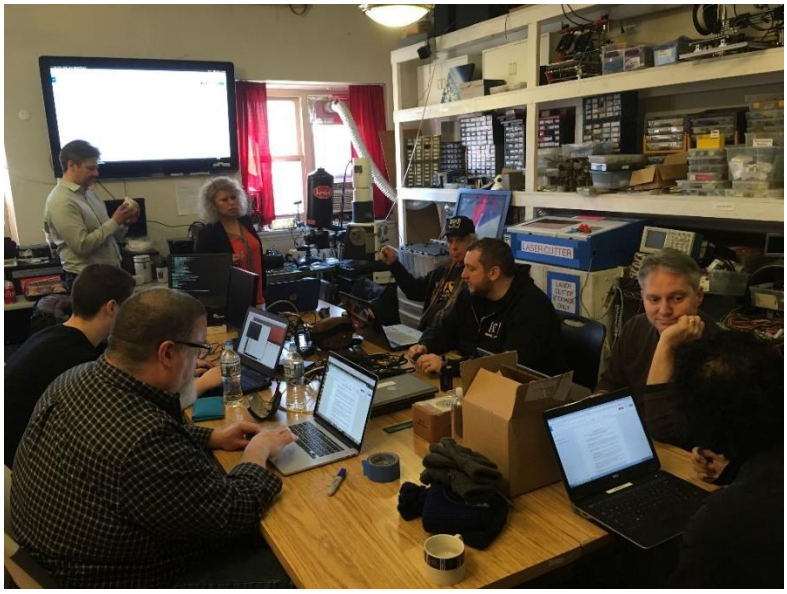

Image 2: HacDC's Physical Space
Source: HacDC’s website

The HacDC Model

Makerspaces exhibit a range of activities, governance structures, scope of ambitions, regularity of use and attendance, and exist in diverse local contexts. Halbinger (2018) points out that makerspaces provide access to and lower the costs of those factors known to support innovation, e.g. resources. In this light, HacDC, as all Makerspaces has characteristics that could be more or less conducive to prosumption practices. In this research we consider prosumption to involve consumers producing some of their own goods and services, as opposed to buying them (Ritzer et al. 2012).

Advantages for prosumption in HacDC model:

1. Hours (24/7)
2. Financial accessibility

The first advantage that is conducive to prosumption that I observed is that the space is open 24 hours/7 days a week. This means that anyone who is a member can use the space and tools at essentially anytime – day or night, thereby allowing consumers to prosume - make their own goods and services – whenever works best for their schedule and routines. A second advantage I identified is that HacDC is relatively accessible from a financial perspective – monthly membership is only $60, compared to private Makerspace models which range anywhere from $100-200. This means that only for only $60/month a consumer has access to a space with tools and other people, to make, create, and fix as they please.

Disadvantages for prosumption in HacDC model:

1. Tools out of service
2. Small scale – small physical space

Some disadvantages of the HacDC model are that tools and technologies available are not very accessible to consumers that aren’t tech-savvy, as they are often broken or in need of repair by the members. The space itself also simply doesn’t fit that many people, meaning prosumption activities mostly happen in smaller groups of maximum

10-15 people, making it harder to disseminate knowledge to consumers and help consumers build self-sufficiency to prosume independently.

The HacDC model attends to predominantly one consumer group – techies. Technology is manifold in nature, so HacDC attracts consumers interested in a variety of technologies, but mostly only those individuals that have a prior understanding of technology. Manifestations of community at HacDC will be explored in a later section.

4.2. Arlington Central Library

Background

The second Makerspace observed was Arlington Public Library. This Makerspace is classified as a Makerspace in the general sense of the term – a space where people gather to make things with tools and materials (Smith et al. 2016). The Maker programming at Arlington started in 2015, when librarians identified Makerspaces were trending at other libraries and they decided to ask the Library board for funding for Maker events. The Library is located in the Arlington neighborhood of Virginia, which is relatively affluent and well developed.

Funding and Governance

Funding for all Maker events is through the Friends of the Library, a nonprofit dedicated to “supporting life-long learning in Arlington, VA.” This funding is separate from the Library’s regular budget, which is resourced by public funds. The programming is run by paid librarians and is free and open to the public. Decisions related to the programming are made by the Maker Librarians; there are two Maker Librarians at Arlington Central Library – one for teens and one for adults. Other librarians assist with the programming as needed and as identified by personal interest areas.

Mission of Maker Programming

The library identifies you as Maker “If you want to go beyond buying and consuming technologies, devices, and products to redesigning, fixing, and creating them… If you are curious about how stuff works, and think you could build something better… If you like to find new uses for old things, look for solutions to real-world problems, and to

overcome barriers… If you have great ideas, and want to develop hands-on skills to match…" This description is very much aligned with the philosophy of the Maker Movement, which embraces the idea that anyone can be a Maker, that anyone can design, create, produce, and distribute renewed and improved products and artefacts (Nascimento & Polvora 2016).

On Meetup.com, the group that promotes Maker events at Arlington is called "Imagine, Create, Share: Makers in Arlington" and they state their purpose as "The Maker Movement at Arlington Public Library encourages a fun, participatory and inclusive learning community through free and open access to tools and technology. Discover new ideas and interests, create connections and develop useful skills! Help us plan future programs by telling us what you'd like to code, build, craft, share, or make." The language used here is very similar to findings in the literature, which identify Makerspaces as cultivating a learning community (Kostakis et al. 2015; Hsu et al. 2017), with access to tools and technology (Fleischmann et al. 2016, (Halbinger 2018).

Physical Space

The space that is used for Maker programming and events at Arlington is also used for other programming. This means that there is not an actual physical space dedicated exclusively to Maker programming. One interpretation of this lack of a physical space is that it would mean Arlington is not actually, or 'technically' a Makerspace. Another interpretation – which is the one we use here – is that while there is no exclusive Makerspace per say, there is a room for the Maker events and programming that is reserved and used only for those programs for a specified amount of time. A permanent Makerspace is currently under construction on the second floor of the Central Library, which has been in the works for over five years and just now got the funding approved.

Programming

Maker events are announced on both the Library's website, as well as on Meetup.com. Frequently held events include: Make/Fix Anything Mondays, Make it Wednesdays, Creative Coffee, etc. I attended 02 Make/Fix Anything Mondays, as well as a special event in partnership with a local organization.

The description for the Make it Mondays: Make/Fix Anything event on Meetups.com, displayed below, focuses on fixing things that are broken or need repair – such as jeans, and a digital camera. It also mentions some of the tools available at the event – sewing machine, electronics parts, hand tools, etc.

The other event I attended was focused on upcycling old bicycle parts. This was a onetime event, as compared to the Make It Mondays events which are monthly or bimonthly. This event offered tools, materials, and a workshop on how to make belts from old bicycle parts.

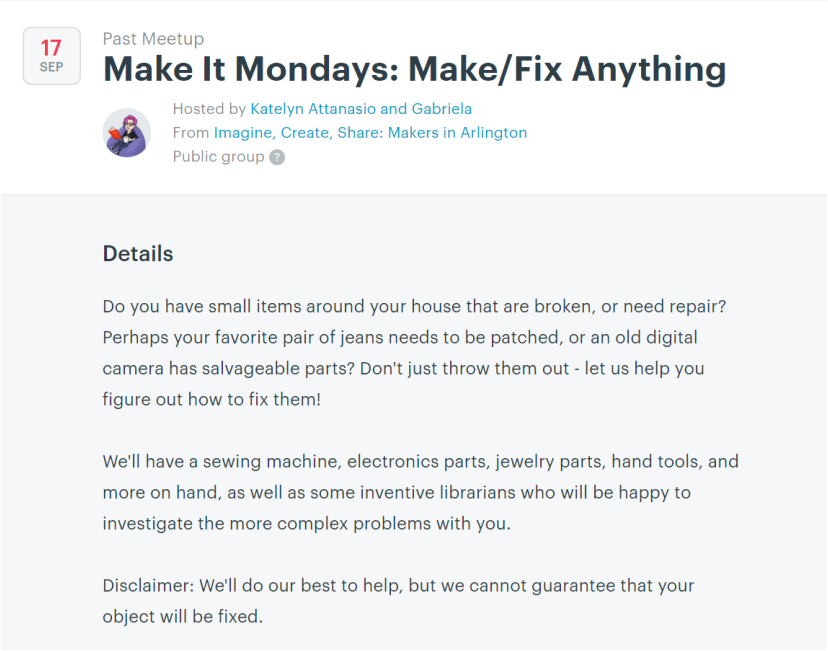

Image 3: Arlington Makers Make/Fix Event

Network

The Arlington Central Library is part of a county library system, which is made up of eight other branches. All these branches have Maker programming and share resources. The original idea and impetus for Maker programming came out the Central Library in 2015 and spread to the other branches in the system over

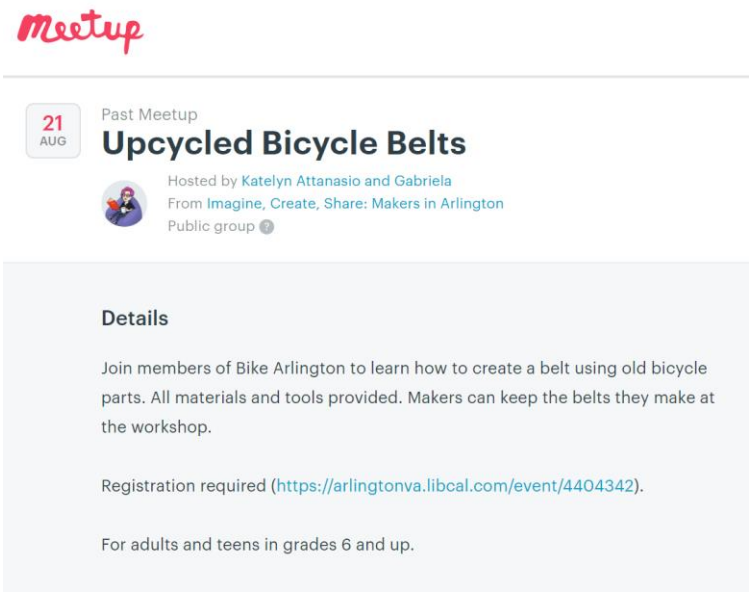

Image 4: Arlington Makers Upcycled Bicycle Belts Event

the years. This network allows for resource (both material resources and knowledge) to be shared, pooled, and disseminated, thereby lending the possibility of a more effective and responsive model for consumers (or patrons as the librarians refer to them).

Arlington Maker Model

The Makerspace model at Arlington is unique, presenting both advantages and disadvantages.

Advantages for prosumption in Arlington model:

1. Financial accessibility – free
2. Physical accessibility – known community space

The biggest advantage of the Arlington Makerspace model is that it is free and open to everyone. This advantage of accessibility is very central to the Maker Movement philosophy (Halbinger, 2018).

Disadvantages for prosumption in Arlington model:

1. Limited resources (tools, knowledge)
2. Limited hours

The biggest disadvantage of the Arlington model is that it has limited resources, which could limit its prosumption potential. This is because the space is not permanent, meaning that patrons cannot go into the space whenever they want to prosume, as they can at HacDC, but rather must wait to attend specific programming. Arlington also has limited tools available, in comparison to other Makerspaces.

In short, Arlington is the most financially accessible of all the Makerspace models, as it offers free programming, but rather limited in potential. In this sense, the library model attends to a few distinct consumer groups: (i) consumers interested in picking up a new hobby, such as crafting; and (ii) consumers interested in learning new tool, such as a 3D printer or a sewing, but don’t have the money, necessity or even desire to buy one for solely personal use. The library can give consumers the opportunity to try out a new

craft or technology tool by removing financial barriers. In the case that a consumer attends Maker events and programming and decides to pursue a hobby further or use of a specific tool, s/he could seek out a membership at a private Makerspace, in order to have access to a permanent space and more high technology tools.

The Adult Maker Librarian at Arlington, Stacy, is very aware of both the benefits and drawbacks of this model. During an interview with Stacy, she spoke about accessibility of the Arlington Maker programming, in comparison to other Makerspace programming, she brings up the point that the library can serve as a "gateway" for patrons interested in trying out a new hobby or craft, but that don't have access to financial resources to invest in the tools for such a hobby or craft:

> *The initial buy in for many crafts can get expensive. The library offers materials and equipment free of charge to patrons. And if they try it out and it's not for them, at least they didn't have to invest money into it.*

The concept of the library as a gateway into more prosuming activities is reinforced by the consumer centric mindset of the librarians. When asked how they come up with programming, all the librarians responded that they do what patrons ask for. This information is gathered via survey at the end of events and in informal conversations with patrons. This consumer centric mindset is also present in the librarians' discourse about how the Maker programming is raising awareness among patrons that the library's mission remains unchanged, although the means and methods have changed. This point was brought up during an interview with Dawn, the other Maker Librarian at Arlington. She speaks to the fact that patrons are often surprised that the library hosts and funds Maker programming, as it is very different than the 'traditional' idea of what a library is and should be – a quiet place to read books. Dawn normalizes the Maker programming, stating that it's like what the library has always done – shared resources, skills, and helped one another.

