What Makes a Maker: Common Attitudes, Habits and Skills from the Do-It-Yourself (DIY) Community

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Abstract

New technologies, communities, and identities are changing the way that many Do-It-Yourself (DIY) practitioners work. These changes are shaping a 'modern' DIY practice and have inspired interest from Interaction Design researchers. This study explores 'modern' DIY practice and the demographics of its practitioners, using interviews and a survey. Results indicate that DIY practitioners are: finding inspiration from friends and online reading; making projects for others and customizing items they own; developing expert problem solving skills; and working within flexible schedules. Respondents were balanced by gender (51% of respondents were female). Nearly half had post-secondary training in design or technology, but the majority of respondents reported that they were self-taught to some extent. Implications of these findings for designers are explored. This study contributes useful data and insights about modern DIY practitioners' habits, attitudes, skills, and demographics, providing design researchers with a broader and more complete understanding of this community.

Keywords: DIY, Do-It-Yourself, maker, hacker, craft, everyday design, STEM, interaction design

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List of Acronyms

BMA	Bayesian Model Averaging
CSCW	Computer Supported Collaborative Work
DIY	Do It Yourself
HCI	Human Computer Interaction
OSHW	Open Source Hardware

Glossary

Artist	A person who identifies as an artist. Artists tend to create highly aesthetic, expressive or conceptual projects, which may involve traditional art practices (painting, sculpture) or new media (electronics, video).
Attitude	A belief about yourself or the world. For example, the belief that people should be independent.
Crafter	A person who identifies as a crafter. Crafters tend to produce hand-made crafts, such as: textiles, clothing, housewares, jewelry, costumes or decorations.
Designer	A person who creates products, systems and art to for a specific purpose. Examples include graphic designers, industrial designers, and architects.
Digital Fabrication	The production of parts using automated machinery and digital design files.
Engineer	A person who identifies as an engineer. Engineers tend to designs functional systems to solve specific problems, and tend to works as an engineer or have formal engineering training.
Habit	Behaviours that an individual often engages in. For example, frequently reading design magazines online.
Hacker	A person who identifies as a hacker. Hackers tend to work with computers and electronics and/or participate in a hackerspace.
Hackerspace or Makerspace	A shared space where DIY practitioners meet to share tools, collaborate and socialize. Makerspaces can be independent or tied to an institution. They may focus on one specific content area (e.g. electronics and computers) or provide facilities for multiple activities.
Make Magazine	A magazine published by Maker Media (previously O'Reilly Media) that features DIY news, projects and profiles.
Maker	A person who identifies as a maker. Makers enjoy making things as a pastime and are often associated with Maker Media publications and events (Maker Faire and Make Magazine).
Maker Faire	A series of annual events hosted in cities around the world where 'makers' gather to show off their projects. Maker Faire was founded by O'Reilly media in 2005.
Manual Fabrication	The process of creating physical parts using hand skills or machine operation skills (e.g. using a manual lathe)

Modern DIY Practice	Do-It-Yourself practice that incorporates new technology, new online communities or new physical communities (such as Maker Faire events, or hackerspace network).
Open-Source	Products where the ‘source files’ are made freely available online. This may be source code for software or blueprints and parts lists for hardware.
Skill	A competency that allows someone to achieve a desired outcome. For example, knowing how to knit.
Tinkerer	A person who identifies as a tinkerer. Tinkerers tend to build and modify things (usually mechanical or electrical systems) as a pastime.
Traditional DIY Practice	Do-It-Yourself practice as it has existed for decades, even centuries, which continues today (for example, knitting circles).

Executive Summary

New technologies for fabrication, new online learning resources and new social movements are changing Do-It-Yourself (DIY) practice. This has attracted the interest of a growing number of Interaction Design researchers who are looking to this "modern DIY practice" for ideas to enhance technological design.

The DIY community is also growing rapidly in popularity; in 2013 Maker Faire events (where DIY practitioners gather to show off their work) were hosted in one hundred cities around the world and attracted half a million attendees. DIY workshops and programs are also being started by schools, libraries, museums and governments.

This study develops the concept of modern DIY practice, and surveys this community of practitioners to identify common attitudes, habits, and skills. The survey also asked practitioners about demographic information in order to generate a more complete picture of the people who make up the modern DIY community.

Surveys questions were generated based common themes from interviews with 13 local DIY practitioners. The surveys were distributed at a local DIY event and through online DIY websites, and, nearly 800 practitioners responded. The results indicate that common elements of modern DIY practitioners:

- Find inspiration for projects by talking to friends and reading online.
- Start projects to customize items for themselves or make projects for others.
- Want to understand how the things they own work and want to solve their own problems.
- Learn new skills through online resources, like tutorials, and by asking friends in their social network
- Embrace failure as part of the learning process and learn through trial and error and play
- Consider themselves experts at troubleshooting and internet research, and are confident that they can solve their own problems
- Develop social groups that share their interests
- Prefer to be flexible with their DIY work schedule, working at irregular times and working on multiple projects at once

Demographic questions were also included on the survey that asked about participants' educational background, gender and whether they associated with several DIY sub-communities. These questions addressed my second and third research questions: what are the demographics of the modern DIY community, and do any patterns emerge between different DIY sub-groups?

My results showed that overall the survey sample was well balanced for age (median age 33) and gender (51% female), but that females tended to associate with the "Artist" and "Crafter" communities and males tended to associate with the "Tinkerer", "Engineer" and "Hacker" communities. Gender was the only factor strongly associated with particular labels.

Nearly 40% of participants currently worked in a technical or design field, and 70% of participants had some kind of artistic or technical training (50% had training at a post-secondary level, and 20% at the high school level). However, 80% of participants also indicated that they were self-taught. This suggests that practitioners extend formal training through self-directed learning.

These results help to address a gap in the Interaction Design literature by providing a broad description of DIY practice from a large sample of practitioners. They also provide practitioners who are designing workspaces and programs with useful information about modern DIY practice.

Chapter 1.

Introduction

1.1. What does modern DIY look like?

It is early summer in 2013. A crowd of people are standing around an exhibit table admiring a 3D printer, a device that automatically 'prints' physical three-dimensional versions of computer models. The crowd consist of 3D printer enthusiasts, a curious family that have never seen a 3D printer before, and a jeweller who is stopping by on the way to her own exhibition table.

Figure 1.1. A scene from Maker Faire

"What should I make next?" one of the exhibitors calls out from behind his table. "Tea. Earl Grey. Hot", jokes the family's father, mimicking a character from the classic

TV show *Star Trek* who often asks the computer in his spacecraft to materialize his favoured beverage. "No problem" says the exhibitor, as he opens his laptop. He browses to a website called *Thingiverse* – an online repository of printable 3D models – where he finds a tea cup design and downloads it to the 3D printer. Motors buzz as the machine whirrs to life, building a three dimensional tea cup shape out of molten plastic squirted through a computer controlled nozzle. The exhibitor explains that the print is made of food-safe plastic, so you can actually use the cup, but it will take 45 minutes to finish and (unlike the sci-fi technology) it will not arrive full of hot tea.

This scene is from the Vancouver Mini Maker Faire, a festival where Do-It-Yourself (DIY) practitioners gather to celebrate and share their work. DIY has experienced a resurgence of popularity in recent years, led by events like Maker Faire: in 2013, one hundred of the events were held in cities around the world, and they attracted half a million attendees (Merlo, 2014). The rise in popular interest may be a result of several new developments that are changing much of contemporary DIY practice:

- DIY practitioners are pioneering new technologies and incorporating them into existing practices.
- DIY practitioners are socializing and learning through a growing network of online communities.
- New social movements, such as the "maker" movement, are bringing together practitioners from many different DIY sub-communities, and are promoting broad, interdisciplinary identities.

In this thesis I refer to work that incorporates these elements as "modern DIY practice". I use the term to make a distinction between the new developments in the DIY community and "traditional DIY," much of which is decades (even centuries) old. I focus on modern DIY practice because the trends mentioned above have the potential to contribute to the field of technological design, which I will discuss in the following sections.

1.2. New technologies for design

The modern DIY community is pioneering new technologies for design. 3D printers are an example of a *digital fabrication* technology, machines that automatically produce physical parts based on a digital design file. While these machines have been in industrial settings for years, they have only recently become affordable enough for individuals to own. Computing and electronics have also experienced a similar drop in pricing, making it more affordable than ever for individuals to use digital technology to produce physical parts and to embed digital components into their projects.

Engineers and designers interested in making fabrication and computing more accessible have created several devices popular in the DIY community, such as low-cost 3D printers (Lipson & Kurman, 2010; Sells, Bailard, Smith, & Bowyer, 2007), and the Arduino microcontroller board (Banzi, 2014). Members of the DIY community function as early adopters and testers of these new tools, and are increasingly becoming active co-creators of these devices. By releasing their original design files online as *open-source hardware* projects, researchers have seeded vibrant development communities that have improved upon the technology and spawned a host of successful businesses (Sharma, 2013). These new technologies are also making their way to traditional practices. Examples can be found of 3D printed jewellery (O'Connor, 2014) and digitally fabricated furniture (Shopbot, 2014). In addition to creating new design possibilities, these tools change the skills required of designers, allowing individuals to substitute digital design skills for hand skills or machine operating skills (Blikstein, 2013a).

1.3. Online Communities

The recent growth in online DIY communities and the ease with which we can now share media are also changing the way many DIY practitioners work, even for those who do not otherwise integrate new technology into their projects. For example, the website Ravelry.com, a knitting and crochet community, boasts 4 million registered members (Ravelry, 2014). These modern day knitters use the online community to discuss techniques, rate and review patterns and supplies, and post photos of projects that they have completed. While the internet has been enabling knowledge sharing in

niche communities since its inception, the physical element of DIY skills make them especially challenging to communicate. Today the ubiquity of digital photography and video sharing have greatly enabled online sharing of DIY skills and projects (Torrey & McDonald, 2007). Researchers are studying the way that these media are used in online DIY communities (Kuznetsov & Paulos, 2010; Torrey & Mcdonald, 2009; Tseng & Resnick, 2014), and the ways that they impact practice (Goodman & Rosner, 2011).

1.4. Interdisciplinary Social Movements

The third defining feature of the modern DIY community is its emphasis on interdisciplinary projects and communities. This feature is of particular interest to design researchers and institutions that see the modern DIY community as a source of innovation and as a way to attract more diverse audiences to the field of technological design. At a project level, DIY practitioners are pioneering ways to blend technology and traditional practices, such as sewing electronic circuits into clothing. These activities present technology in novel ways that appeal to people who are drawn to tactile, aesthetic or expressive work (Leah Buechley & Perner-Wilson, 2012). The interdisciplinary nature of modern DIY *communities* also presents an opportunity to attract diversity to technological design and promote "technological literacy" (the basic skills everyone needs to interact with technology) (Blikstein, 2013a). Maker Faire events exhibit work from multiple DIY sub-communities, ranging from knitting to art to robotics. This interdisciplinary blend of work attracts more diverse audiences than many technology education programs (Maker Media, 2013; Pryor & Eagan, 2012). Institutions including schools, libraries, museums and even governments are building multipurpose workshops, often called makerspaces, to support DIY activities and they are running DIY programs (the White House hosted its first Maker Faire in 2014) (Ginsberg, 2013; Kalil & Miller, 2014).

The growth of public popularity and institutional investment in DIY gives impetus to the academic work on DIY practice. If public institutions are going to invest in the creation of DIY spaces and programs then we should understand modern DIY practice, how it incorporates new technologies, how it differs from traditional DIY practice, and how it can enhance efforts to encourage participation in technology and design.

I have personally encountered these questions in my work as a designer of DIY programs and tools for youth. As part of a research fellowship, I designed a classroom toolkit for students at Science World, Vancouver's science museum, to learn about new fabrication and electronics technologies. I also created DIY programs for the museum, classroom kits for science outreach, and professional development workshops on DIY and technology for teachers[1]. Throughout this work, as I have tried to cultivate the positive elements of DIY within public institutions, I have struggled to identify the core elements of modern DIY practice. Most of the kits, programs, and workshop spaces that I created needed to support a range of interests and activities, but it proved challenging to identify the elements of DIY practice that are common across different disciplines and sub-communities. My conversations with other designers and educators at events like Maker Faire confirmed that other practitioners would find this type of information useful. And a review of the Interaction Design literature showed that, while there is a growing body of design research on specific DIY sub-communities (such as hackers or crafters) or specific elements of practice (such as open-source hardware design), a broad description of modern DIY practice was missing from the literature.

1.5. Research Questions

My research begins to address the gap in the Interaction Design literature concerning the demographics and common elements of practice of the modern DIY community. Specifically, I explore the following questions:

RQ1: What common attitudes, habits and skills are shared by modern DIY practitioners?

RQ2: What are the demographics of the modern DIY community?

RQ3: Do any patterns emerge between different DIY sub-groups?

[1] The fellowship was funded by the Mitacs Accelerate program and Science World. Through it I developed a kit that included open-source design and programming software, a home-made 3D printer, and electronics components. I have continued to work at Science World, creating and running technology programs for youth, and have also worked with a social venture Maker Mobile (makermobile.org), the North Vancouver School District, and the Vancouver Maker Foundation.

Answers to these questions will be of interest to Interaction Design researchers and other academics investigating the DIY community. It is also my hope, based on my personal experience and involvement in the DIY community, that the findings from this research will be useful to designers and others who are working to support the growing modern DIY movement. In addition, answering these research questions will help inform discussions about DIY's potential to bring more diversity into the field of technological design. Finally, information about the composition of my participants is also critical for identifying any clustering in the data, checking for bias in my sample, and understanding how results can be generalized.

1.6. Approach

The primary goal of this study is to identify common elements of modern DIY practice across a broad sample of practitioners. With this goal in mind, I chose to use a survey method, so that I could gather data from a large sample of respondents. The survey was constructed based on qualitative analysis of interviews with local DIY practitioners, which helped me to ground survey questions in the real experiences of modern DIY practitioners.

Surveys were distributed in person at a DIY event called Maker Faire and online through DIY websites. These events attract DIY practitioners that exhibit the "modern" characteristics of practice described above, so the avenues through which I collected survey data served to operationalize my definition of "modern DIY practitioner". Survey results were analyzed using quantitative analysis, which allowed me to test whether interview themes generalized to a larger sample. It also gave me an opportunity to look at the demographics of a large sample of DIY practitioners. This sequence of interviews, qualitative analysis, survey, quantitative analysis, and interpretation form an embedded mixed-methods approach (Creswell, 2014).

My interviews and qualitative analysis were guided by my focus on core elements of modern DIY practice, which I initially organized into 'attitudes,' 'habits,' and 'skills' – a framework based on my previous experience working with DIY practitioners. This initial framing informed how I organized the themes from my qualitative analysis, so I use

these categories to present my interview findings. However, when analysing survey results and discussing overall findings, I found this initial framing to be overly constraining and not representative of the themes that emerged from the study overall. Therefore, I reorganized my findings into more specific core elements of practice, which I found to be comprised of clusters of complementary attitudes, habits, and skills.

Chapter 2. Literature Review

A wide range of literature can be related to aspects of DIY practice. This body of work comes from the fields of design, engineering, education, sociology, history and art. It is far too broad to review as a whole, so I have restricted my review to the field of Interaction Design. Literature from this field is divided into two sections: research from designers who make tools for DIY practitioners and research that describes DIY practice.

2.1.1. Tool-Makers

Since 2001, Neil Gershenfeld, an engineering professor from the Massachusetts Institute of Technology, has been building a network of DIY workshops (called FabLabs) around the world. The Fab Labs are similar to hackerspaces, but have a standard set of core tools. The Fab Labs have built a DIY curriculum for outreach work, and are continuously inventing new tools and techniques for low-cost DIY production (Gershenfeld, 2008). The efforts of Gershenfeld and the researchers in the Fab Lab network have been joined by other engineers who are pushing the limits of low-cost and accessible manufacturing, such as the ones from Cornell University and the University of Bath who created the first desktop 3D printer designs (Lipson & Kurman, 2010; Sells et al., 2007).

Designers in the field of Human-Computer Interaction have also been developing platforms to help people easily create interactive systems. The most notable example is the Arduino microcontroller board, a tiny low-cost computer that can be used to control interactive devices. The boards were originally developed for computer science students to study interface design, but have become extremely popular in the DIY community (Banzi, 2014). They are an open-source hardware project that has spawned dozens of derivatives (which add additional functions, such as wireless internet connectivity or electronics for controlling motors). Other projects from interaction design

target specific groups of users, like the Phidgets system for interaction designers (Greenberg & Fitchett, 2001), or the LilyPad Arduino, designed to allow for electronics to be sewn into textile projects (L Buechley, Eisenberg, Catchen, & Crockett, 2008).

The tools created by engineers and designers are joined by tools specifically created for learning. In his 1980s book *Mindstorms: Children, Computers, and Powerful Ideas* Seymour Papert outlined the educational theory of *constructionism*, the idea that people learn especially well when building their own tangible projects (Papert, 1980). Papert helped developed the Logo programming language for children in the late 1960s, while at the Massachusetts Institute of Technology. Since then, several generations of researchers have continued to build tools for children to learn programming and electronics (Asgar, Chan, Liu, & Blikstein, 2011a; Bdeir, 2009; J Silver, Rosenbaum, & Shaw, 2012; Sipitakiat, Blikstein, & Cavallo, 2004). These include the popular Scratch programming language and the Lego™ Mindstorms robotics system. Constructionist designers have also written about effective design for children, outlining the need for usable tools that minimize the user's exposure to confusing functions while highlighting creative possibilities (Blikstein, 2013b; Resnick, Bruckman, & Martin, 1996).

2.1.2. Ethnographers

The majority of the research that I have found that describes the modern DIY community has come from the field of Human-Computer Interaction. This body of research is small, and much of the research focuses on specific DIY subgroups or specific elements of practice, but these studies sketch out a picture of some of the common elements of practice.

Several HCI researchers have investigated the motivations behind DIY practice. Tanenbaum et al. (2013) suggest that DIY practitioners in North America and Thailand are motivated by a combination of pleasure, utility and expressiveness, and they reject the dichotomy that projects are either purely utilitarian or purely for leisure (J. G. Tanenbaum, Williams, Desjardins, & Tanenbaum, 2013). Other authors have focused on the political motivations behind DIY. Lindtner and Li suggest that hacking in Chinese and American hackerspaces has a significant political element to them, and highlight the involvement (and reaction to) the Chinese government and United States military's

funding of DIY programs (Lindtner & Li, 2012). Garnet Hertz (2013) continues the political examination of the DIY community and criticizes Make Magazine for presenting a sanitized version of DIY for mass consumption, removing any of the political aspects that might be controversial (Hertz, 2013). His self-published magazine “Critical Making” is a collection of critical art pieces and essays from various authors that discuss issues in contemporary DIY (Hertz, 2012).