> *People are sometimes surprised we're doing soldering and sewing at the library, but when you think about it a little further, it's not so different from what we've always done in the library, we share resources, we share skills, we help each other…. Patrons want to have fun here. We want to communicate to all patrons that the mission of the library is more than just books and story time. It shouldn't be a quiet*

place. It should be a place for community gathering and sharing. And the Maker programming is a big part of that.

The next section will explore how each makerspace relates to the literature – on prosumption, participatory culture, and community. This section will address the research topic (i) contextualization of each case.

4.3. Contextualizing the Case Studies via Literature

HacDC and Arlington have similarities and differences in terms of potentialities for consumer empowerment. These will be explored using the lens of consumer studies literature topics – prosumption, participatory culture, and consumption communities – related to consumer empowerment.

4.3.1. Prosumption in the Cases

Prosumption is a backdrop from which to understand what is happening in the makerspaces observed. We consider prosumption to be the "what" in these case studies, while consumer interaction with things and the enabling environment are the "how."

Prosumption has been defined as "value creation activities undertaken by the consumer that result in the production of products they eventually consume and that become their consumption experiences" (Xie et al. 2008: 110). Both HacDC and Arlington Central Library gather consumers in the same place and give them the tools – physical, social, cognitive, experiential and emotional - to make their own things. In this sense, these makerspaces provide the possibility of prosumption, as they are places in which consumers can become producers of diverse artefacts. It can be argued that there is a continuum of potentialities for prosuming at these makerspaces, which is to say at each space there can be enablers of higher or lower intensity for prosumption activities. For example, HacDC is open 24/7, making the possibility for prosuming much more accessible, whilst Arlington has more of a learning culture, making it easier for a layman to pick up a new skill necessary for prosumption.

Observation and interviews suggest that the makerspaces foster environments ripe for stimulating consumer empowerment. This stimulation of consumer empowerment ultimately happens through consumers being exposed to new contexts with materials (human-thing interaction) and learning how to prosume (collaborative environment). Both HacDC and Arlington are places where consumers can combine their efforts and resources to make and fix their own products, and in this way their consumption interests can counter traditional capitalistic models. This idea is similar to Denegri-Knott et al. (2006), who suggest that consumers often combine resources to feel empowered in the face of mainstream producers.

Data collected suggest that there are a variety of characteristics that foster consumer empowerment at the makerspaces observed. These characteristics function in relation to the process of prosumption. Considering that the cases were chosen in accordance with Eisenhardt (1989), who says that polar types can be helpful to make the process of interest “transparently observable”, identifying these characteristics can help elucidate the differences and commonalities of the empowerment process in the case studies. The next section serves to elucidate some characteristics by looking at the case studies in relation to the literature on participatory culture and consumption communities.

4.3.2. Participatory Culture in Cases

Participatory culture seems to be a central element to facilitating prosumption. This is to say that aspects of participatory culture contribute to consumers having an enabling environment and supporting other consumers to prosume. HacDC was observed to have more elements of participatory culture than Arlington Central Library.

As theorized by Henry Jenkins (2006), participatory culture stems from the constant evolution of the digital landscape and a shift to more social, collaborative forms of consumption. Understanding participatory culture for this research is relevant because the Maker Movement seeks to bring online communities to physical spaces. The Movement has been referred to as a new industrial revolution which happens “when the web generation turns to the real world” (Anderson 2012: 42).

Elements of this type of culture where observed at both Makerspaces, in varying forms and degrees. There are three key elements of participatory culture that we address – (i) low barriers to expression and engagement; (ii) support for creating and sharing one's creations with others; and (iii) informal mentorship.

The first element of participatory culture – low barriers to expression and engagement (Jenkins 2006) - was more present at Arlington Public Library than at HacDC. Arlington is generally a more receptive space for all Makers, whereas HacDC is more focused on the technology side of making. The profile of members at HacDC impeded expression to some extent, as most members tended to be introverted and shy. Whereas at Arlington, many participants were eager to express their thoughts and ideas about their projects. During an interview with Dave, who is 38 and has 3 years of experience as a member at HacDC, he made similar observations of these distinctions between the 'profile' of people that tend to go to hackerspaces, as opposed to makerspaces. The profile type described by Dave, namely 'autistic' and 'little to no social skills,' can be less conducive to expression and engagement. Whereas Dave noted that makerspaces tend attract to a profile type that is more 'communicative' and 'socially savvy.'

Dave, 38, member, HacDC:

> *It's somewhat pejorative to say, but I would say that this [HacDC] tends to attract people who are hush on the autism spectrum. I see other spaces as attracting a more normal, socially savvy kind of person, here there's a high degree of tolerance for people who have little or no social skills. The Makerspaces tend to attract a more artistic…even if they can't communicate with the public, they want to communicate through their art. Here though, many of us want to talk to machines, Screw people!*

The second element of participatory culture - support for creating and sharing one's creations with others (Jenkins 2006) - was very present at both sites. At HacDC, many of the creations or pictures of the creations are displayed in the actual space. For example, there is a big picture of a space blimp that was made there, and now orbits the Earth. HacDC also displays many of its' members projects on its website, which is rather extensive. Additionally, some members of HacDC attend the Maker Faires in the US, to share their projects with other Makers and the wider public. At Arlington, this

sharing happens during the event, where participants organically inquire about projects. One of the Maker librarians also promotes the creations on a library Twitter account.

The last element of a participatory culture – informal mentorship – was more present at HacDC than Arlington. Frederick, a HacDC member, is an avid mentor. He is one of the oldest members, in both age and time at the space, and although he was not part of the group that founded HacDC, he was one of the first members. He works professionally as a mentor for high school students and he sees HacDC as a place where he can extend this knowledge and passion he has for mentoring. Another interesting point that appears in Frederick's discourse is the 'hands on learning' aspect of HacDC that attracts him, that instead of grading papers he would rather be helping someone to make something:

Frederick, 58, Director-at-large HacDC:

> *I work with some local high schools doing a mentoring program. I'm a better mentor than a teacher. I don't want to grade papers, I want to find people that want to learn something about technology and say 'Come, we can do this thing.' And I have that here at HacDC, if you are interested in technology, we're friends and I'll help you make whatever it is you want.*

Jenkins (2006) also theorizes that in participatory cultures, consumers are no longer passive audiences, but play the dual role of "consumer" and "producer" (Wang, 2018). The case studies suggest the importance of the development of collective experiences of prosumption, which happen in makerspaces. In this sense, it can be theorized that participatory culture and prosumption enable consumers to be less passive and more active, as they can create and share their works and products. In Makerspaces where participatory culture is present and prosumption is active, as is the case of both HacDC and Arlington, consumers can become less reliant on the market, as they gain the practical know-how and have access to resources to produce some of their own goods. This concept of makerspaces as places where alternative forms of consumption are possible is very present in the literature on hackerspaces. Hackerspaces have been researched as a critique of neoliberalism (Coleman 2013), an alternative to globalized production (Anderson 2012), means of opting out of mainstream consumption (Davies

2018) or the opportunity, although one that is constantly frustrated, to intervene in capitalism (Söderberg et al. 2015).

This idea of being less reliant on the market and thinking of alternative consumption routes came up in many interviews and during field observation. During an Open House I attended, one of the older members at HacDC was explaining to me his interest in joining HacDC and described his desire to join the open software movement and consume outside the capitalist model:

> *I kind of grew up in the culture of 'software you share it' software is a living system, that everyone shares and contributes to. So, when the PC came along, and the model shifted, I was ANGRY. There's this cage being built around me. Rules – we don't need no rules. Licenses – we don't need no stinking licenses. I want to find something else and that's when I found there was a Linux open source software movement that said,* ***'Screw this bureaucratic, capitalistic, proprietary model****.'*

Since the Maker Movement is touted as being grassroots (van Holm 2015) and revolutionary (Anderson 2012), some members are hyperaware of their model and ideas and way of being in Makerspaces getting commodified. This discourse was most frequent at HacDC, where many members are very keen on open source, as demonstrated in the quote above. HacDC members relayed that any invention that is scalable or life changing that comes out of the Makerspace will be open source. They are critical of Makerspaces in the area that are more market facing and interested in patenting any type of products that come out of the space. This backing of open source at HacDC can be seen as closely related to the second element of participatory culture – support for creating and sharing one's creations with others. What better way to share your own creations with others than through open source?

This issue was brought up during an event I attended at HacDC. I was chatting with a few members about the different types of makerspaces and the specific makerspaces in the area. One member cited that some of the other makerspaces in the Washington, DC metropolitan area have a vested interest in the members developing a patent and ultimately profiting from that. Whereas at HacDC, there are entrepreneurs developing specialized products, but the space actively supports open source.

> *Some of the spaces around the area are more interested in helping develop a patent and keep it closed source. And I think most Hackerspaces are generally hostile to that, even what they're doing in there, he's pushing for open source…Just the idea that just because this looks like you can't get into it, ohh that's not true, you should be able to open this up… It's not our core mission, but I would say many of us are militantly open source. I think it's more important here than at Makerspaces in the area.*

If this commodification were to increase over time at these spaces, this could decentivize Makers who have an open source, countercultural ethos from participating. This commodification also deters from consumers feeling empowered, as their inventions and creations are being put back into the logic of industrialized, mainstream consumer culture. This point, of being less reliant on consuming mainstream goods and services offered by the market, will be explored throughout this research. It is important to note here that participatory culture reinforces this possibility – by offering a platform, be it physical or digital, to share ideas and projects and receive mentorship.

4.3.3. Community in Cases

A strong community seems to be a central element to prosumption. This is to say, the stronger the bonds and shared interests and practices, the more support consumers may have to engage in prosumption activities. More elements of consumption communities were identified at HacDC than Arlington. We suggest that HacDC may be conceived as a prosumption community, described by Tapscott and Williams (2006) as spaces where "customers participate in the creation of products in an active and ongoing way." Through prosumer communities, consumers have the opportunity to co-innovate and coproduce the products they consume. The following paragraphs explore the ways in which each makerspace is distinct in its expression of elements of consumption communities.

Three elements of a consumption communities include: (i) a common consumption interest (Beverland et al. 2010); (ii) shared commitment to a product class, brand, activity, or consumption ideology (Cova & Cova 2002; Muñiz & O'Guinn 2001; Schouten & McAlexander 1995); and (iii) shared practices (Wenger et al. 2002).

The first element of consumption community – common consumption interest – was significantly more present at HacDC. Most members at HacDC are united and relate to one another based on their consumption of technology. While this consumption of technology takes on various forms, which will be explored in later sections, technology is the common thread throughout all programming. Whereas at Arlington, there is a wide variety of Maker programming – ranging from arts and crafts, to 3D printing workshops, to fix/repair events. This means that participants also have a wide range of consumption interests, and this varies from program to program. This was also observed during field visits – at HacDC I identified many of the same members at different programming, whereas at Arlington I did not identify any of the same patrons at different programming.

The second element of a consumption community – a shared commitment to a product class, brand, activity or consumption ideology – was much more present at HacDC. At Arlington, participants at each of the different Maker programs did share a commitment to a consumption activity – be it arts and crafts or fixing/repairing things. But this shared commitment was only within those specific programs and not common to all Maker programs at the library. Whereas at HacDC, there was a shared commitment to a consumption ideology, an ideology that is cited in the literature as hacker ethos or ethics. This ideology is based on sharing, collaboration, and learning through deconstruction and reconstruction (Levy 2001).

The last element of a consumption community, specific to a community of practice in this case – shared practices – was only observed at HacDC. Some of the shared practices observed at this Makerspace include the common use of tools, the hacker ethic which guides members on how to address persistent issues, and countercultural undertones. One of the interviewees, Dave, 38, talked about this hacker ethic that all members should have and that guides them on how to address situations. He specifically talked about this difference between a hackerspace and traditional makerspace, saying that in a hackerspace a member would be expected to fix a tool if it broke, whereas in a Makerspace this would not be the case. This illustrates a common expectation and shared practice of how to handle things that break at HacDC:

> *I joke about it, but when you go to a Makerspace or FabLab, you go with the expectation of using the tools… In the Makerspaces around the area, you should be very disappointed if you go in to use the 3D printer and the 3D printer isn't working. If come here [HacDC] and it's not working, you shouldn't be disappointed, you should know where the manual is to start rewiring it and fix it yourself. It's the ethic, the philosophy for the Hackerspaces…*

Both makerspaces observed encourage collaboration and knowledge sharing, which is aligned with Humphreys and Gayson (2008) use of the term 'collaborative consumption,' applied to describe situations where consumers collaborate with companies or with other consumers to produce things of value.

Inter-community conflicts were observed at both sites. The conflict was more extreme and persistent at HacDC than at Arlington. This is coherent, as this is a community of practice, where members are in contact with some frequency and there are decision making structures. The issues at Arlington were related to the decision to fund Maker programming, as opposed to other more 'traditional' library programs, as well as volunteers interrupting the maker empowerment process, as cited below by interviewees:

> *There has been some push back from people who think that this isn't what libraries should be doing. 'Why are you spending X amount of $ on this space and why not on this other thing?'*

> *There was a volunteer who was really knowledgeable, but he was overbearing. He would jump in and fix things for people. And so, we had to have a little cultural meeting to be like…explain the teaching philosophy …Our goal is to make the participants feel smart, feel that they can do this. There's a lot of inhibition to that in our culture of expertise.*

This is consistent with other findings that argue is a fundamental tension between a hacker ethos of individual responsibility and agency and the care required to maintain the close-knit communities of hacker and makerspaces (Toombs et al. 2014).