Other authors have described particular aspects of the DIY method that they believe can be incorporated into interaction design. Silver, Diana and Williams (2012) describe the DIY method as emphasizing rapid prototyping, open sharing, and constant engagement with a community of users and peers throughout the design process (Diana, 2008; Jay Silver, 2009; Williams, Gibb, & Weekly, 2012). Tanenbaum et al. (2012) examine the “steampunk” community – crafters and costume makers that reimagine modern technology using the Victorian materials of wood, leather and brass – as an example of a group that uses a *design fiction* to generate ideas for new work and suggest that this method can be used by researchers (J. Tanenbaum, Tanenbaum, & Wakkary, 2012). Bardzell, Bardzell and Rosner (2012) conducted interviews with master craftspeople from America and Taiwan, and suggest that the craft definition of quality, which is based on skillful work, material properties, tradition and expression should be applied to interactive technologies. A similar notion is put forward by Buechley, who argues that the aesthetic and material aspects of craft should be incorporated into interaction design in order to encourage diverse outcomes and widen the appeal of electronics (Mellis & Buechley, 2012). Ratto (2011) has developed the idea of *critical making* where hands-on work is used as a method to reflect on and discuss issues about technology.

Together these researcher and DIY practitioners describe several interesting aspects of DIY. They suggest motivations for practice that include pleasure, utility and politics, and they highlight specific aspects of DIY practice that may have relevance to interaction design, including: rapid prototyping, open sharing, using fiction for inspiration, aesthetic appreciation, focus on materials, and an appreciation for skill, tradition, and reflection.

Most studies from HCI that describe contemporary DIY communities use interviews or observation to create a rich description of a particular sub-culture, such as steampunks or knitters. I have summarized the results from these studies in Table 3.1. Groups that have received attention include: crafters, knitters, quilters, gardeners, hobby jewellers, steampunk enthusiasts, furniture modifiers, families, electronics builders and hackers.

Table 2.1. Review of Previous Research on DIY from HCI

Study Title	Methodology	Location	Participants: #	Participants: Type	Results
How-To Pages: Informal Systems of Expertise Sharing. 2007. Christen Torrey, David W. McDonald, Bill N. Schilit, and Sara Bly	Semi-structured Interview	Online	12	All male, hackers and makers (hackaday, MAKE, hacked gadgets)	*Participants:* - have a habit of reading other blogs online - use internet search - are members of online communities - use multiple sources when searching for information - documented projects after they were completed - collect all projects on personal website into portfolio - were interested in internet recognition - answer personal Q&A after project is posted
Learning How: The Search for Craft Knowledge on the Internet. 2009. Christen Torrey, Elizabeth Churchill, David W. McDonald	Semi-structured Interview	Online	15	Crafters (7 men, 8 woman)	- use browsing to identify keywords in unfamiliar areas - constantly read online - participate in online communities - get information from friends in person - understand information by trying techniques - some work on multiple projects, some work sequentially - were motivated to engage with communities to: find knowledgeable individuals, connect with others around activity, find unique ideas
From Garments to Gardens: Negotiating Material Relationships Online and 'By Hand'. 2011. Elizabeth Goodman and Daniela K. Rosner	Semi-structured Interview	California	46	15 Gardeners (half male, half female), 33 Knitters (all female)	- emphasize craft as counterpoint to screen time, industrialization - emphasize visceral, sensual aspects of work - value patience, effort and special skills of craft - gardeners searched for info separate from practice, knitters search as they work - used pictures to convey concepts hard to put in words - use online networks used to support face-to-face networks

Study Title			Participants:		
	Methodology	Location	#	Type	Results
Manifestations of Everyday Design: Guiding Goals and Motivations. 2013. Audrey Desjardins, Ron Wakkary using the work of Lean Maestri	Field Observation and Interviews	Vancouver	17	3 families, 6 hobby jewelers (all female), 8 steampunks (3 female, 5 male)	*Families*: - design to support daily activities - improvise quick systems - develop systems over time *Hobby Jewelers:* - are motivated by aesthetics - take pleasure in working with their hands - are sensitive to the properties of different materials *Steampunks:* - are driven by the idea of the fictional steampunk world - are driven by participation in the community
Inventive Leisure Practices: Understanding Hacking Communities as Sites of Sharing and Innovation. 2011. Tricia Wang and Joseph Kaye	Semi-structured Interview	California	19	Hackers and Makers	- practice is motivated by identity - involves development of skill - practitioners are motivated by reputation in the community - resistance against authority is a theme - community participation is often low-level (easy), this form loose`` communities - sharing is emphasized - participants learn through teaching
Technology's Impact on Creative Traditions: Pieceful Co-Existence in Quilting. 2004. Joyce Starr Johnson, Jana M. Hawley	Text Analysis	Online	~	Quilters	Participants valued: - patience - expression - connectedness to community through quilts and quilting practice

Study Title			Participants:		
	Methodology	Location	#	Type	Results
Crafting Technology: Reimagining the Processes, Materials, and Cultures of Electronics. 2012. Leah Buechley, Hannah Perner-Wilson	Open Question Online Survey	Online	40	10 painters, 10 sewers, 10 carvers, 10 electronics hobbyists	*All participants* - enjoy hobby - share with group *Craftspeople (painters, sewers, carvers)* - value aesthetics - find activity peaceful and relaxing *Electronics builders* - never mentioned aesthetics or peacefulness - focus on ideas, concepts and theories - emphasize personal use

Study Title			Participants:		Results
	Methodology	Location	#	Type	
Rise of the Expert Amateur: DIY Projects, Communities, and Cultures. 2010. Stacey Kuznetsov & Eric Paulos	Closed Question Online Survey	Online	2608	Female (90%), crafters (Etsy, Ravelry, Crafster + 500 respondents from Instructables)	- nearly all respondents participate in multiple online communities - nearly all respondents participate by commenting and posting pictures of projects (a small proportion use video or how-to pages) - a significant proportion attend in person meetings - participants were motivated to participate in online communities to: get inspiration, learn new concepts, give/receive feedback on projects, meet people with similar interests - most DIY projects are low cost (<50$), typically take less than 30 hours - 40% work on projects once a day, 40% once a week - nearly all participants work on projects to express themselves, most to learn new skills, few to make money (<25%), few to gain reputation online - majority of participants work alone (>60%) but most contribute to online communities to meet people with similar interests (>80%) - lack of time, low-evaluation of personal project are barriers to participation - other people's images and how-tos, were most influential on projects. Other's comments were least influential

Reviewing the studies covered in the table above, one can start to sketch an outline of DIY practice. Elements of practice that were found in multiple sub-communities include: participation in online communities, a reliance on search and social networks to find information, learning through experimentation, and political motivations. However, the conclusions that we draw from these papers are limited by the fact that each study was based on a small sample of practitioners from a specific sub-community. One exception is the survey conducted by Kuznetsov and Paulos (2010), who collected data from a large number of respondents, but they encountered significant gender bias in their respondents (despite the fact that they distributed their online survey to a wide range of communities); the majority of their participants were females (>90%) who were members of online craft sites, such as Ravelry.com, Etsy.com and craftster.org.

Though the body of literature on contemporary DIY is small, the work that has been done provides interesting personal reflections on DIY practice and qualitative studies of small groups of practitioners. Kuznetsov and Paulos take a step towards understanding DIY practice more generally with their survey, but more work needs to be done to ground conclusions about the common elements of DIY practice in data.

Chapter 3.

Interviews

3.1. Interview Methodology

3.1.1. Interview Participants

I recruited a purposive sample of DIY practitioners from the local Vancouver DIY community for interviews. I have been involved in several local hackerspaces and DIY events (including the Vancouver Hack Space, Vancouver Community Laboratory and Vancouver Mini Maker Faire) so I approached participants directly or was referred by someone that I knew.

Participants were chosen because they were active DIY practitioners, regularly working on projects, and because they were active in the DIY community. Because recruitment through personal networks is a potential source of bias, I also made an attempt to select practitioners with as wide a range of genders, ages and interests as possible. Table 3.1 summarizes the demographics of the 13 interview participants.

Table 3.1. Demographics of Interview Participants

Participant #	Gender	Age	Type of Making
1	F	26-30	Crafting, Fiber Arts
2	M	31-35	Coding, Electronics
3	M	41-45	Electronics
4	F	26-30	Community Art, Crafting
5	M	26-30	Film, Machining
6	M	18-25	3D printers
7	M	26-30	Coding, Electronics
8	F	46-50	Machining, Crochet
9	M	31-35	Robotics
10	F	36-40	Sculpture, Architecture
11	M	41-45	3D Printing, Furniture, Art
12	M	36-40	Electronics
13	M	51-55	Electronics, Music

3.1.2. Interview Procedure

Interviews lasted between half an hour and one hour and were audio recorded for transcription. I met participants at a café or other public place that was convenient for them, and offered them a meal as compensation for their time. They were given an informed consent form to fill out and could stop the interview at any time (see Appendix A).

Interviews were semi-structured. This structure consisted of questions intended to solicit a description of practice indirectly (early pilots indicated that directly asking participants about the important elements of DIY practice was not effective). Fixed questions included: describing a recent DIY project in detail; how the interviewee interacts with the DIY community; how DIY fits into their daily routine; and how they got started in DIY. During these questions, I probed for additional details, such as personal attitudes and specific strategies used to learn or overcome obstacles in their projects (see Table 3.1 for full Interview Script).

Table 3.2. Interview Script

Informed Consent form – review and sign 1. Can you describe a project that you recently worked on?				
Why this project? *Where do you find inspiration?*	Did learn anything new? *How did you learn?*	Did you collaborate? *Describe…*	Will you share the project?	How did it go? Will you pursue idea further?
2. I'd like to hear about your involvement with the maker community…				
Are you a member of groups? Online groups?	How long have you been there?	How do you participate there?	How much?	What do you get out of it?
3. I'd like to ask a bit about your daily routine, and how making fits into it…				
When/where do you usually work? *Anywhere else?*	Work on one project at a time, or have many? *How do you decide what to work on?*	What motivates you to work on projects?	Interested in other hobbies, any other major hobbies?	Internet use: what do you usually find yourself doing online? *Games, news, wiki?*
4. How did you get started making? *Prompt for more info as appropriate*				
Optional Questions (time permitting): What do you think makers have in common? Do you think you've become a better maker over the years? *What's changed over that time? Is there anything you're trying to improve now?* Any ideas for novice makers?				