The next section will address the research topic: (ii) consumer empowerment via interaction with things.

5. Levels of Consumer Empowerment in Makerspaces

As explored in the literature review, there are many definitions and theories related to consumer empowerment. Some are more focused on individual consumption, and others on collective consumption. Both types of consumer empowerment, were observed in the case studies to varying degrees

On the individual level, we consider Hunter and Garnefeld's definition of consumer empowerment (2008: 2):

> *consumer's subjective experience that they have greater ability than before* ***to intentionally produce desired outcomes and prevent undesired ones*** *and that they are benefiting from the increased ability.*

In this framing, consumer empowerment can be a positive subjective state which results from a mental comparison of a consumer's abilities relative to existing or previous abilities. From this definition, intentionality is a key element in consumer empowerment. Recently, there has been criticism of this individualistic view of consumer empowerment. Papaoikonomou and Alarcón (2017) argue to move the focus from the individual to the collective level. In this sense, to address collective nature of consumer empowerment, we consider Holt (2002) and Denegri-Knott et al. (2006) who view consumers as empowered when they can manipulate and even produce special spaces within the market in which they can construct their cultural (consumer) identity. This concept of consumer empowerment is very applicable to makerspaces, as makerspaces are literally spaces where countercultural consumption can take place.

As explored in other sections, the common thread observed in these case studies was prosumption – in which consumers gain practical know-how and have access to resources in order to produce some of their own goods. Prosumption in makerspaces is distinct from other types of prosumption because much of the literature studies prosumption in online communities (Tian et al. 2017), whereas the case studies for this research observed prosumption in physical spaces. Much of the prosumption literature is based on DIY consumption (Watson & Shove 2008; Xie et al. 2008) and the prosumption in the case studies is different because it is Do It with Others (DIWO) as well as DIY. Lastly, the literature touches upon diffused technologies as a means of

prosumption (Toffler & Toffler 2006), whereas this research observes prosumption through technology, as well as hand tools and art and crafts.

Building upon the concept of prosumption in physical settings, we extend Hunter and Garnefeld's definition of consumer empowerment as it happens in makerspaces to "prosumer empowerment." This extension is well situated, as the father of the Maker Movement, Dale Dougherty, believes the Movement has come about in part due to people's desire to engage with artefacts in ways that make them more than consumers (2012). In this case, it is in a way that makes them prosumers. This definition is extended, as our exploration goes beyond the subjective, individual, psychological aspect of consumer empowerment to explore empowerment as a collective experience in collaborative environment where consumers are empowered to become prosumers. This extension of consumer empowerment to prosumer empowerment is related to Ratto's (2011) theory of "critical making." Ratto explores two modes of engagement in makerspaces – critical thinking and physical making. The first mode – critical thinking – deals with the cognitive aspects of making and the second mode – physical making – deals with the material aspects. Ratto (2011: 53) defines critical making as:

"…a desire to theoretically and pragmatically connect two modes of engagement with the world that are often held separate—critical thinking, typically understood as conceptually and linguistically based, and physical "making," goal-based material work."

During observation and interviews it was possible to perceive that these two modes are intertwined, as are the individual and collective consumption experiences in makerspaces, and while we can examine them individually, by considering their connectedness we can get a clearer picture. Critical making was observed in the case studies. We extend Ratto's concept of critical making by breaking down the aspects of critical thinking and physical making that can lead to consumer empowerment, with the backdrop of prosumption. As stated previously, prosumption is the "what" is happening in the makerspaces and human-thing interaction and fostering environment are the "how." As such, we theorize that the process of consumer empowerment at makerspaces occurs on these two different levels. On the first level - critical thinking - which is more cognitive and subjective, participants become empowered via interaction

with things. This can be conscious or unconscious. And on a second level, which is more collaborative and social, participants can construct an alternative that constitutes a different means of consumption and production (i.e. prosumption). In this collective prosumption experience, consumers become empowered by being in an enabling environment that stimulates acquiring skills for self-sufficiency by gaining practical know-how and having access to tools to be able to produce some of their own goods.

The next subsection serves to expand upon the research topic (ii) consumer empowerment via interaction with things.

5.1. Interactions between Humans and Things

To define humans and things, we use Latour's concept of actants. Latour (1999) poses actants as anything that "…modif[ies] other actors through a series of…" actions (75). Here we distinguish between human actants – namely the participants at the makerspaces observed – and non-human actants, what we call here, 'things' – as the actors present in makerspaces that are not humans, i.e. physical and virtual objects such as materials, tools, and technologies.

According to Dant (2008), it is through our interactions with material objects that we make sense of them and come to understand how to transform them to suit our needs. In his own words:

> *Our interactions with material objects are dependent on us making sense of what they mean and* ***what actions will be effective in transforming them to suit our purposes.***

In makerspaces, consumers encounter material objects, be it through making something from raw materials or fixing an old product. In the sections to follow, many examples and stories of consumers transforming material objects to suit their purposes will be explored. Common examples include consumers fixing broken objects, such as fans, lamps, and clothing.

Dant's quote above helps to shed light and guide this first level of consumer empowerment, which deals with empowerment via our interaction with things. Some research suggests that our interaction with things - making by hand - is fundamental to

how humans comprehend the world (Hatch 2014). Hatch (2014: 94) states that we must make, create, and express ourselves through physical things to feel whole.

> ***There is something unique about making physical things.*** *Things we make are like little pieces of us and seem to embody portions of our soul.*

In this quote, Hatch suggests that we embed meaning into the things we make and that there is something singular about this interaction and relationship with something we made using our hands. Holt (1995: 2) explains that consumers use material objects (e.g. goods, products) as "vessels of cultural and personal meanings". Similarly, Bardzell et al. (2015) suggest that acts of making can enhance an object's personal meaning, leading to greater attachment and fostering an ethic of long-term care. In a similar sense, it has been proposed that Making with our hands is part of what makes us human. And materials are central to this making process. In an informal conversation with a patron at a Make/Fix Event at Arlington, during a field observation, he brought up this very point. In his mind, these phenomena related to makerspaces that we are detailing here are nothing new and are in fact very intrinsic to being human.

> *While we have new names for these things [makerspaces, hackerspaces, decentralized production models]…they aren't new,* ***humans do this….It's possible that creativity, artmaking are actually what makes us human.***

In this sense, one of the values of makerspaces is that they can bring back creative capacities and allow people to intervene in their world via materials. Following Dant's concept of material interaction, I suggest that this human-thing interaction is a way of activating consumer empowerment. Makerspaces provide value and activate consumer empowerment by (i) offering tools and technologies consumers do not have access to in their own homes (Smith et al. 2016) and (ii) providing a context for consumers to interact differently with things. The table below is a non-exhaustive list of some of the tools and technologies available to consumers:

Tool/Technology	HacDC	Arlington
Sewing machine		X
Sewing materials		X
Saw		X
Craft materials		X
Button matters		X
Toolbox (hand tools)	X	X
Power tools	X	X
Laminator	X	X
Robotics kits	X	X
3D printer	X	X
Computer components (graphic cards, video cards, etc.)	X	
Chemicals (acids, solvents)	X	
Laser cutter	X	
Soldering iron	X	
Function generator	X	
Oscilloscope	X	
CRISPR	X	

Table 2: Sample of tools and technologies available at HacDC and Arlington

Tools are central to makerspaces. In both case studies, consumers had access to tools they would not have necessarily had access to in their own homes. For example, very few consumers have 3D printers, laser cutters, or soldering irons to make their own

goods, but these are available for use at makerspaces. Illiach (1973: 34) speaks to how humans can produce meaning in their worlds by using tools:

> *Tools are intrinsic to social relationships. An individual relates himself in action to his society through the use of tools that he actively masters or by which he is passively acted on.* ***To the degree that he masters his tools, he can invest the world with his meaning.***

Makerspaces can provide a context, a place, for consumers to interact differently with materials and tools than they do daily. We are in the Information Age and the nature of the digital has altered the ways in which we exist in the world (Dufva 2017). This is to say the Information Age has distanced consumers from working with our hands, from understanding how products we use every day work and function. And the Maker Movement celebrates the lost arts of traditional handicraft skills (Anderson 2012; Lang 2013). In this sense, Makerspaces could serve to bridge the gap between consumers competencies with digital and physical artifacts. This point was also present in Mike's discourse, a volunteer at the Make/Fix Anything events at Arlington. Mike volunteers monthly for these events. He started a similar project during his Master of Arts (MFA) in Maine and when he moved to D.C. he wanted to continue with the project. During an interview with Mike, we were talking about makerspaces in the context of American, capitalist society, and their important role in bringing us back to a more intimate, intentional relationship with things. His concept, similar to the point above, is that makerspaces are actually an outcome of modern, digitalized, industrialized society in which your average consumer has no understanding of how things they use on a daily basis actually work.

> *I think this [advent of makerspaces in the US] is something that is an outcome of modern society and industrialization that* ***we're at the point that we don't understand the things that we're using on a regular basic….****their politics, their supply chain.*

In the next subsection, I will address the ways in which this human-thing interaction can empower consumers in makerspaces, further delving into the research topic on (ii) consumer empowerment via interaction with things.

5.1.1. Action Intentions and Prosumption Practices in Makerspaces

Dant (2008) explains that we (humans) change material objects, both physically and their meaning as signs. We suggest that things, on the other hand, are embedded with the intentions of their designers, who anticipated how they would be interacted with. For purposes of this research, the intentions of designers are considered synonymous with the inbuilt limitations of objects. The literature on sociomateriality explores how users recognize the limitations of objects (Jarzabkowski et al. 2013). It is important to note here that intentions can be either conscious or unconscious. The interaction of humans 'changing' material objects and objects being embedded with intentions, is played out in makerspaces. In this section I explore the action intentions in human-thing interactions.

Members go into HacDC and patrons to Arlington Central Library for a variety of reasons. When members and patrons interact with one another and materials in these makerspaces, we suggest they have certain intentions. For example, when a patron attends a Make/Fix Anything event at Arlington, the intention is to make and/or fix a thing. Here I distinguish between intention and action intention, as there are many dimensions of intentions. Here I consider the definition of action intention that is used by leading American marketing theorist Richard Bagozzi (2010):

> *An action intention is defined as a person's commitment, plan, or decision to carry out an action or achieve an outcome.*

This definition of action intention is related to Hunter and Garnefeld's (2008: 2) concept of consumer empowerment explored in the previous section:

> *consumer's subjective experience that they have greater ability than before to intentionally produce desired outcomes and prevent undesired ones and that they are benefiting from the increased ability.*

Both definitions use the words ***intention*** and ***outcome***. This use of words is significant, as these are two phenomenon that were relatively observable in the makerspaces – what action intention the consumer had coming in to the makerspace

(i.e. fix, create, hack) and what was the outcome (i.e. repurposed product, new product, no product, etc.). To capture this idea of intention > outcome in the context of this research, I will use the term “prosumption practice.”

While the action intention/prosumption practice of each consumer that walks into HacDC or Arlington is distinct, I suggest here that they are shaped by the Maker programming. As mentioned above, if a patron goes to a Make/Fix Anything event at Arlington, it can be assumed that their action intention is to make and/or fix something. Likewise, if a patron goes to a Make it Wednesdays event, his/her action intention would be to make something. Below there is a table with the main events I attended.

Makerspace	Event	Objectives
HacDC	Open House	• Open space to potential members to learn • Contribute to collective on-going projects • Source ideas from other members for on-going individual projects
Arlington	Make, Fix Anything	• Fixing things that are broken or need repair • Grant access to tools and practical learning
HacDC	3D Thursday	• Work on projects using 3D printer • Upskill members to use 3D printer
Arlington	Upcycle Bicycle Belts	• Make belts out of old bicycle parts • Bond with family and/or friends

Table 3: Sample of Events at HacDC and Arlington

The following analysis delineates a typology of prosumer practices and design intention of the objects observed at the makerspaces. Prosumer practices have action intentions embedded into them, but go beyond the cognitive aspects of intentions, to encompass emotional and social aspects. Each of these prosumption practices will be explored in the following sections.

The prosumption practices are typified as:

(1) **Fix/repair**: consumers fix/repair broken finished products, using tools and/or raw materials
(2) **Create/invent**: consumers create/invent new products, using tools and/or raw materials
(3) **Hack/modify**: consumers hack/modify a finished product to have an unintended function, using tools and/or raw materials

The design intentions of objects below is a non-exhaustive list. We only identified those intentions that pose a challenge to the consumer, meaning consumers would have a reason/intention for wanting or needing to disrupt the object's intention to successfully implement a prosumption practice. For example, we don't consider objects that are designed to be repaired, as they do not present a challenge to human action intentions and/or prosumption practices. The design intentions of objects are typified as:

(1) **Built-in obsolescence**: "the conception, design, and production of a commodity with an intent of it being useful, functional or popular for a certain period of time, after which it becomes obsolete, that is, unfashionable or no longer functional (Jones et al., 2015)
(2) **Non-repairable**: the design of a product with an intent to only be repairable by the manufacturer or not at all. (Jones et al., 2015).