3.1.3. Interview Analysis

I transcribed my interviews into QSR Nvivo 10 (software designed for qualitative analysis) and processed them using thematic analysis. This analysis technique, as described by Richards (2009) in *Handling Qualitative Data*, involves iterative passes through the data to develop interview 'themes' (concepts that are mentioned across multiple interviews). In the first pass, I annotated transcripts with information about the speaker and the topic of each statement. Then, in subsequent passes through the transcripts, I generated themes based on meaningful statements in the interviews. Statements that relate to the same theme were collected together. After all of the interview data had been coded for meaning and grouped into themes, I revisited each

theme to check for consistency. If two themes contained similar statements they were merged together, and if a single theme contained divergent statements it was split apart. In this way, the themes were refined and their internal consistency improved. After this process was complete, I excluded any theme that was mentioned by less than 25% of my participants (4 out of 13 respondents). Given the diversity of my interview participants, this seemed like a reasonable cut-off to deem an interview theme as "common", and it left me with a number of interview themes that was reasonable for the length of my survey. A full list of interview themes can be found in the Interview Results section that follows, and a sample of data from NVIVO can be found in Appendix B.

My primary research question is: what common attitudes, habits and skills are shared by modern DIY practitioners? It alludes to the framework that I developed to describe practice and organize interview themes. I define attitudes as a practitioner's beliefs about themselves and the world, skills as competencies that allow them to achieve a desired outcome, and habits as behaviours that practitioners often engage in. These categories arose from my need to convert interview themes into elements of practice. However, my findings are structured according to higher level categories that may include habits attitudes and skills. For example, the skill of problem solving might be supported by an attitude that you are an excellent problem solver and a habit of learning by trial and error.

3.2. Interview Results

A summary of interview results is presented in section 3.2.1 and followed by a more detailed description of each theme, including example quotes in section 3.2.2. Section 3.3 discusses the results in the context of previous research. Survey themes are organized into common categories here, but each of the 30 individual themes listed in table 3.2.1 was converted into a survey question (see the Survey Construction and Research Approach section for more details).

3.2.1. Summary of Interview Results

The following table summarizes all of the interview themes that arose from my qualitative analysis. Themes are organized into common categories, the number of interviewees who mentioned each theme is listed in the center column, and the theme's categorization as a habit, attitude, skill or demographic trend is listed in the rightmost column.

Table 3.3. Summary of Interview Themes sorted by Category

Interview themes Organized by Category	Number of Interviewees who mentioned theme	Habit, Attitude, Skill or Demographic Trend
Keep project work enjoyable		
often work on creative projects	5	Habit
work on projects in irregular bursts	5	Habit
work on multiple projects at one time	9	Habit
incorporate play into their process	6	Habit
Continually search for inspiration		
use projects to solve daily problems	7	Habit
use projects to help others	7	Habit
frequently read online for inspiration	8	Habit
talk to friends to get ideas	9	Habit
keep an idea journal	4	Habit
Productive work environment		
have a workspace at home	8	Habit
get the most work done when alone	4	Habit
Have a peer group		
had adult DIY mentors when young	11	Habit.
had a peer group with shared interests when young	6	Habit
currently have a peer group that shares interests	7	Habit
Desire for control over environment		
believe people should understand the things they own	7	Attitude
desire to customize the world to fit your needs exactly	5	Attitude
Curiosity leads to understanding		
desire to understand the word around you	8	Attitude

Interview themes Organized by Category	Number of Interviewees who mentioned theme	Habit, Attitude, Skill or Demographic Trend
always taking things apart	5	Habit
desire for deep knowledge	7	Attitude
Sense of empowerment		
feel you can overcome problem you encounter	10	Attitude
can understand how anything works	10	Attitude
want to solve problems yourself	6	Attitude
Embrace Failure		
failure is an important way to learn	5	Attitude
learn through trial and error	5	Habit
Good at troubleshooting		
good at troubleshooting	9	Skill
adaptive	4	Skill
tenacious	5	Attitude
Effective researcher		
good at internet research	8	Skill
use online tutorials	4	Habit
ask friends when trying to learn	7	Habit
Have technical Training	13	Demo.
Work in technical field	10	Demo.

Together, these themes provide a rich description of the common elements of practice from a small sample of Vancouver-based practitioners. They also provide a set of questions for survey development that is grounded in the context of the modern DIY community. Each theme is described in more detail in section 4.2.2 below.

3.2.2. Detailed description of interview themes with quotes

The following section provides a brief description of each interview theme, along with illustrative quotes. Interview themes are presented in **bold font** throughout, so that they can more easily be connected to the summary table above.

Keep project work enjoyable

Unsurprisingly, many interviewees mentioned that they **often worked on creative projects** and found them enjoyable. Interviewees also mentioned three other habits that support this goal. The first habit was to **work on projects in irregular bursts**, capturing inspiration and motivation when they occurred. The second was to **work on multiple projects at one time**. Participant 1 described the process:

> I work on one for a while, then get tired of it, then work on something else. Then I'll have an idea in the shower about how to improve, two projects back, so... if I don't have more than one at a time I'm going to get quite bored with whatever I'm doing.

The third habit was **incorporating play into your creative practice**. This unstructured time was often used to experiment with new tools or generate ideas.

Continually search for inspiration

It seems that an important part of DIY practice is maintaining a steady supply of inspiration for new projects. Interviewees mentioned several habits related to this need. One common method was to **use projects to solve problems from daily life** or, as some participants put it, to "scratch an itch". Interviewees also **use projects to help others** by solving their problems or creating gifts. Many participants also mentioned the habits of continuous **online reading for inspiration** and **talking to friends for inspiration**. Interviewee 10 summarized their sources of inspiration saying:

> Most of my work now is more about being inspired or getting a gem of an idea from the Hack Space people or from the web or from Arduino or YouTube, seeing what somebody's done and saying "oh, I wonder how they did that" and often trying to reproduce it and extend it.

Interviewees also mentioned their process for capturing and fostering ideas, the most common of which was **keeping an idea journal**. Several participants described highly intentional processes of recording and working on ideas using a notebook.

Productive work environment

Several common habits related to work environment also arose. Contrary to my expectations, one of these was working alone. There were some exceptions to this rule,

one interviewee talked about going to a local art collective on the weekends to do “fun projects”, but a greater number of participants emphasized the fact that they **get the most work done when alone.** Participant 5 complained that:

> If I'm at the Hack Space and I try to work on something, I either get distracted talking to someone or I get distracted trying to find something that doesn't exist there and I'm like, "well I should have worked on this at home in the first place."

When asked about their work environment, many interviewees elaborated on their **workspace at home**. Participant 10 explains that, “having a fixed space to work means that I don't have to do much teardown and setup and that means I have less of a barrier towards actually doing things.”

Have a peer group

The value of having a supportive peer group was emphasized by interviewees in three different ways. The first two were about getting started in DIY. **Having adult DIY mentors when young** was a common story of beginnings, as was **having a peer group with shared interests when young**. Participant 1 explains:

> I'm pretty sure that peer influence is a huge thing. If you do have other friends around that do find some of this stuff interesting, it sort of reinforces whatever latent interest you may have. I know that worked for me, knowing that a few of my friend and acquaintances were into this stuff.

When describing their lives today, the value of **currently having a peer group that shares your interest** was also reiterated.

Desire for control over environment

When probed about the attitudes that motivate their work, interviewees showed a wide range of opinions: from utopian ideas about the promise of technology to negative opinions about screen time and a desire to return to more hands-on crafts. One common thread that ran through these comments was participant’s desire for control over their environment. This was expressed as two related attitudes. The first was a

belief that people should understand the things they own, a reaction to “black box” technology and passive consumerism. Participant 10 expresses this attitude:

> I'm not just going to accept the fact that everything I need I have to buy…I have to take it as it is, and if it's broken I have to throw it away or take it to somebody else to fix. This idea that I'm as capable as other people to create, discover, modify, build, command, envision, dream. This is something that I got in my early times.

The second was a more personal **desire to customize the world to fit their needs exactly**, which was often expressed as a strong drive to make things fit the interviewee’s needs exactly. As interviewee 4 put it, “the status quo works if it fulfills 100% of what we need, but if there's 5% that isn't there, we're willing to say, "let's make it better.“

Curiosity Leads to Understanding

Interviewees often expressed an intense **desire to understand the world around them**, which lead to the habit of **taking things apart**. As described by participant 6, “Ripping apart stuff that my parents brought back was a big one for me. Understanding how things worked. So... we lived close enough to a junk yard that I could go bring junk back, rip them apart.”

Interviewees also described a more specific consequence of intense curiosity: a **desire for deep knowledge.** Many interviewees talked about the need to fully understand tools and ideas. As participant 4 explains, “I like to understand why something works. I never accepted things that were just ‘oh it works this way.’”

Sense of empowerment

Another attitude that was commonly reference in the interviews was a sense of empowerment. Many of the interviewees expressed confidence that they **could overcome any of the problems they encountered** and **could understand how the objects around them worked.** Several interviewees joking referred to this as DIY “ego” or “hubris”, but cited it as a constructive force that prevented them from being intimidated. Participant 10 elaborates:

> I think it's the maker's credo… it's "wow, everything that's made by humans on this planet is made by people like me." Maybe smarter, maybe with more education, but the makers credo is: if somebody made it, I can understand how it works and given enough time or energy I can probably make it or enhance it.