The diagram below outlines the human-thing interactions on a basic level, as observed to have occurred in the makerspaces.

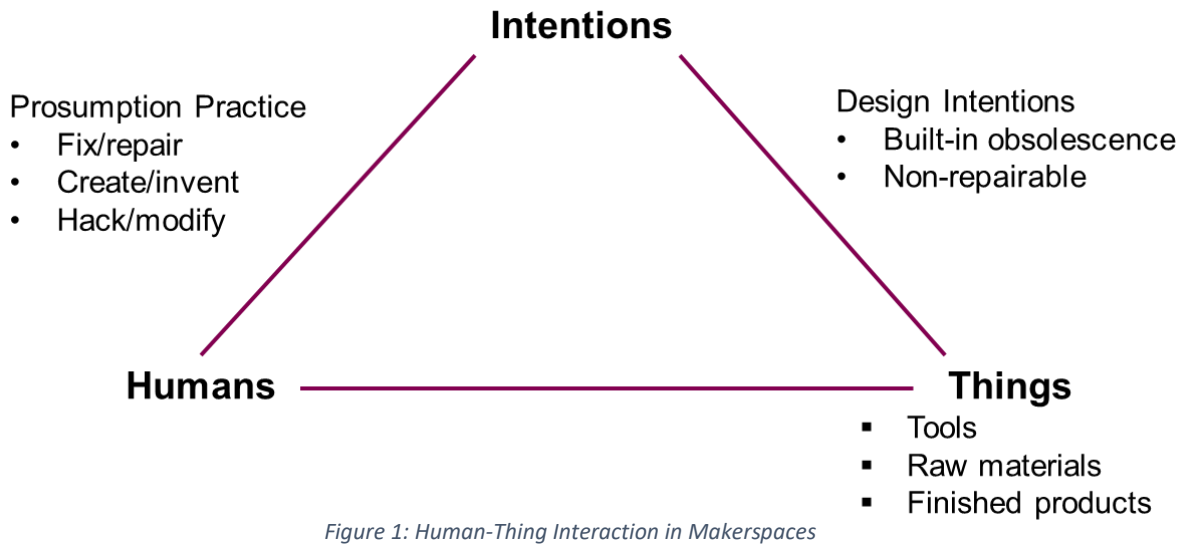

Figure 1: Human-Thing Interaction in Makerspaces

In the literature, it is generally accepted that many consumer goods are built to be either obsolescent or nonrepairable, which could mean anything from a product not being made for disassembly, parts not being sold for modular repairs, or repairs are only possible through the company (i.e. Apple phones). The literature cites a variety of types of obsolescence (Zallio & Berry 2015) and the above design intentions are by no means an exhaustive list, rather they are the types of design intentions that were readily observable in the field. Although these concepts are present in the literature, this does not mean to say that consumers are necessarily readily aware of them.

It is also important to note that these design intentions can be related to the sociomateriality concept of affordances. The difference between design intentions and affordances is that affordances are context specific, whereas design intentions are rather static. Affordances refer to the properties materials have in specific contexts (Gibson 1986). We recognize that this research was done in a specific context, so the affordances cannot be boiled down to their material constitution, but are inextricably entangled with specific, historically situated modes of engagement and ways of life (Bloomfield et al. 2010). This is to say that in other makerspaces, the affordances

observed could very well be different from those I observed. More importantly, affordances for the same object in an individual's home could (and would most likely) have distinct affordances in a makerspace. For example, an object in a consumer's home could have the affordance of being broken, but that same object in the context of a makerspace – with all the tools and human resources available – could have the affordance of being functional, as it could more easily and readily be fixed.

In the sections to follow I offer examples of consumer empowerment from the makerspaces case studies. In the makerspaces observed, we theorize that consumer empowerment was activated in two main ways:

1. Fulfillment of prosumer practice, leading to a sense of accomplishment from achieving desired outcome
2. Disruption of prosumer practice from being fulfilled, leading to a sense of agency being activated from not achieving desired outcome

In the following subsections the analyses will explore situations in which prosumer practices were fulfilled or not fulfilled and how this led to consumer empowerment. This section helps to answer the research question (ii) consumer empowerment via interaction with things.

5.1.1.1. Prosumption Practice | Fix, Repair

This prosumption practice is perhaps the most relatable. Something breaks at your house or is not working, and you have the intention of fixing or repairing it. As a consumer, you could go out and buy a new thing (product) or contract a service to fix your thing for you. In this sense, the very act of the patron at a makerspace wanting to fix or repair something constitutes functioning outside commercial forces and mainstream consumption options.

This prosumption practice can be imagined as the task of a handyman, and or someone who employs bricolage. I observed this being carried out by consumers using hand tools, interacting with volunteers to get assistance, and generally tinkering.

The nature of the products fixed or repaired were either:

(1) household items: lamps, clothes, shoes, bags, bikes, ceramics, eyeglasses, plates, toys, etc.

(2) technology items. garage door opener, cellphone screen, computer hard drives, cellphones, HDTVs, LCD displays, etc.

Image 5: Arlington Make/Fix Event, member fixed bag

Image 6: HacDC LCD Fix it Event

This idea of repairing is present in the literature on sociomateriality. Repairing can be an important conceptual extension in understanding the situated interaction between the social and the material. 'Repair' has been used to mean the sense of restoring the original affordances to objects, but it could be given a wider meaning whereby repair itself is used to repurpose objects (Jarzabkowski et al. 2013). Affordance here refers to the properties materials have in specific contexts (Gibson 1986). This concept of consumers creating new affordances will be explored throughout this section. Repair is often at the heart of human interaction with materials, as part of the practical coping involved in accomplishing a task in situ (Orr 1996). This idea is related to the concept of action intention, which is to carry out an action or achieve a goal.

As explored previously, analyses suggest that consumers are empowered in Makerspaces in a number of ways. One of these ways is when a consumer with a certain action intention effectively carries out this action. In the case of fixing or repairing, this would involve a consumer coming in to the Makerspace with the action intention of fixing or repairing an item and effectively having a favorable outcome. This empowerment happens through a sense of self-fulfillment and accomplishment, and ultimately the human fulfilling the action intention. The consumer would break the design intention of the object and ultimately grant a new affordance to the object or return the object to its original affordance. These concepts are displayed in the diagram below.

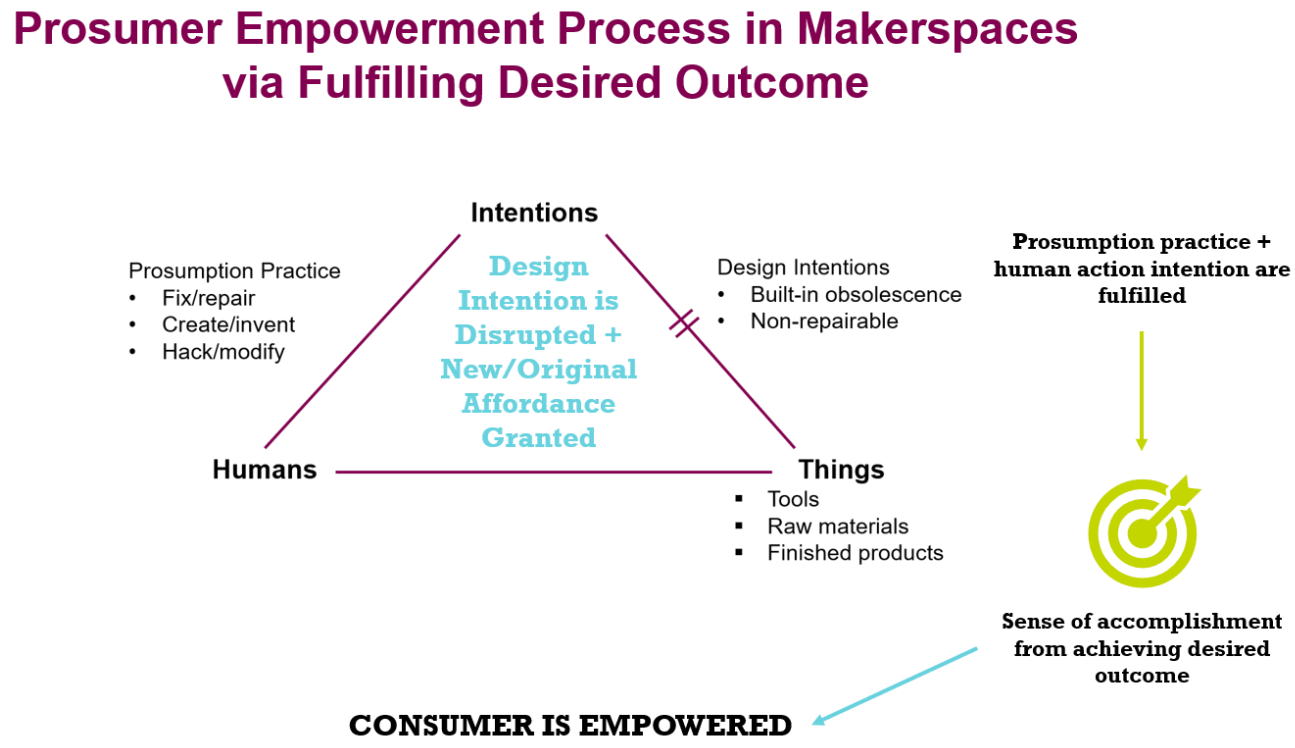

Figure 2: Prosumption Process via Fulfilling Desired Outcome

The first example of prosumer empowerment via carrying out the prosumer practice of fix/repair is at Arlington. During an interview with Maria who is 29 and a Library Associate at Arlington, she told me a story about a woman who recently brought in a fan to a Make/Fix Anything event. She made it clear that the woman needed a lot of encouragement and external motivation, but that she ultimately fixed the fan. The

takeaway is that the patron gained an emotional benefit – of being very happy – from being able to have fixed the fan and take it home, and that she did that herself. She fulfilled the prosumption practice she sought out to accomplish – of fixing the fan. Maria believed that this empowerment via self-fulfillment was more important to the patron than having saved money by fixing the fan herself.

> *She brought in a fan, and she needed a lot of encouragement from [the Maker-Connectors] and she got a little more help [than other patrons], but she was just really happy being able to walk away with fan that worked, and* ***I think most of that comes from the fact that she did it herself, not that she saved herself a few bucks or anything*****.**

The second example of prosumer empowerment via carrying out the prosumption practice of fix/repair is at HacDC. During an interview with Frederick, who is 58 and a Director at Large at HacDC, with 10 years as a member, he shared a story with me about how he fixed a drying rack for his wife with the 3D printer available at HacDC. This is a creative, nonconventional use of the 3D printer, as many people I observed during field work used the printer to create new things, rather than repair finished products.

> ***I used the 3D printer to print feet for a drying rack. My wife asked me because the feet were broken. The feet fit perfectly, and we didn't have to throw it away.***

This act also illustrates a situation in which a consumer effectively completes his action intention, while also "disrupting" the intention of the thing. In this case, one action intention of the drying rack is to be nonrepairable, considering that individual parts aren't sold for drying racks. This is also an example of the consumer creating a new affordance by seeing the possibility of fixing the object. If this member hadn't used the 3D printer to make the feet to fix the printer, he said they would have thrown away the rack. Instead, he showed a sense of empowerment by being creative, using the resources available to him at HacDC, and breaking with the intended nonrepairable use of the drying rack. This example also speaks to the potential of 3D printers for customization of products and the transformation manufacturing, transitioning from a society reliant on mass production and consumption, towards a distributed digital fabrication model characterized by "mass customization" (Millard et al. 2016). HacDC is

not producing anything at scale, but this is an example of a first step in the ideal of the Maker Movement towards a decentralized production model.

The third example of prosumer empowerment via fix/repair is at Arlington, at a Make/Fix Anything event. During an interview with Stacy, who is 30, the Adult Maker Librarian at Arlington, and has been involved in Maker programming for 2 years, she shared a story about a lady who brought in a lamp to be rewired. From Stacy's perspective, the consumer had the skills to rewire the lamp herself - "she turned out to be completely capable of rewiring it herself"- but she needed external support from the Maker librarians. The fact that the library patron effectively fixed the lamp herself at the event makes her a prosumer.

> *A few months ago a lady brought in a lamp, and she really liked the base of it, but it looked like maybe the internal parts weren't working anymore, so it might need rewiring and she turned out to be completely capable of rewiring it herself, but she really, really needed encouragement from staff, and* ***she was able to bring in the broken lamp, take it apart, rewire it, put it back together and then plug it and have it work, and it was so cool!***

As explored previously, it seems that one way prosumer empowerment is activated is by humans successfully fulfilling their prosumption practices, leading to a sense of accomplishment from achieving desired outcome. A second way prosumer empowerment was seen to be activated is by the disruption of prosumer practice from being fulfilled, leading to a sense of agency being activated from not achieving desired outcome.

Observation and interviews suggest that when the human is unable to fulfill the prosumption practice, this can stimulate a sense of agency. This happens when a human is unable to carry out their action intention, as the design intention of the thing supersedes. Disruption here comes from the psychology concept of 'sense of agency,' which refers to the feeling that we control our actions, and through them, events in the outside world (Haggard & Tsakiris 2009). This activation of a sense of agency involves establishing a link between our intentions and our actions, and between our actions and their external outcomes. This concept of 'sense of agency' is directly related to the concepts of consumer empowerment and action intention explored above, as they all

speak to individuals establishing a connection between their intentions and the outcomes of these intentions. Research shows that we become especially aware of our sense of agency when the smooth flow from intention to action to outcome is disrupted (Haggard & Tsakiris 2009). This concept of sense of agency being activated on the individual consumption level is related to findings from Frauenfelder (2011), who explains that DIY can be empowering by lending a more comprehensive awareness of the environment and consequently consumers' the sense of control over that. In a similar vein, Hartmann (2015) theorizes that craft consumption involves judgement (consciousness of materials used in the production process).

During this research, I observed consumers who came into the makerspaces who intended to fix or repair an object and were unable to do so. In this sense, their action intention was disrupted, and their sense of agency was stimulated. The resulting frustration and even realization that not everything is repairable can reveal the commercial forces that shape consumption to some extent and can serve to empower consumers by giving them the opportunity to rethink their consumption and relationship with things. In this sense, we suggest that this activation can also lead the consumer to think critically and evaluate their current consumption. The diagram below displays these concepts.

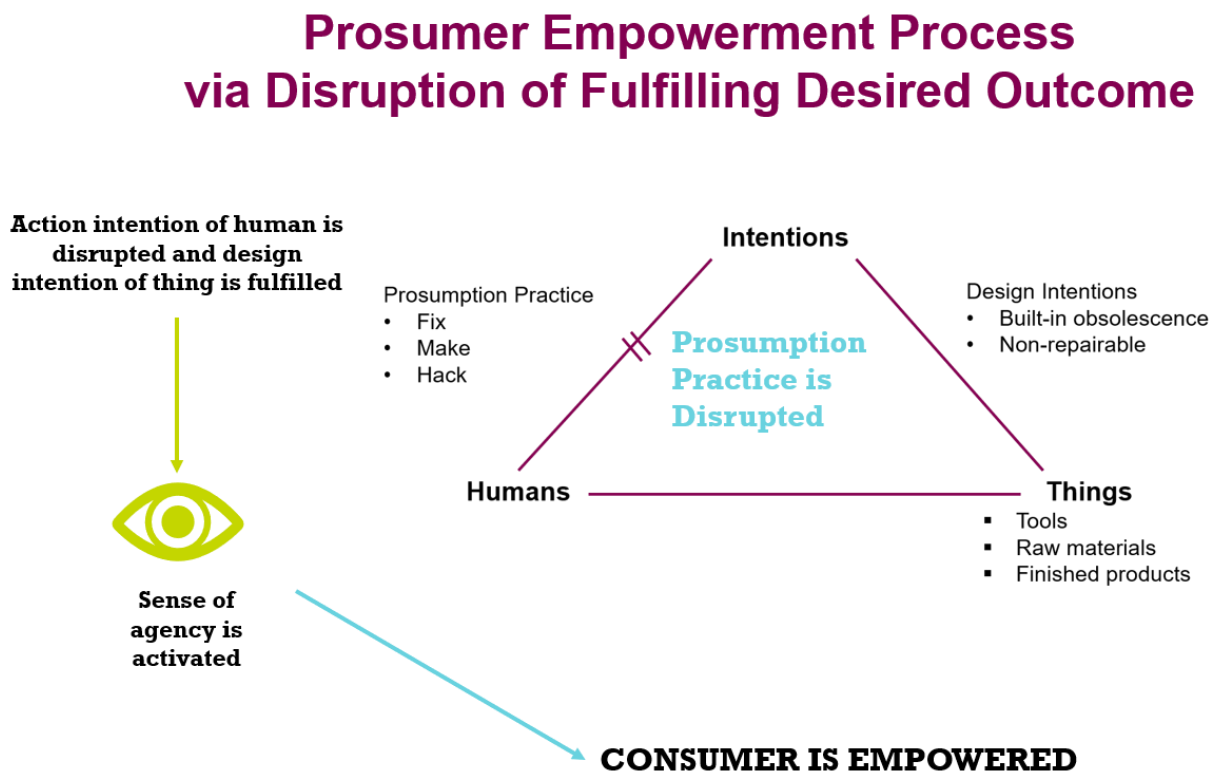

Figure 3: Prosumption Process via Disruption of Fulfilling Desired Outcome

This concept of disrupting or 'breaking' the action intention of the consumer arose during an interview with Mike, a volunteer at Arlington Make/Fix Anything events. He considers himself to be professional Maker, meaning he is handyman, an artist, a designer, etc. From his perspective, when a consumer brings in something to the Arlington Maker program that they think can be fixed but, cannot, this interaction can cause him/her to rethink future consumption. He explains that in the case of technology, the intention of the thing is to not be fixable, to not be repairable by us consumers. This is to say that many technology products are made to be repairable only by the company. But this realization, this engagement, this contact the consumer has with this reality, can lead them to think twice the next time they purchase a new product.

> *Unfortunately, some technology can't really be fixed by us, they weren't meant to be fixed by us, you dig into something pretty hard, and the one part is toast and people throw it out, it becomes trash, which is unfortunate* ***but I think it's good for people to engage in, especially when you think in terms of what you're***

> ***doing when you buy a new thing that's like that, maybe the next time you buy a new thing, you say hey 'is this gonna last, is this really worth buying? Do we wanna turn the resources of the planet into this thing that's ultimately gonna be a piece of trash?***

In this case, the action intention of the consumer – to fix a technological artifact – resulted in a disruption to fulfilling the desired outcome of being able to fix it. Following Haggard & Tsakiris' (2009) concept, this could result in the consumer having a greater sense of control over the world, and therefore over their own consumption power.

Latour frames this discussion in terms of 'reopening' artifacts. Latour (2008) argues that people are increasingly recognizing the "designed" rather than "discovered" quality of artefacts, a realization that reopens them:

> *When things are taken has having been well or badly designed then they no longer appear as matters of fact. So as their appearance as matters of fact weakens, their place among the many matters of concern that are at issue is strengthened.*

In this sense, the interaction between humans and things in an intentional manner could give consumers an opportunity to critically think about the consumption (Ratto 2011). It could allow consumers to see materials in a different light, showing them the poor design of some products and giving them the tools to restore the original affordances. The actual act of using the materials to restore affordances can empower consumers to build the world they want to see. Consumers in makerspaces have the possibility of seeing matters of fact as matters of concern. As in the example above with Mike and a patron wanting to fix a technological artefact and being unable to, this disrupted action intention can lead to more than a sense of agency, it can lead to the consumer viewing their consumption of technology not as a matter of fact, but as a matter of concern. The diagram below extends the above diagram by adding Latour's (2008) concept of matters of fact become matters of concern. We theorize that this type of realization can stimulate a sense of agency on a deeper, more cognitive level by turning a matter of fact into a matter of concern.

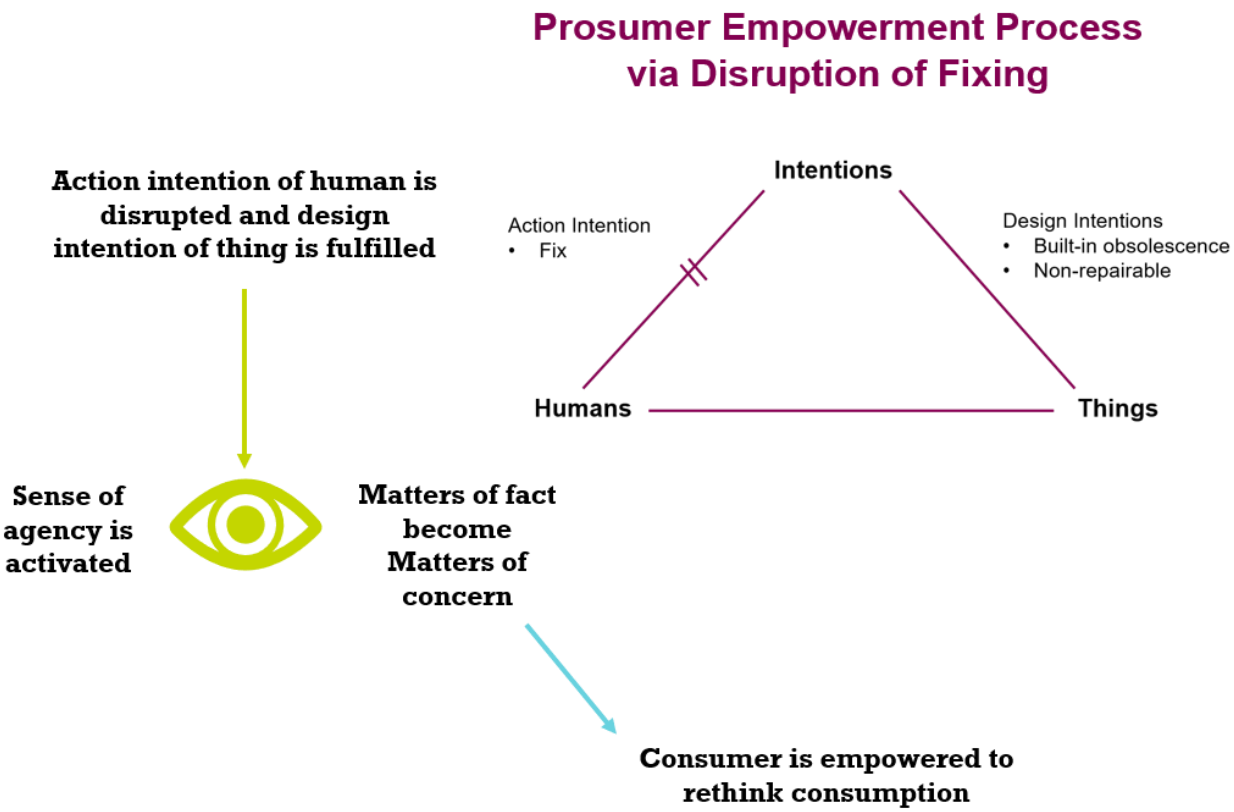

Figure 4: Prosumer Empowerment Process via Disruption

Following these concepts, it is possible that the human-thing interaction can serve to make makers aware of aspects of things and design intentions they might have not thought about before. This consumer empowerment can happen individually, when a consumer realizes that an object is not able to be fix/repaired, as well as in a group, when a consumer witnesses this situation happening with another consumer. This last situation constitutes collective consumer empowerment and is also related to Bagozzzi's (2010) extended definition of action intention to include shared or collective intentions, which is a personal intention to do something with a group of people.

I therefore suggest that as consumers interact with their own intentions – either by having them fulfilled or seeing them 'disrupted' by the design intention of things – they can become empowered to prosume. The next section explores action intention when makers invent and create new things.

5.1.1.2. Prosumption Practice | Invent, Create

Inventing and creating are grouped together because they have a similar outcome intention – to produce something brand new from raw materials. This is distinct from repairing, which is returning things to original affordances (Jarzabkowski et al. 2013). Inventing has a scientific, commercial connotation, while creating has an artistic, exploratory connotation.

The human-thing interaction that happens when this action intention is carried out is related to the Piagetian idea that to understand is to invent (Martinez & Stager, 2013). This means that it is through invention that consumers come to a greater understanding of something – be it of things, consumption, etc. The prosumption practice of creating is similar to the concept of craft consumption in the literature. For example, Campbell (2005) theorized that craft consumers, unlike the majority of buyers in the marketplace bring their identity into the products they use for their consumption. This prosumption practice in is also related to Holt's (1995) concept of consumption as experience, which refers to how consumers use consumption objects to produce subjective and emotional reactions.

Inventing is related to the documented cases of entrepreneurship in makerspaces. It also speaks to the innovation potential as documented in the literature (Halbinger 2018). This makes sense, since the startup costs are very low for entrepreneurs in Makerspaces, as compared to incubating at a private model or independently, entrepreneurs have more room to experiment and try things out without having a financial burden. And the more they try and are encouraged to try, the higher the probability that they will produce a 'successful' product for the market.

Examples of things created or invented at HacDC and Arlington:

(1) Created – pallet flags, household decorations, sheets, pillowcases, bags, toybots
(2) Invented – space blimps, cellphone cases, parts for household items.

I will now share a few examples of how consumers were empowered while carrying out the prosumption practice of creating or inventing at the Makerspaces.

The first example details a Take-A-Part program at Arlington, as conveyed to me during an interview with Dawn, 58, Maker Librarian. Take-A-Part maker programs are common in makerspaces, especially hackerspaces. At these events, old hardware is taken apart, with the objective of either (i) putting it back together again; or (ii) making something new out of the salvageable parts. At the Arlington program, the objective was more towards the artistic, creative end. One overarching theme at these Take-A-Part programs is to give consumers the opportunity to take apart, piece by piece, objects that have been deemed obsolete, see how they work on the inside, and create something of their own out of these materials.