This confidence is also reflected in the common theme of **wanting to solve problems yourself.** As participant 1 put it, "I suffer from a fair amount of "not invented here" syndrome, so I'll look at all [these products], and then I'll do it myself. I want to own it by the time I'm done it." Whether arrogant or optimistic, a deep sense of empowerment was a clear theme amongst interviewees.

Embrace Failure

Perhaps related to a sense of empowerment, interviewees expressed an attitude that **failure is an important way to learn**. Interviewee 2 put it succinctly by saying, "someone once said just keep making new mistakes, and that's exactly what I aim for." This attitude was also evident in the common habit of **learning through trial and error.** Interviewee 9 describes her process, "I also tend to be somebody who isn't super intimidated by a lot of that stuff with my hands so I'll just dive in and figure it out as I go."

Good at troubleshooting

In addition to habits and attitudes, two skills were commonly mentioned as essential parts of DIY practice. The first of these was **being good at troubleshooting**. Interviewees also emphasized two attributes that support the problem solving process, **being adaptive** and **being tenacious**. As interviewee 7 describes it:

> I think [makers are] the people that don't give up... you couldn't last very long if you got really depressed from sucking. If you're making things… you're going to have a lot of times when you're like "oh crap that didn't really work out the way I thought", and you have to have the guts to do it again, and do it again, and do it again, and not feel embarrassed about doing it wrong the first couple times, or doing parts of it imperfectly.

Effective researcher

The second skill that was identified as important for DIY was research. In particular, online research skills were emphasized as both **effective internet research** and **use of online learning resources,** such as videos. Participant 8 explains:

> I find the internet to be good for referencing things, like, if I forget how to cast on and if I want to learn a new way, I can just search. And I can see pictures of a video where they show me with their hands, because you need to see the hands.

Interviewees also pointed out the value of their social network for finding information describing how they **ask friends for help when trying to learn new skills.** Participant 2 expressed this clearly:

> When I can, I talk to local makers. If there's anyone I know who's actually done anything related to what I'm doing I turn to them first, because that's even faster than [chat]… because I've built up a personal relationship with that person. That's immensely helpful, social networking all the way.

Technical Training

The final theme is related to demographics. Interviewees often **had formal training in a technical field**, and many of them **worked in technical fields** like programming or architecture. The advantage of this training was described by participant 12:

> We actually had pretty good courses in high school physics, we got to play with some logic chips and debounce switches and various other things, like RS flip flops… in university we had more op amps and logic and whatnot, kind of low level stuff… good foundation.

3.3. Summary

Semi-structured interviews were conducted with a purposive sample of 13 DIY practitioners from the Vancouver area (see table 3.1. for participant details). Questions asked about: a recent project, interaction with the community, participants routine around their DIY practice, and how they got started.

A thematic analysis was conducted on interview transcripts and 30 common themes identified. These themes can be grouped into the following categories: keeping project work enjoyable, searching for inspiration, keeping a productive work environment, having a peer group, wanting control over your environment, being curious, having a sense of empowerment, embracing failure, troubleshooting, and effective research.

Chapter 4.

Survey

4.1. Survey Methodology

4.1.1. Survey Construction

The 30 interview themes from the qualitative analysis were converted to survey questions. I used three types of question: questions about the frequency of habits ('how often do you…'), questions of agreement ('how much do you agree with the following…'), and demographic questions (age, gender, education level). A full list of interview themes and survey questions is listed in Appendix D. I reversed the meaning of 6 questions out of the 30 in order to check for positive response bias. Survey respondents were also asked to agree or disagree with seven labels that represented sub-groups in the DIY community, including: maker, hacker, tinkerer, engineer, artist, designer and crafter. These labels were drawn from the most common self-identification labels found in a market research study on attendees of the Bay Area Maker Faire (Make, 2013). The survey was piloted with colleagues and a small sample of DIY community members using an online survey that was augmented with areas for feedback on question wording and survey structure. The full survey, with demographic questions, can be found in Appendix C.

4.1.2. Survey Distribution

I distributed the survey in two phases: in-person and online. Survey participants were incentivised to participate with the chance to win one of three Amazon™ gift cards ($50, $100, $150). These prizes were distributed after all survey responses were collected.

In-person surveys were distributed at the Vancouver Mini Maker Faire (makerfaire.ca) on June 1-2, 2013. The event is a DIY festival that draws approximately 4,000 attendees. I set up a booth on the fair grounds and asked attendees to participate in my survey. Participants took approximately 10 minutes to fill out a paper survey (see Appendix C for full survey). Informed consent was collected separately from surveys, so that surveys remained anonymous, and adult consent was collected for minors. Participants were free to withdraw from the survey at any time. I collected 339 complete survey responses using this in-person method.

I replicated the paper survey online using FluidSurveys (an online survey tool) and distributed it through a range of DIY websites[2]. In each case I created a profile on the website and posted the survey information to its forums. In two cases, Instructables and the Make Magazine's Facebook page, the editors of the site promoted the post (see section 6.1.5 for a full breakdown of where respondents came from). Informed consent was collected before the survey began and only participants older than 16 were asked to complete the survey, as no parental consent could practically be collected online. This age-verification protocol was in agreement with a special exception to the collection of informed consent for minors as overseen by Simon Fraser University's research ethics board. I collected 584 surveys using this online method.

4.1.3. Survey Analysis

Excluded Participants

923 total surveys were collected. Of these 9 were excluded because participants were less than 10 years of age, which was deemed too young to accurately answer survey questions (at the time of collection, these participants were allowed to complete a paper survey with their parents because several parents suggested that it would be a good experience for them). Another 118 online surveys were incomplete, with a small portion of the survey filled out. These incomplete responses were included in statistical

[2] The online survey was posted to: Make Magazine's facebook feed; the forums of Instructables, Ravelry, Hackaday, RepRap, Makerbot, Craftster, Etsy, Adafruit, Arduino, Raspberry Pi, and Processing; and the mailing lists for the Vancouver Hack Space, Noisebridge, 3D604, the Coalition of Canadian Creative Spaces email list.

analysis that is robust to missing data, but are excluded from graphs and summary statistics. After filtering out all excluded participants and incomplete surveys, 796 responses remained.

Statistical Analysis

I used several non-parametric statistical methods to analyse survey data. There is debate in the research community about whether Likert scales generate ratio or ordinal data (Jamieson, 2004), so I chose to treat all Likert data as ordinal. Medians and quartiles are used for descriptive statistics, and non-parametric statistical tests are used for analysis.

Tables, graphs and descriptive statistics were used to describe the demographics of the survey sample, and median scores were compared to identify the most highly agreed upon survey questions. Most survey questions were worded positively, so that agreement with interview question indicated agreement with the interview themes it was based on (e.g. Interview theme: “Have workspace at home” -> Survey question: “I have a well-equipped workspace at home”). However, some questions were worded to express the opposite of their interview theme. For these questions, disagreement with the survey question indicated agreement with the corresponding interview theme (e.g. Interview theme: “Embrace failure” -> Survey question: “Failure should be avoided”). This was done to check for agreement bias, where survey respondents tend to agree with every question in a survey. The scores from negatively worded questions were inverted for survey analysis, so that positively and negatively worded questions could be compared.

Comparisons between DIY subgroups (indicated by the seven labels: maker, hacker, tinkerer, engineer, artist, crafter, designer) were conducted using Bayesian Model Averaging. Survey question and label associations could also be measured using Spearman’s ρ, but I elected to use the BMA on the recommendation of my department’s statistics consultants. Bayesian Model Averaging is similar to Spearman’s ρ in that it uses a linear regression model to find the optimal combination of explanatory variables (in this case survey questions) to explain a response variable (a self-report label). It differs from Spearman’s ρ because it does not assume that every explanatory variable has to be in the model. Instead it uses computational methods to explore *every* possible

combination of explanatory variables (every possible combination of survey questions) and determines the fitness of each combination[3]. After the top models are ranked the method looks at the impact of each explanatory variable across the hundred top ranked models and estimates its importance based on all of the models.

For example, suppose that we are looking for survey questions that associate with the "Maker" label. The BMA procedure starts by testing how well different combinations of survey questions predict the movement of the Maker label. One combination may involve questions 1, 3, and 5 another combination may involve all 30 questions. After the fitness of each model is calculated, they are ranked from best to worst. The top 100 models are kept, and the rest are discarded. Now the influence of each explanatory variable is considered across these 100 models, and the probability that it is strongly associated with the response variable (in this case "Maker") is calculated. These probabilities are then used to rank each explanatory variable in order of importance, allowing the most highly associated labels to be identified.

This analysis allowed me to look for any clustering in the data that would be missed by taking median scores from all groups combined. For example, Hackers may consider themselves good at troubleshooting, but Artists may not.

4.2. Survey Results

4.2.1. Responses to Survey Questions

This section addresses my first research question: what common attitudes, habits and skills are shared by modern DIY practitioners?