> *Another one of my favorite programs is Take-A-Parts… we get old equipment – DVDs, CD players, computer parts, toasters, all sorts of things and let the kids take them apart and it's just awesome. Cuz how does something work?* ***And you can look inside, and the best time is when we have when Engineer Dan there and he can tell the kids what they're seeing and taking things apart and maybe putting them back together in some weird artistic way. I call it constructive deconstruction.***

Take-A-Parts empower consumers by providing them the chance to have a deeper contact with everyday objects (things). Consumers see everyday things in a different light, as they take them apart piece by piece. They see the design of things, as Latour (2008) puts it. They have the opportunity to see matters of fact – obsolete DVD players, computer parts, etc. – as matters of fact. For example, a DVD player that is taken apart at one of these events by a consumer is made into a 'sculpture' by the end of the event, thereby granting a new affordance to the object. The DVD player had the design intention of built-in obsolescence, but this was broken, as the patrons used the parts to make something new. This 'constructive deconstruction' empowers consumers because they can begin to see that consumer products can be upcycled or downcycled and can be used for ends they weren't intended for.

The second example deals with an invention made at HacDC. This story was told to me during a field observation by a HacDC member who is approximately 35 years old and has been a member for a few years. As a part of the Maker Movement, there are Maker Faires, both in the United States and globally. Makers gather at these Faires to showcase their creations and interact with other makers. For the local DC Maker Faire

in June 2018, members at HacDC invented a circuit board system to showcase. This was a collective effort that involved a creative process and many materials. This is a prime example of creating a customized product. This product – the desoldering circuit board - could have been bought on the market for $3,000, but instead the hackers pooled their knowledge and energy and created one for $60. The functionality of this invention was to desolder circuit boards into their respective parts once the circuit board is no longer functional or you want to use some of the parts for another project. This example illustrates collective consumer empowerment, by pooling resources and knowledge. This story is also very interesting because it is an example of how the human action intention of inventing something is directly related to disrupting the design intention of the thing – a circuit board in this case – which was built-in obsolescence.

> We showed a system [at a Maker Faire] that allows you to quickly desolder boards. Let's say you have a circuit board, you can painstakingly remove each one or you can buy a $3,000 system, or you could be [President of HacDC] and **take $60 worth of materials like a halogen lamp and a screen, old hard disc platters with different sized holes in the centers and my raspberry pi with the infrared sensor and the software. And we built the system and desoldered the circuit.**

The third example deals with a craft Maker program at Arlington. Dawn, the Maker librarian at Arlington, who was directly responsible for pitching Maker programming to the library board in 2015, told me about a craft Maker program she ran with teens. This example is distinct because it uses things that are not technological artifacts, but rather mostly everyday items you would find in an office. The prosumption practice of creation and invention in this example is for the end outcome of fun and artistic value. This lack of deeper design intention in the materials lends to a more creative, low tech, accessible use for crafting. Dawn highlights these points – that she used whatever materials she had around and that all the patrons really enjoyed themselves.

> *For the Pet Bots* ***I used whatever I had around, like corks and cardboard and googly eyes and duct tape, basically you use a hobby motor and batteries and you just create these little wobbling critters. Everybody had the best time.***

This example shows consumer empowerment in a much more implicit, indirect manner, but nonetheless relevant and important. Teens were encouraged to create fun, artistic toys out of things – cardboard and duct tape – that one would normally consider to be for very certain purposes. Instead, they give these things new affordances.

5.1.1.3. Prosumption Practice | Hack, Modify

Hacking or modifying is distinct from the other two action intentions explored – fixing and inventing – as it seeks to explicitly change the affordance of objects. Hacking is a creative process, embedded in the hacker ethic of problem-solving (Erickson 2008) as well as of producing novel artifacts (Söderberg 2007). It seems that the beauty of the makerspace is that this hacker ethic, of disrupting the design intention of things and making them 'work this way', can be instilled in consumers. Thereby effectively making a consumer a hacker, at least in that moment when the action intention is played out as an outcome.

This prosumption practice interaction is similar to Bardzell et al (2015) concept that makers are able to adapt products to suit their needs and purposes, and that makers see "finished products" as "unfinished." I will now give a few examples of consumer empowerment playing out through human action intention at the makerspaces.

The first example was shared with me during an interview with Dawn, a Maker Librarian at Arlington. Our conversation was around upcycling Maker programming. I inquired about the sourcing of the materials used in these events. Dawn responded by explaining how she really started to see 'trash' differently once she began the Maker programming. This example illustrates the disruption of the design intention of obsolescence of CDs. Dawn explains that these CDs don't work after they're used 100 times, but she plans to use them for an art project. Dawn goes on to explain that this consumer empowerment – of seeing things for uses other than they are intended for – was passed on in some sense to a friend of hers who brought her a sewing machine because they thought she could use it. This exemplifies how a consumer that is peripherally connected to the Arlington Public Library started to think about these

issues, as an influence of Dawn, and showed signs of empowerment by believing that some use could come out of the sewing machine, as opposed to becoming trash.

> ***Once you get your mind that way, it's hard to walk by a so-called pile of "trash" and not like look at it again and think 'Can I do something with this?' and that's what I do all the time.*** *I've been accumulating stuff, I've got several carts of stuff that I'm just looking around now.* ***The library went through their DVD and CD collection and got rid of a lot of them. You know DVDs get played 100 times and get weeded. I've got an old sewing machine that somebody brought to me because they saw it sitting on the side of the road and they thought we could do something with it.***

This example is also in line with Bardzell et al. (2015) concept that makers repurpose what would most consider to be "consumer waste". Although Dawn has not yet repurposed or upcycled/downcycled these specific things mentioned in the example – CDs and sewing machine – her intention is to do so, and she has done Maker programming with alleged 'trash' or 'consumer waste' in the past. Items that were upcycled in specific programming events include: bicycle belts (made out of 'old' bicycle tires and bike chains) and wooden flags (made out of upcycled pallets).

The second example was shared with me during a conversation at HacDC. I was there doing a field observation during an Open House vent. Open House Thursday is an event that happens weekly in which HacDC opens its doors to any new members interested in learning about the space. Members are normally working on on-going projects during the Open House as well. The conversation proceeding this specific example was focused on members of HacDC taking pride in 'breaking' things and making them better. This shows a general resistance to mainstream products and cultural, which is very present in the hackerspace literature. The example that follows demonstrates how a during a collective prosumption activity, members at HacDC modified software in a way that wasn't 'intended to be used'. This shows a direct disruption in the design intention of products and a fulfillment of the human action intention to hack software for hardware. It also speaks to Delgado and Callen's (2016), concept of hacks as "tangible demonstrations that realities could hold together differently".

> ***Some other hardware stuff is writing more modifying software for hardware that isn't intended to be used the way we're using it****. For example, we had an infrared camera designed for a phone, it's called a flur, F-L-U-R, and Julia said I want to use the infrared with raspberry pi and not a phone and I said, 'This sounds like a software problem' And so that's one of the things I've done for the space…I've also modified software for the 3D printer, so now you can monitor the temperature as you're working on it.*

The third example is quintessential to the hacker ethic of learning through deconstruction and reconstruction (Levy 2001). This example was shared with me during a field observation at HacDC by a member who has been there for a few years. I was asking him about his current projects at the makerspace and he responded that he's become interested in blowing things up and experimenting to learn how they work.

> *I found this amazing book on analog electronics that says,* ***'Burn things out, blow things up' and that's how you learn, by experimenting. Let's slice this open with a box cutter and see if we can keep it working while its being cut open.***

This concept of physically "breaking" something to figure it out how it works and then make it work better is a prime example of improving affordances and "disrupting" the design intentions that are embedded in objects – built-in obsolescence, nonrepairable. It also speaks to how hackers view the interaction with materials – "we can take you apart and make you work even better than you do now." This attitude prevalent at HacDC and leads to consumer empowerment and agency because members are in a space where it is expected that you fix things, that you know how to improve them. In this sense, members literally "fix" a problem – something that isn't working or something that could work better. In this sense, they are able to see beyond the intentions implicit in the objects.

5.1.1.4. Action Intention | Beyond Physical Things

The interaction between humans and things at makerspaces can allow for the expansion of the affordances of many objects. It also increases consumer empowerment – by allowing consumers the opportunity to fulfill their prosumption practice and desired intentions or have their intentions disrupted by the design intention of the thing.

It is possible that this mindset that is honed and fostered in Makerspaces – of fixing things, seeing things in a different light, breaking things to understand how they work and making them work better or with a different purpose – is transferable for consumers onto nonphysical things as well. This concept was brought up during my interview with Mike, a volunteer at the Arlington Maker programming. Mike envisions the day when patrons ask themselves about how to fix things that aren't things. If we extrapolate on this idea, we can see the Make/Fix Anything sessions at Arlington Public Libraries as building the mindset of being able to fix things in general – be they physical or figurative.

> *So, when I started out I was* ***interested in people making/fixing things that weren't necessarily things, that's why I kept it kind of opened ended. I'm still waiting for the day when someone is like, 'well how do we fix plastic in the ocean? Or how do we fix homelessness?'*** *or something bigger, but so far people tend to be right here with it.*

This idea of fixing both physical things and figurative things is well illustrated visually by Mike's toolbox, in the picture below. This is the toolbox he brings to the Maker programming at Arlington, which reads "*Free! Help with nearly anything, specialties making. Fixing. Bicycles to broken hearts*." Here the intent is to note that this mindset that is instilled in consumers in makerspaces – that you have the tools, knowledge, and community to help you fix and make physical things – can be transferred to figurative things, such as broken hearts. It seems possible that it is through the lens of material action that consumers feel empowered to fix 'bigger' problems, such as poverty or pollution.

Image 7: Toolbox at Arlington Make/Fix Event

5.2. Acquiring Self-Sufficiency Skills via Fostering Environment

Based on field observation and interviews, it is possible to theorize that the more skilled participants are in makerspaces, the more rapidly and efficiently they will prosume by producing goods and services. It can also be argued that the more skills consumers gain through their prosumption practices, the more ability they have to function outside the traditional marketplace. Hartmann (2015) theorizes that craft consumption goes beyond consuming tools, raw materials and energy, by involving consumption relating to skill and knowledge. Here we explore this type of consumption – of practical, hands-on skills and knowledge.

It is also possible to conjecture that a makerspace with stronger elements of participatory culture and consumption community would also be stronger in promoting prosumption. In the previous section that explored these topics, it was suggested that HacDC has more elements of a participatory culture and consumption community than Arlington.

Members at HacDC were observed to be much more skilled than patrons at Arlington. Many of the members at DC were formally trained in computer programming or engineering, while the patrons at Arlington came from diverse professional backgrounds. The literature on Makerspaces is line in with these findings, as many researchers have identified a variety of skill levels – ranging from professional to hobbyist (Martin 2015). There is also research that speaks to the craft consumers as consistent with prosumers, as both use various skills including weaving, carving, making and similar skillful activities to turn raw materials into a product (Campbell, 2005). Skills consistent with craft consumption were only identified at Arlington, as there are Maker programs that are specific to carving and weaving. Additionally, Arlington provides a sewing machine, which is considered a form of craft consumption.

At both sites – HacDC and Arlington – consumer empowerment was firstly observed through human-thing interaction, either building empowerment through accomplishing an action intention or activating sense of agency through disrupting an action intention. And now I describe the second way consumer empowerment was observed – through the general environment and organization of these makerspaces. Interviews and observations suggest that there are various mechanisms at work that allow consumers to gain practical know-how and skills, as well as interact with things. These mechanisms enable a fostering, supportive environment for prosuming/making, and thereby consumers empowerment.

These subsections address the research question (iii) consumer empowerment via acquiring skills in an enabling, fostering environment.

5.2.1. Enabling Mechanisms

Specific attributes seem to facilitate and accelerate the prosumer empowerment process and acquiring practical know-how. During interviews and field observations, six enablers were identified in the case studies observed that fostered a collaborative environment, conducive to acquiring skills for prosumption. These enablers include:

1. Do It With Others (DIWO)
2. Problem Solving

3. Encouragement
4. Normalizing Failure
5. Less Talk, More Making
6. Vulnerability

Do it with Others (DIWO) (Wen 2017) and Problem Solving (Papavlasopoulou et al. 2016) are documented in the literature related to makerspaces. The other four – Encouragement, Normalizing Failure, Less Talk, More Making, and Vulnerability were not identified in the literature. When applicable, I will share stories and instances of these enablers occurring in the Makerspaces and how they contributed to the prosumer empowerment process.

Figure 5: Enabling Mechanisms to Consumer Empowerment

5.2.1.1. Do it With Others (DIWO)

Do it With Others has been conceptualized as extending the DIY ethos of art. DIY has been documented in the literature on prosumption as contributing to consumer empowerment (Wolf & McQuitty 2011; Frauenfelder 2011). However, there is little connection in the literature on consumer empowerment via DIWO activities. DIWO extends the concept of DIY to groups of people creating things together (Wen 2017).

In the present research DIWO appears as a key enabler in the makerspaces observed, as it is directly related to the concepts of collaboration, as seen in participatory culture (Jenkins 2006) and consumption communities (Thomas et al. 2013), and all these concepts refer to consuming a group context. DIWO links humans to other humans and things in the same space and time. The word “together” came up with frequency in the interviews. Most Maker programs at the library and at HacDC have a specific theme, but instruction is minimal, it any at all. This lack of a traditional ‘teacher’ giving instructions leads to participants helping one another, whether that be by sharing knowledge or tools/materials. The interaction and support given during the production process allows participants to gradually build skills and confidence necessary for prosumption, both inside and outside the Makerspace.

This concept of learning and making things together, in a collective manner, was brought up during an interview with Stacy, a Maker Librarian at Arlington. We were talking about how library patrons that come into the events with little to no practical knowledge or skills on the subject at hand are often supported by other patrons to make the artefacts. Stacy gave an example of an event where patrons used a Cameo cutter to make stickers. This is a piece of hardware that can be a little tricky or intimidating for some people. Those patrons who had facility using the Cameo cutter assisted other patrons in learning how to use the machine. In this sense, the prosumption process in this instance, of using the Cameo cutter to make stickers for personal consumption, could be considered a Do It With Others process, as it was a collective effort among many patrons to produce the stickers.

> *With any of the programs, patrons start to work together. For example, at a program last December, we were using Cameo cutter to create vinyl stickers. We*

had to learn silhouette software and how to use the Cameo cutter. And people who caught on started helping the people around them. This happens at the Make Fix Anything events as well.

The concept of DIWO, as opposed to doing things alone, was also found to be an enabler of empowering entrepreneurial prosumers. In an interview with Dave, an entrepreneur who uses HacDC as a coworking space, touched upon the importance of the space being collaborative and members pooling knowledge resource to make products together. Dave states that for him human capital is the biggest benefit at HacDC. He recognizes that he doesn't have all the answers and skills needed to prosume the goods he wants to make and that HacDC offers the possibility of DIWO, via consulting other members.

I'm a tech guy, I've been an entrepreneur since I was 25, so I've been at it for a really long time and it's my thing and coming up with technologies and products. And that's what's great about the Makerspace. I can't be an expert in everything, right? The benefit of the Makerspace isn't really the technology that comes up there, it's not really access to facilities. The benefit is the human capital. When you go there, you're meeting people with god knows how much experience. You can go there and consult with them, because it's a collaborative community.

5.2.1.2. Problem Solving

Building off the DIWO or DIY approach common in these spaces, is creating an environment where problem solving is the norm. This concept of problem-solving is observed in the literature as being specific to hackers (Ericksonf 2008). I identified problem solving in the context of both makerspaces. For example, at the Make Fix events at Arlington, this role is usually played by the Maker Librarians or Master Maker volunteers, when a participant comes to them with a project. The Maker Librarians will say things like 'What do you think the problem is?' 'How can we test that?' 'Does this work similarly to anything else?' This approach can empower the prosumer to figure it out, to 'become the expert'.

This technique, of framing the issue at hand in terms of problem solving, came up during an interview with Mike, who is a Master volunteer at Arlington. Mike speaks to this idea that instead of giving a direct answer on how a patron should or could fix/make

something, he challenges them to ask questions like “How does this go in here?”. He views this technique as empowering the consumer to “become the expert”, thereby gaining self-sufficiency skills.

> *I’ve found that when I don’t give an answer, it’s a little frustrating for them [participants] at first, but the next little road bump they hit, they figure it out, ‘how does this go in here…? ‘And that to me is more valuable and empowering than ‘go find an expert’. No, you become the expert, you figure it out. We have so much access to knowledge, with technology and our fingers and our cognitive abilities. And when you have more people on it, you get a richer experience.*

5.2.1.3. Encouragement

The Makerspaces observed are generally very positive, calm environments. Makers at both spaces are keen on encouraging other members throughout the production process. This was especially observed in the Arlington Central Library, where many participants that came in were consumers and gradually gained production skills. For example, participants would often come to the Make Fix Anything events with clothes to repair but did not know how to use a sewing machine. Maria, a librarian at Arlington shared a story about a patron who said he was ‘too older to learn how to do something new.’ Maria, in response, walked him through how to use the sewing machine, until he got it. This is a prime example of how building skills for self-sufficiency are nourished, especially for an elderly adult. Maria’s encouragement and sharing of practical self-knowledge gave the patron the space to pick up a new skill for prosuming – learning how to sew.

> *Adults are usually the least confident. They think they’re doing it wrong. And we [librarians] really encourage them to stick with it. There was this one patron that came in to use the sewing machine and wasn’t getting it on the first few tries and became frustrated. He said something like, “Oh I’m too old to learn how to do something new.” And I stayed there with him until he was comfortable do use the machine on his own.*

5.2.1.4. Normalizing Failure

Another mechanism at work in Makerspaces is creating an environment where it is okay to fail, where experimenting is praised. This concept, of gaining skills by making mistakes, was not observed in the literature on makerspaces. I suggest that normalizing failure is a fundamental enabler of empowering prosumers, as it breaks down American cultural norms of perfection, having to be right on the first try, immediate gratification, and efficiency above all. Many of the interviewees spoke about how afraid members were to fail, more so at Arlington than at HacDC. I observed this during my fieldwork as well. Many participants were keen to make/fix something, but said things like 'Oh, well I don't want to break it even more,' or 'I don't know how to make anything pretty,' showing fear of failing.

The prevalence of this fear of making something that would not come out as expected was countered, in the case of Arlington, with the idea of play. In an interview with Stacy, the Adult Maker Librarian, she was telling me about how afraid many patrons are that they don't know how to do something well, and how this can stymie the creative process. She said they stimulate play at the events, by encouraging patrons to try various iterations of an artefact, until they get a thing that they are satisfied with. This normalizing of failure enables empowering consumers by creating an environment where it is okay to try new and different things, to prosume without expectations of 'being right' or wrong.

> *We try to get patrons back to the mentality of play by making mistakes and learning from them. We see that adults are usually worried about making mistakes. These events give patrons the opportunity to play around with stuff and try different iterations until something works. ….. I'm not like a teacher, here's one thing I would say, not being afraid to make mistakes with the people you're working with.*

5.2.1.5. Less Talk, More Making

The Maker Movement has a certain ethos and purpose behind it (Dufva 2017). The political nature of the movement was expressed differently in each makerspace.

Arlington took a very non-politicized approach and passed on political messages through the actual programming – the act of doing, as opposed to talking. HacDC took a more countercultural, politically laden approach, but again passed on political message through their interactions with materials. As explored in previous sections, members at HacDC often resist mainstream products by breaking them and using them in ways they weren't intended for. As Coleman (2013) observes, this material action demonstrates hackers right to express themselves, learn, and create technology over the right to privatize the fruits of their labor.

In both cases – Arlington and HacDC – the act of making, whether it be arts, crafts, or technological artefacts served as a political statement within the Maker Movement, whether members were conscious of it or not. This concept of making as a political act came up during an interview with Mike, a Maker volunteer at Arlington. From his perspective, the mere act of a consumer bringing in an item to be fixed is a political act. It is an act that challenges the mainstream consumer industry, that challenges the throwaway culture that is so prevalent in the United States. Mike talks about involving patrons in a way that isn't politicized in the discourse, but rather involving patrons by the very act of doing. Mike believes that he doesn't have to explicitly state that what is going on at Make/Fix events is political in nature, that it is part of a larger Movement, but rather that the politics is "embedded in the action."

> *At the Make Fix Project, we help people make and fix things. And the politics of the item they bring in are sort of exposed by the action. Right? There are things that can't be fixed. So, trying to get people involved in that in a way that's not preachy or prelatizing, it's just there, it's just intrinsic in the very act that we're doing, I don't even have to say these things, it's a truth that's embedded in the action.*

5.2.1.6. Vulnerability

During field observations and interviews, vulnerability stood out as a unique enabler at work in Makerspaces. This element of vulnerability is not present in literature on makerspaces. Many Makerspaces at first glance are reminiscent of Shop class or Home Economics – with power tools, sewing machines, textiles. Of course, a

Makerspace isn't a traditional classroom, and this makes all the difference. The makers I interviewed believe there should be no imparting of knowledge, that Makerspaces should be places of collective learning.

The tools in Makerspaces can – and are – still dangerous. And asking for help in the American culture, in which independence is valued above collaboration and sharing, can be challenging and a real stretch for people. In this context of going into a new space, with tools available to use that are potentially dangerous, all participants are making themselves vulnerable, by being open to and depending on other people for help. Some makers were very open and conscious of their abilities and were not hesitant to make this known to other makers. Some makers cited their lack of knowledge and how they didn't see this as an impediment, but rather as a strength to be more involved in the production process with other makers.

Frederick, a longtime member at HacDC, spoke to how he has made himself vulnerable in the space. His background and personal interest in making is related to computer software programming. As such, Frederick considers himself to be a 'software guy' as opposed to a hardware guy. At the same time, he recognizes that the outcome of much of what is being done at HacDC is hardware, in the form of goods and products. Frederick has therefore sought out from other HacDC members, how he can apply his software skills to ongoing projects at the spaces. In this sense, he makes himself very vulnerable, by recognizing he doesn't have the hardware skill set to make goods himself, but wants to participate, so he looks for ways to assist other HacDC members.

> *I'm still very much a software guy. That's kind of my failing here, I've been hanging around the place for 10 years and keep telling myself more of a hardware guy, but I fall back to my comfort zone. I've made some progress…A lot of what I've done here [at HacDC] hasn't been self-directed… With the hardware stuff, this concept that this stuff is really cool, well what do I want to do with it? I'm not sure.*

Maria, a librarian at Arlington, explained during an interview how she isn't an expert on the sewing machine. Her role at Maker events is to assist patrons in using the tools and technologies and ultimately producing something. In this sense, there is an

implicit expectation that Maria knows how to use all the tools and technology very well, in order to be able to support patrons. This is not the case, and Maria is very open and vulnerable about her lack of knowledge in using the sewing machine. She ultimately sees this in a positive light, as patrons can see she is also still picking up new skills.

> *The sewing machine…it's a little intimidating for me, I think for people maybe that didn't grow up learning that skill…what Make Fix has been for me is make sewing machine something that I can tackle, that you can learn step by step, the basic components of the sewing machine … I hope that people [on the sewing machine] can understand that I'm a newbie helping other newbies, but that's a positive thing, I'm learning as I'm teaching and I'm saying we're both completely capable of figuring this out together…we have the tools and the information.*

We have explored elements that contribute to enabling a collaborative, supporting environment for consumers to acquire practical know how and ultimately be empowered. Another layer to this discussion is the 'why' behind consumers coming back to these spaces. These elements of 'why' are important if we consider that the more consumers go to makerspaces, the more empowered they will feel and the more practical know they will have prosume.

The next subsection addresses the research topic (iii) consumer empowerment via acquiring skills in a fostering environment, including enabling mechanisms and benefits.

5.2.2. Social Benefits of Makerspaces

Consumers who participate in Makerspaces, whether they are new to prosuming or advanced, have benefits that go beyond the functional use of the space and simply producing products. We suggest that many of these benefits serve to motivating participants to come back to the spaces repeatedly and solidify elements of community. Identifying these benefits is significant as these contribute to the 'why' behind people going back to HacDC and Arlington and continuing to prosume and challenge conventional consumption practices.

I identified three benefits, which contribute to consumers coming back to makerspaces, and thereby gaining more skills necessary for prosumption. These include:

1. Space to Fulfill Sociopsychological Needs
2. Experience of Place
3. Emotional Attachment

5.2.2.1. Space to Fulfill Sociopsychological Needs

One of the main benefits identified during in the case studies was social interaction, and the accompanying psychological benefits. Some participants would come to these events and spend more time, or all their time, socializing and asking people about their projects, than actually working on their own. There are still other participants that would not bring or work on a project at all, preferring to observe and/or help other people with their projects. Many interviewees spoke to how the spaces instilled a sense of community in the members.

This manifestation comes about in different ways. Sometimes participants simply come to the Makerspace to socialize and hang out. This concept of the makerspace as a place to socialize was brought up during an interview with Dave, a member at HacDC. We were chatting about the different members, and how some members come to HacDC for different reasons. I asked Dave what types of projects people normally bring in to work on at the space, and he observed that while many members do bring in projects, much of their time is spent hanging out and chatting.

> *Some members come in with a project and they do work on them, but they also just hang out and have conversations.*

Another component of this need for socialization is a space in which to do it, in which you don't have to consume other things. And the Makerspace provides that. This concept was brought up during an interview with Mike, the Maker volunteer at Arlington. Mike observed that there are less and less places where you can go, and you don't have to consume something – like a cup of coffee. Makerspaces provide a place for people to go and socialize, without having to buy any products.