Interpreting Survey Results

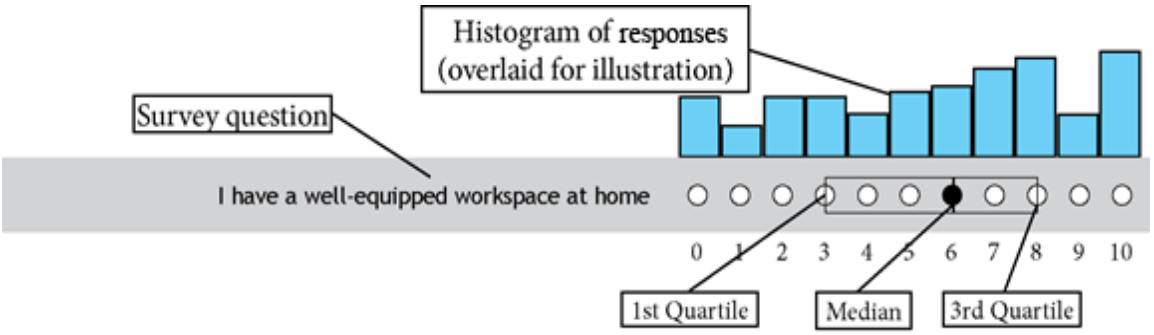
Each survey question was based directly on an interview theme (discussed in section 4.1.1 "Survey Construction") and there were 30 survey questions in total (see Appendix C for full survey). The scores from negatively worded questions were inverted

[3] Instead of actually computing the millions of combinations of 30 variables, BMA actually uses an algorithm to explore the space of possible combinations.

for survey analysis, so that positively and negatively worded questions could be compared (see section 4.1.3 for details). This is indicated by the prefix "Inverse of:" in the following figures. All data is treated as ordinal data, so medians and non-parametric statistics are used.

Given the large number of possible responses on my Likert scales, I chose to collapse responses into three categories, where questions with a median score of 9, or 10 are considered 'highly agreed with', questions with a median score of 7 or 8 were considered 'agreed with' and questions with a median score of 5 or 6 are considered 'ambivalent'. In the following figures, I have presented results overlaid onto a Likert scale that is similar to the scale used on the survey. Median scores are indicated by a filled black circle, and interquartile range indicated with a box plot. The edges of the box plot indicate the 1st and 3rd quartiles of the data (25% of questions lie below the 1st quartile and 25% of questions lie above the 3rd quartile). Figure 4.1 shows an example of this display, with a histogram of responses overlaid for comparison.

Figure 4.1 Diagram explaining Likert scale-Box plot graph

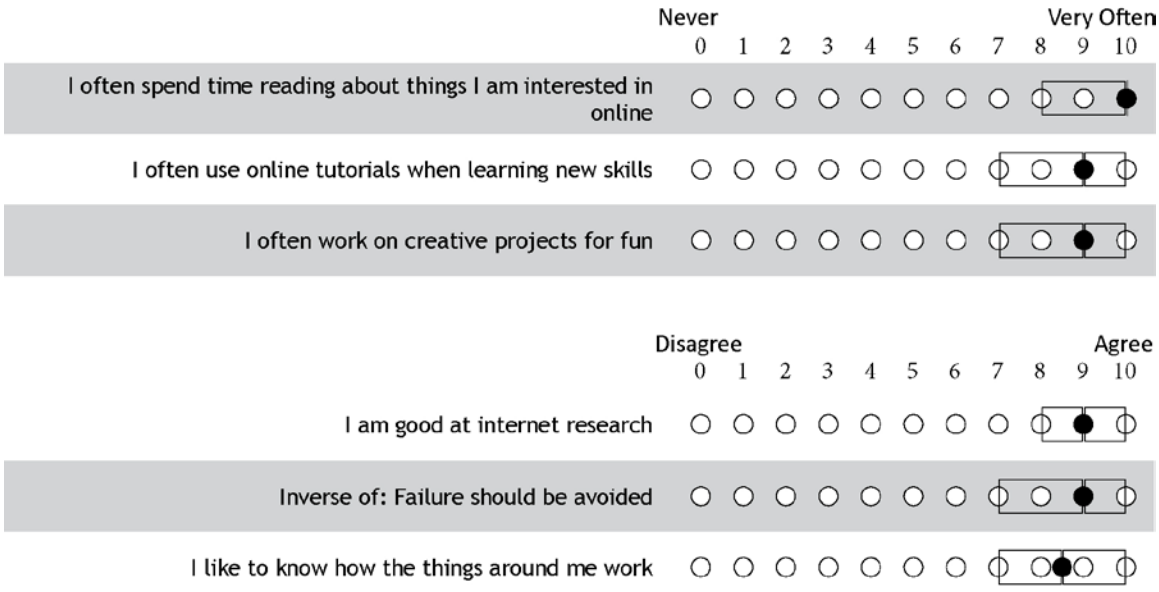


Elements of the Likert scale-Box plot graph. 25% of the responses fall under the 1st quartile and 25% fall above the 3rd quartile. A histogram is provided in this example for comparison.

Survey Questions Ranked by Median

Figure 4.2 shows the 6 most highly agreed upon questions, with medians of 9 or 10 (I've also included one question that had a median of 8.5). Questions are separated by type and ranked by median score.

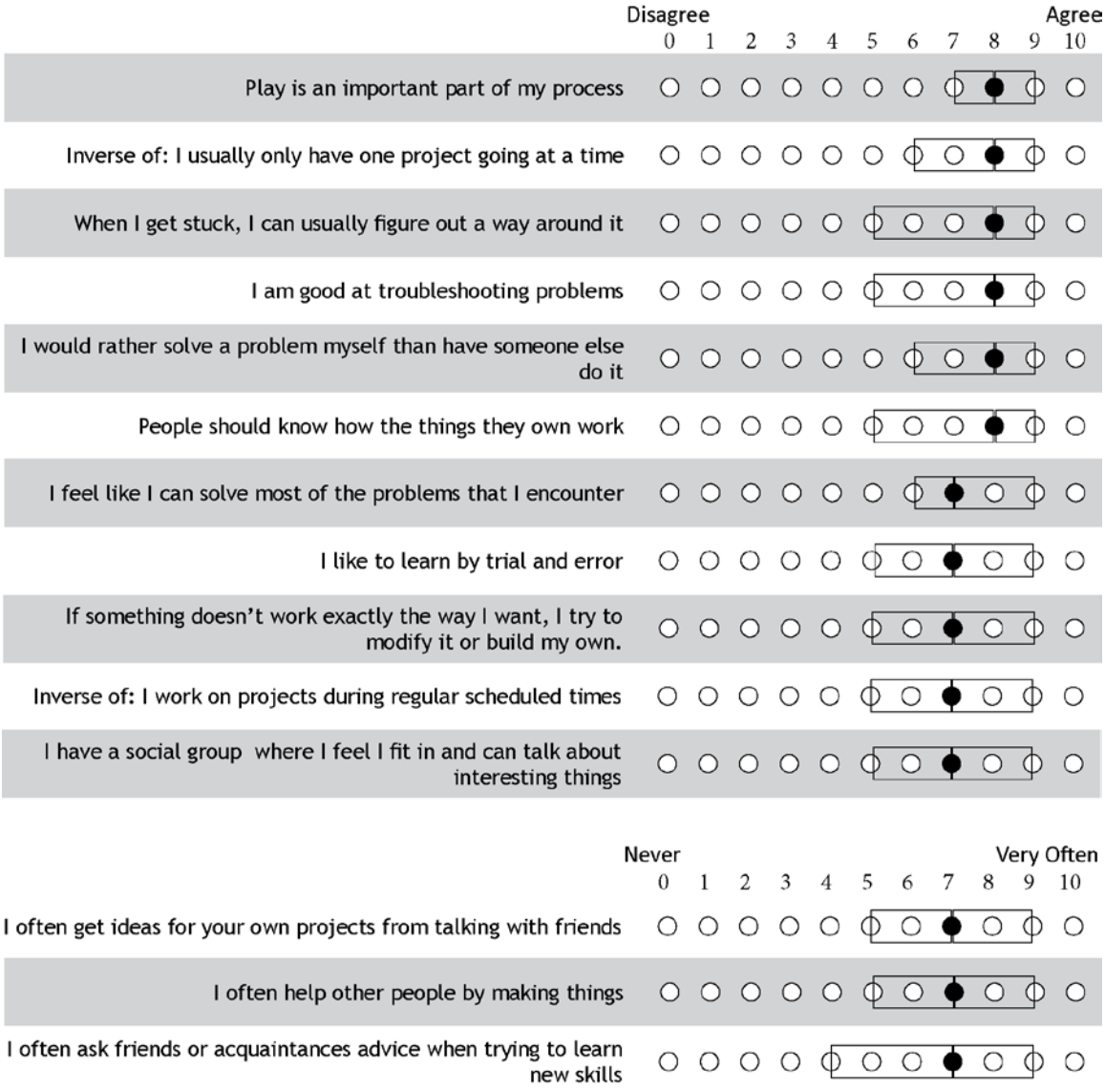
Figure 4.2. Survey Questions with Very High Agreement



Of these six questions, three are related to internet use, including interest reading, online tutorials and online research. A large portion of the surveys were collected online, so this sample is bias towards internet use, but these the median responses are still high when looking at only the respondents from Maker Faire (the median for "I often spend time reading about things I am interested in online" is 9, the median for "I use online tutorials when learning new skills" is 8, and the median for "I am good at internet research" is 9).

Figure 4.3 lists survey questions with a moderate level of agreement (medians of 7 or 8). Responses are presented in with the same box plot format.

Figure 4.3. Survey Questions with moderate levels of Agreement



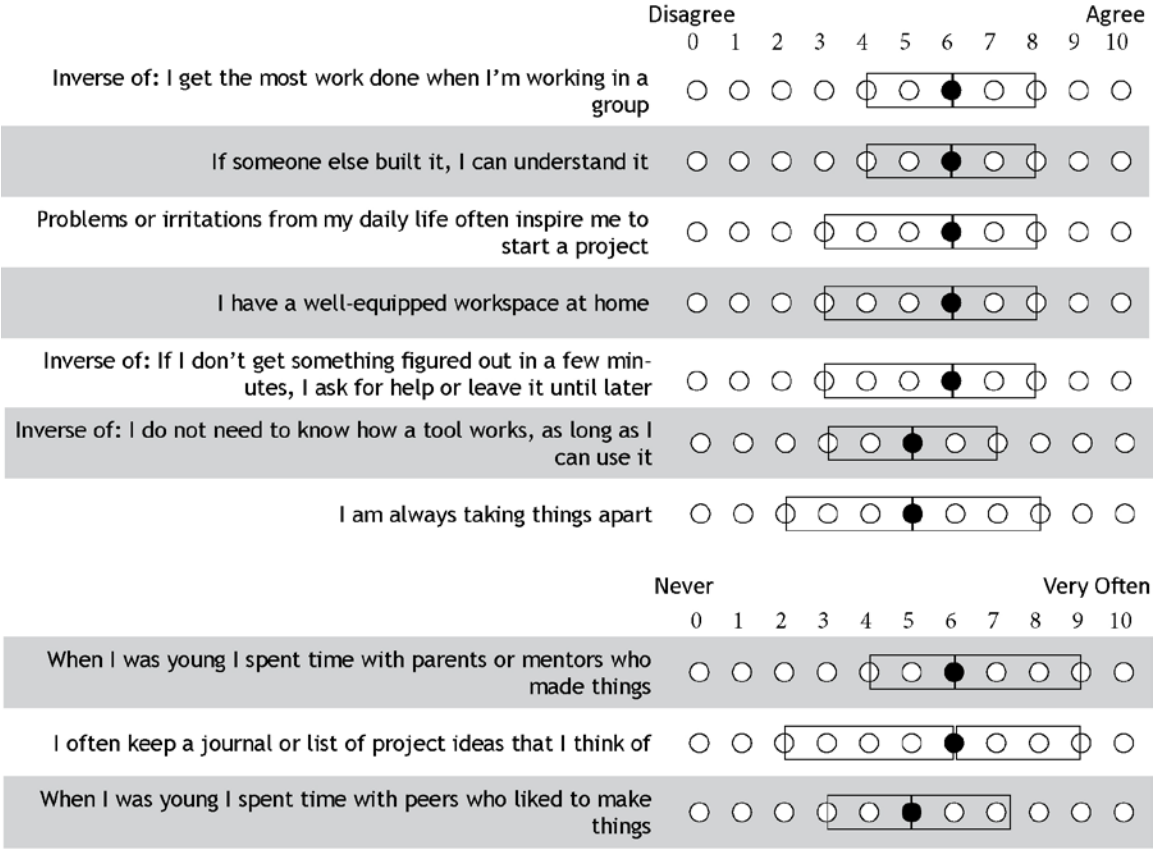
Together, the highly and moderately agreed upon questions inform my answer to the primary research question in this study: what common attitudes, habits and skills are shared by modern DIY practitioners? They suggest that DIY practitioners:

- Find inspiration for projects by talking with friends and reading online. They also start projects to solve problems for others and customize the objects they own. They like to understand how the things around them work.

- Ask friend when learning new skills, and like to learn through trial and error and play. They explicitly accept failure as part of the process.
- Consider themselves experts at troubleshooting and internet research. They want to solve their own problems and are confident in their problem solving abilities.
- They tend to have a social group that shares their interests and are flexible with their work schedule, working at irregular times and working on multiple projects at once.

The implications of these results are explored in the Discussion section. Figure 4.4 shows survey questions with medians of 5 or 6, where significant portions of respondents leaned towards disagreement.

Figure 4.4. Survey Questions with mixed response



These questions tend to have a larger interquartile range than questions that were highly agreed upon or moderately agreed upon, suggesting that there is diversity in

the community around several elements of practice. These elements of practice include specific habits, such as: taking things apart, keeping an idea journal, having a workspace at home, and tending to work alone. They also include questions about background; several interview subjects talked about having mentors or peers who got them into making when they were young, but this did not seem to generalize to the larger survey sample.

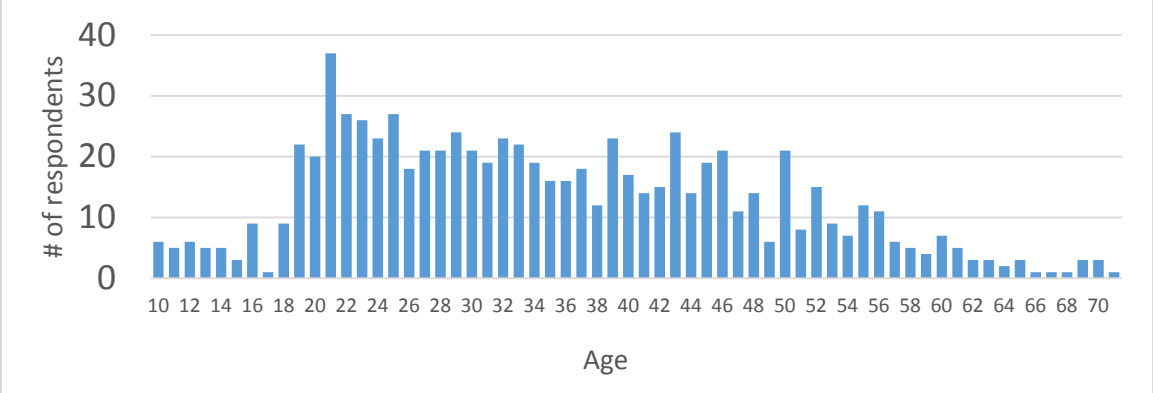
4.2.2. Demographics of Survey Respondents

This section addresses my second research question: what are the demographics of the modern DIY community? This is important to confirm that the survey respondents did, in fact, come from a broad range of DIY sub-communities, and to confirm that DIY culture is drawing in a diverse range of participants.

Age and Gender

Of the 796 respondents who completed a survey, 392 were male (49%) and 404 were female (51%). Age ranged between 10 and 71, with a median age of 33 years. See figure 4.5 for a full age distribution.

Figure 4.5. Number of Survey Respondents of each Age

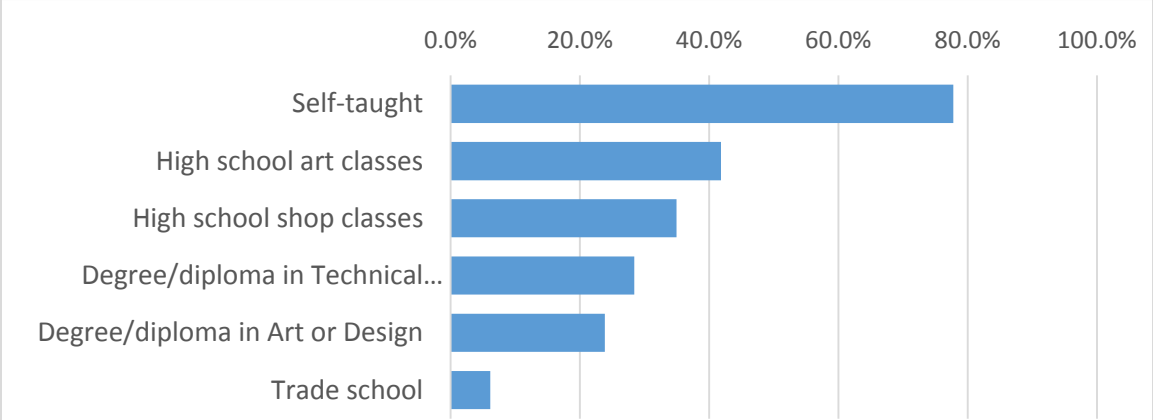


Educational Background

Figure 4.6 summarizes the survey respondent's educational backgrounds. When asked about their educational background, almost 80% of participants indicated they

were self-taught to some degree (participants could check multiple answers). 35% had done hands-on classes in high school, approximately 30% had post-secondary training in a technical field and 25% had a degree in Art of Design. Only 6% reported that they had attended trade school. Accounting for overlap between groups, 47% of participants had some kind of post-secondary education in art, design, or a technical field, and 70% had some kind of formal training in high school or post-secondary.

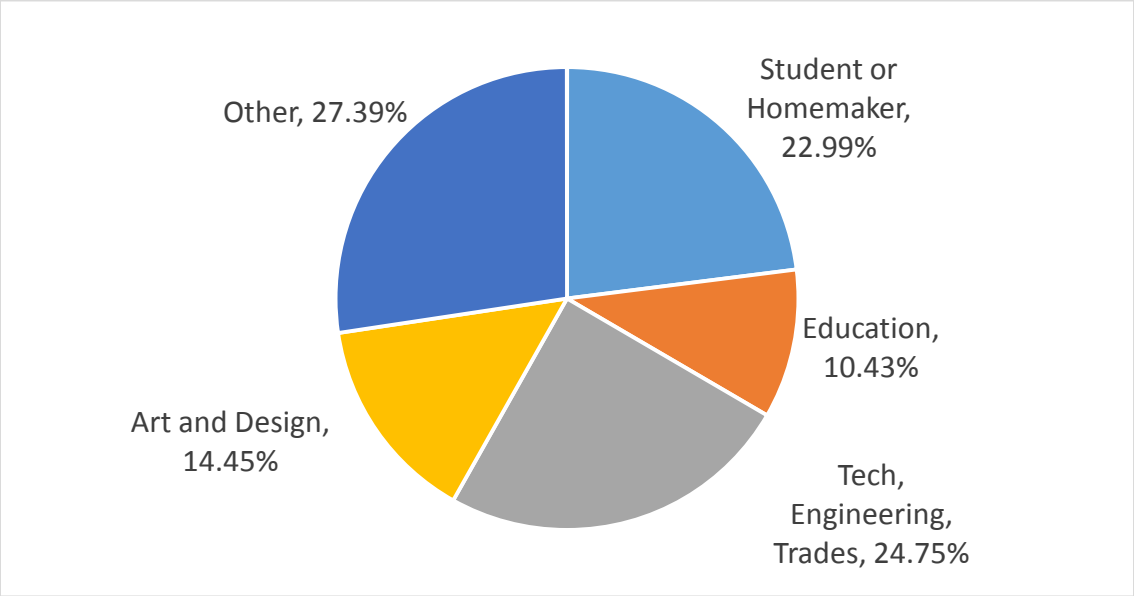
Figure 4.6. Education Backgrounds of Survey Respondents



Field of Work

Respondents' field of work is summarized in Figure 4.7. The largest group of participants (23%) were students or full time parents who had not yet worked in industry. The most represented industries were: Education (10%), Technology (8%), Engineering (7%), Programming (6%), Trades (5%), Arts (4%), Design (4%), Media (4%), and Crafts (3%). Nearly 40% of participants worked in a technical or design field.