> *A lot of people come and yeah there's this physical thing they're working on, but there's also this social thing that's really important, sometimes people just need a place to….**Increasingly there's not a place where you can just go hang out and meet people. There's always spending involved, you have to buy a cup***

> ***of coffee or you gotta go to the bar and drink****… So how do we create a place where people can have some sort of genuine social connection? There are definitely people that come and just hang out.*

This benefit of the Makerspace – as a place to socialize without having to consume – is in line with literature that postulates Makerspaces as a new form of third places (Moilanen 2012). Oldenburg (1999) coined this term to highlight urban social settings or surroundings that provide ‘‘social experience outside of the home or workplace/ school” (Lawson, 2004: 125). It is argued that such places are significant for the empowerment of community ties, the establishment of a sense of place, civic engagement and, therefore, democracy (Oldenburg, 1999, 2001).

This desire also speaks to the increasingly experience economy (Pine & Gilmore 2011), which means that rather than material goods, it is the largely immaterial experiences involved in various aspects of our lives, and consumption, that are of great and increasing importance (Ritzer et al. 2012). Makerspaces also have this element – of making in a common space, which for many consumers is just as much about the experience of making as it is about making itself.

The psychological benefit originally obtained in the context of Makerspaces can extend beyond the walls of the Makerspaces, as relationships form among members. One interviewee cited how a former participant in the Make Fix Anything sessions still emails him a few times a year, just to talk.

> *Another person in Maine corresponds with me…* ***a lot of people just need someone to talk to.***

5.2.2.2. Experience of Place

Participation in Makerspaces can reinforce experience of place and identity. This speaks to the rise in the experience economy and its contribution to the rise in prosumption (Pine & Gilmore 2011). This positive feedback loop could also contribute to more sustainable ways of consumption, if consumers feel connected in these places, they will come back and have the opportunity to acquire more skills and knowledge, thereby gaining self-sufficiency and building a sense of agency.

This concept of experience of place via makerspaces was brought up during an interview with Maria, a librarian at Arlington. I was asking her about her involvement in the Make/Fix Anything event at Arlington and she said she was motivated to participate by being able to DIWO and to create a richer experience of place.

> *My motivation to participate in the Make Fix Anything Project is that I want to pursue things we can do together that are less consumptive and we also create a richer experience of place.*

5.2.2.3. Emotional Attachment

Makerspaces allow consumers to essentially independently design and/or fix their own products. This involves the consumer having the option to customize the product, and literally put his/her own sweat into the product. This process can lead to consumers feeling more emotionally attached to the product made (Maldini 2016), and thereby activate a sense of empowerment. This positive feedback mechanism is also related to Holt's (1995: 2) concept that consumers use material objects (e.g. goods, products) as "vessels of cultural and personal meanings".

This idea that the products made/fixed by consumers at makerspaces are conducive to emotional attachment was brought up in an interview with Stacy, the Adult Maker Librarian at Arlington. I asked Stacy a question about what she thinks motivates people to come to the Maker events and keep coming back. Stacy attributed much of the consumer motivation to people being able to bring something home – to producing a tangible outcome in the form of a physical artefact. She gave a personal example of a Harry Potter wand she made at a Maker event at the Library, stating how simple the raw materials are, but how special the wand is to her, because she made it and that makes her proud.

> *People like getting to take something home at the end of the day. I made a Harry Potter wand that sits on my desk at home.* ***It's basically just chop sticks and paint, but I made that, it's mine and I'm really proud of it.***

6. Conclusion

6.1. Contributions

Makerspaces have been studied in a variety of contexts and lenses. This research project is the first to explicitly explore the nexus of the following concepts as they apply to makerspaces: (i) prosumption; (ii) consumer empowerment; and (iii) sociomateriality.

While HacDC and Arlington present clear elements of prosumption that are documented in the literature, there are a few elements unique to these spaces which are not present in the literature, including: (i) physical community; (ii) DIWO; (iii) physical tools and digital tools; and (iv) in person human capital. Firstly, much of the literature studies prosumption in online communities (Tian et al. 2017), and this research contributes to the literature as it observes prosumption in a physical space. Secondly, much of the prosumption literature is based on DIY consumption (Watson & Shove 2008; Xie et al. 2008), while this research observes prosumption in the context of both DIY and DIWO. Thirdly, the prosumption literature touches upon diffused technologies as a means of prosumption (Toffler & Toffler 2006), and this research observes prosumption through technology as well as hand tools and art and crafts. Lastly, much of the prosumption literature focuses on human capital and knowledge sharing in digital communities (Tian et al. 2017) and this research observes prosumption in a physical space, with in person knowledge sharing.

Studies on consumer empowerment and prosumption tend to be focused on DIY (Wolf & McQuitty 2011; Frauenfelder 2011), while this research studied collective prosumption experiences. This research demonstrated how certain mechanisms in a collective prosumption environment can stimulate consumer empowerment, namely: DIWO; problem solving; encouragement; normalizing failure; less talking, more making; and vulnerability. Additionally, this research demonstrated how social benefits – space to fulfill sociopsychological needs; experience of place; and emotional attachment – provided by makerspaces can serve to motivate participants to go back repeatedly and, in this sense, gain more skills and possibilities for prosuming and opting out of the mainstream consumption model.

Sociomateriality is a rather nascent research topic, which tends to focus on the entanglement of the social and material in organizational settings (Orlikowski 2007). This research contributes to sociomateriality by looking at this phenomenon inside makerspaces, which is very distinct from organizational settings. Furthermore, this research relates sociomateriality to consumer empowerment, by studying consumers' activated sense of agency when they interact with materials. Jarzabkowski et al. (2013) have documented that the user of an object may or may not recognize the affordances and inbuilt limitations of design – such as built-in obsolescence or non-repairability. This research explains how the prosumer empowerment process can lead not only to users more readily recognizing the affordances of different objects, but effectively gain the practical skills to act upon this knowledge – by making some of their own goods and learning how to fix others, thereby defying design intentions and the mainstream marketplace.

The concept of consumer empowerment (Hunter & Garnefeld, 2008) was extended to prosumer empowerment. The process of prosumer empowerment was observed to happen on both an individual level, as well as on a collective, collaborative level. On the individual level, prosumer empowerment occurred by allowing consumers the opportunity to fulfill prosumption practices or have their prosumption practices disrupted by the design intention of objects. And on the collective level, prosumer empowerment happened by consumers gaining practical skills in an enabling environment. The concept of sociomateriality was also implicated, as the interaction between humans and things at makerspaces demonstrated that the affordances of many objects can be restored and expanded. The theory of critical making was expanded, by breaking down the components of critical thinking and physical making. A prosumer empowerment process model was conceptualized to represent the overall result of this research. The model below highlights the components of critical making

that lead to consumers being empowered to prosume and reframe consumption and production.

6.2. Limitations

This research evaluated two makerspaces, located in the same geographic area. Data was collected from a small subset of these makerspaces and therefore should not

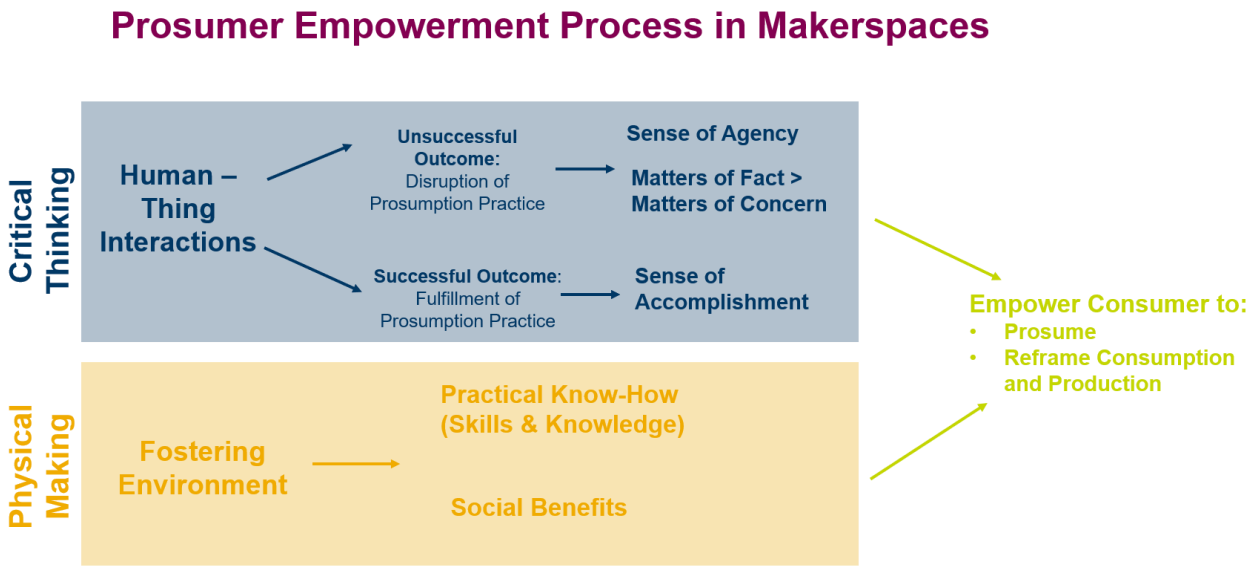

Figure 6: Prosumer Empowerment Process in Makerspaces

be considered representative of all makerspaces. The time frame for this research was also limited, and a longer research period would have yielded more in-depth, comprehensive results. The field research and interviews only touched the surface of the complexity at work in makerspaces. Considering that this was an exploratory research project, many topics emerged from the data but there was not enough rich context to go into depth on any of these topics beyond the consumer empowerment process observed within the makerspaces themselves.

6.3. Further Research

A general recommendation would be to observe makerspaces over a longer period. In this way, connections between consumer empowerment in the makerspace and impacts on consumption patterns outside the makerspace could be forged. There

are many ideas that this research touched upon that could be further investigated in the future. A first example would be to study how different makerspaces enact Maker ethos via material action, as opposed to symbolism and discourse which are more common in social movements, and how this attracts varied consumer groups, such as those that don't identify as particularly political. A second example would be to study library makerspaces as a gateway to prosumption, which would possibly involve an ethnographic account of the consumer/prosumer journey from libraries to other makerspaces and the subsequent impacts on consumption/prosumption patterns. A third example would be how makerspaces are being co-opted and commodified by corporate America – such as Black and Decker – and what impact this is having on makerspaces, entrepreneurs, the hacker ethic, workers' rights, intellectual property issues, etc. A fourth example would be to study how makerspaces solidify and contribute to social cohesion and a larger sense of community, especially at a time in American history where society is suffering from a so called "social recession." A fifth example would be to explore how makerspaces contribute to and make it possible for Americans to come back into contact with the American narrative of independence and self-sufficiency through working with your hands, which is an art and ethos that has slowly eroded during the Information Age. And lastly, the most readily applicable next step for this research would be to delve deeper into the District Makers Collective, to explore the ecosystem of Makers in the DMV area and how this extended community of makers operates, its impacts on decentralized production and consumption, interaction with corporates, etc.

6.4. Implications

This research aimed to explore how makerspaces stimulate consumer empowerment, at a time when consumers are increasingly disconnected from understanding how products they use every day effectively function. The Maker Movement celebrates the lost tradition of handicraft skills and Makerspaces are a place where consumers can come into contact with how to fix the products they use on a daily basis and make new ones. This is an emerging topic that will most likely evolve rapidly in upcoming years.

This research also has implications for makerspace practitioners, as well as corporates. For corporates, there could be a concerted effort to understand the 'why' and the 'what' for consumers repairing and/or modifying their products in makerspaces. From there, corporates could appropriate build strategies, which could be in the form of product modification, partnering with makerspaces to understand consumer demand, and/or spinning out internal makerspaces for product innovation and employee engagement.

For librarians, like those at Arlington and for board members, such as those at HacDC, the model of the prosumer empowerment process could be helpful in designing future programming. Additionally, the enabling mechanisms and social benefits previously mentioned in the Contributions section could be useful in training librarians and new board members in "soft skills" to drive prosumption in these collective environments. Most importantly, although the makerspaces observed are part of the Maker Movement, which has political undertones and ethos, this was not readily apparent in the discourse in both cases. Rather, these makerspaces made political statements – of consuming outside the mainstream system and teaching others how to do the same – by simply making and prosuming. This embodies the concept of "material action" and the enabling mechanism "less talk, more making". This form of empowering consumers implicitly – through giving them the physical and socio-cultural tools to make – should be recognized. At a point in time when politics have become extremely divisive, safe spaces like makerspaces – where people have the possibility of making political statements via materials, but not engage in political discourse – are scarce. These spaces allow consumers to experiment, learn, and have fun in their interaction with materials and librarians and leadership could strive to maintain this free-spirited way of making.

In conclusion, findings suggest that prosumption practiced in makerspaces can offer an alternative form of consumption to globalized production. Makerspaces can provide people the possibility of opting out of mainstream consumption, by giving consumers the critical thinking and physical making tools to prosume, both collectively and independently. Most importantly, this research suggests that makerspaces do this

in a way that is not proselytizing, but rather encourage consumers to make the world they want to see through material action. Lastly, this research suggests that while makerspaces are often a place to consume and prosume, they can also be a place to deconstruct consumption and reframe our relationships with artefacts.

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