Figure 4.7. Field of Work of Survey Respondents



Country of Origin

330 respondents filled out a paper survey at the Vancouver Mini Maker Faire, while 475 completed a survey online. The majority of participants were Canadian (504) or US American (181), the remainder of respondents hailed from 23 other countries filling out the list (see details in table 4.1).

Table 4.1. Country of Origin of Survey Respondents

Country	# of Respondents	Country	# of Respondents
Canada	504	United Kingdom	25
United States	181	Germany	6
Australia	27	New Zealand	5

<5 respondents also replied from: France, Netherlands, Thailand, Philippines, Belgium, India, Ireland, Spain, Finland, Europe, Malaysia, South Africa, Austria, Sweden, Chile, United Arab Emirates, Greece, Argentina, Romania, Italy

Referring Website

The website which referred each respondent to the survey was tracked by Fluidsurveys, the software used to build the online survey. Results are listed in Table 4.2. The largest groups of participants filled out paper surveys at Vancouver Mini Maker

Faire, followed by a group referred by Facebook. Fluid surveys did not provide a detailed source from Facebook (which I did not expect) and multiple sources could have used social media, so these results are ambiguous. However, the survey link was posted to Make Magazine's Facebook feed, which has several thousand followers, so I strongly suspect the majority of the Facebook respondents were directed to the survey from Make Magazine. Between Facebook and Maker Faire, these results suggest that a large number of respondents came from a "Maker" branded source.

Table 4.2. Referring Site of Survey Respondents

Referrer	# of Respondents	Referrer	# of Respondents
Paper Survey (at Vancouver Mini Maker Faire)	321	Make	10
Facebook (most likely Make Magazine Facebook Feed)	194	RepRap	9
Unknown Referral Site	156	Hackaday	5
Ravelry	23	Craftster	4
Instructables	18	Raspberrypi	4
SFU Design Program	17	Arduino	2
Email	15	Processing	2
3D604	14	Etsy	1
Adafruit	1		
			Total: 796

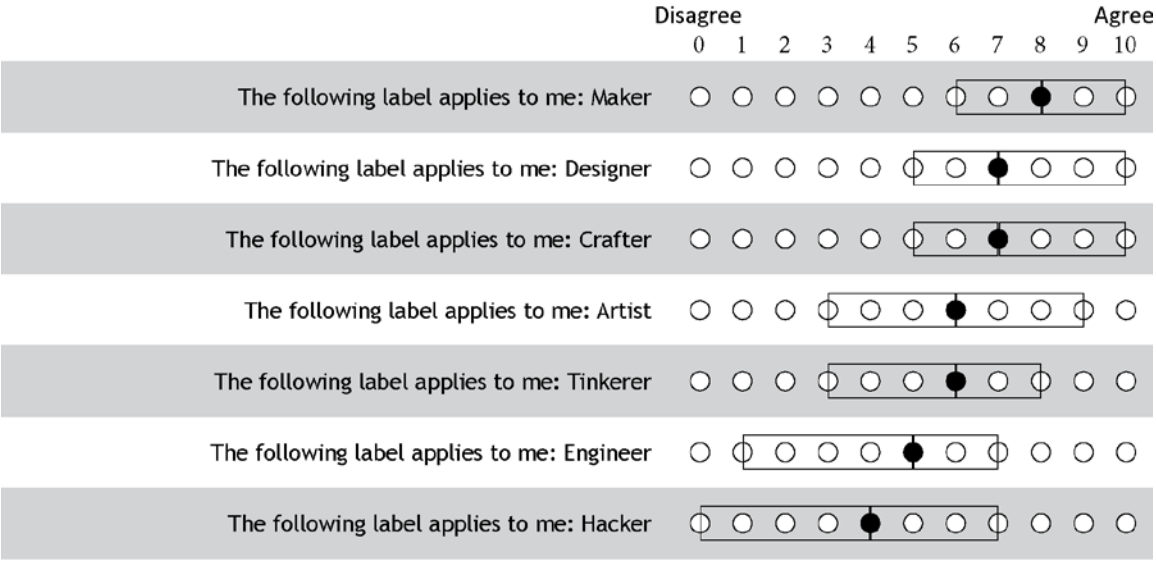
4.2.3. Trends between groups of survey respondents

This section addresses my third research question: do any patterns emerge between different DIY sub-groups?

Self-Report Labels

Participants were asked to rate how much "the following label applies to me" on an 11 point Likert scale (0-10) for seven labels, the results are summarized in Figure 4.8.

Figure 4.8. Median Scores and Box Plot for Self-Identification Labels



Maker was the most agreed upon label, closely followed by Designer and Crafter then Artist and Tinkerer. Engineer and Hacker stand out as the labels that respondents were least likely to associate with. Looking at the number of respondents who rated themselves as a 9 or 10 for each label (note that the questions were non-exclusive) we see the following number of response: Maker (341), Designer (282), Crafter (281), Artist (222), Tinkerer (168), Engineer (135), and Hacker (87). Only 10% of respondents strongly associated with the hacker label. This may mean that they were underrepresented in the sample, or that they actually make up a small portion of the DIY community. It is notable that 15% of respondents firmly consider themselves engineers, given that this label is strongly association with a professional certification.

Correlation between labels

Spearman's ρ was used to measure correlation between the seven self-identification labels. The results are summarized in table 4.3. The Spearman's ρ method ranks all data, then performs a correlation analysis (Pearson`s r) on the ranked results. This means that values of ρ indicate the level of association of transformed (ranked) data, so these measures of association cannot be directly converted back into proportion of variance explained (as is the case with Pearson's r). Strength of association (effect size) was evaluated using the guidelines set out by Ferguson et al.

(Ferguson, 2009). Significance was measured using a p value adjusted for multiple comparisons using Bonferroni's method (the 0.05 cut-off for p is divided by the number of tests conducted).

Table 4.3. Associations Between Self-Identification Labels

Spearman's ρ for correlation between labels						
	Hacker	Tinkerer	Crafter	Designer	Artist	Engineer
Maker	0.17*	0.34*	0.46*	0.42*	0.31*	0.18*
Hacker		0.56*	-.02*	0.07	-0.09	0.55*
Tinkerer			0.07	0.022*	0.09	0.5*
Crafter				0.34*	0.45*	-0.12
Designer					0.58*	0.16*
Artist						-0.04

Colouring based on effect size using: <0 Negative (red) | 0.2 Weak (white) | 0.5 Moderate (light green) | 0.8 Strong (dark green) (Ferguson, 2009)

The correlation data above indicate that labels form two clusters: Hacker, Engineer, and Tinker are all moderately associated with each other, and Crafter, Designer and Artist are weakly to moderately associated with each other.

Each cluster is unassociated with the other (or negatively associated in the case of Hacker-Crafter), the only exception being Tinkerer-Designer which shows a weak positive association. The Maker label spans the two groups, having a positive association with all labels.

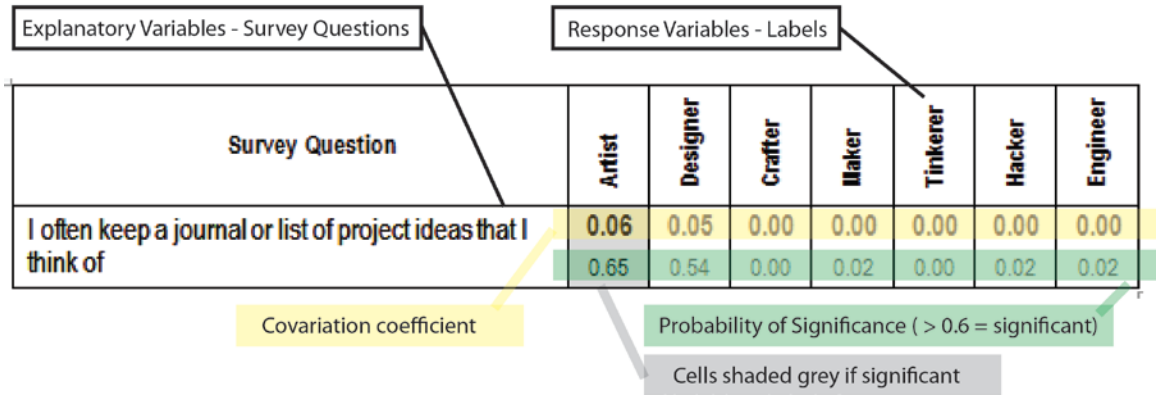
Association between Labels and Survey Questions

Bayesian Model Averaging (BMA) was used to identify patterns between subgroups of survey respondents (Viallefont, Raftery, & Richardson, 2001). A BMA analysis was run for each label (e.g. maker or crafter) to determine which survey questions associated most strongly with it (see section 4.1.3 for more details).

Table 4.4 lists the BMA results for survey questions that showed significant association with at least one of the DIY labels (artist, crafter, designer, maker, tinkerer, hacker, and engineer). Questions that were not associated with any variable are omitted from the graph below, but full results can be found in Appendix E. The legend preceding the table 4.4 explains each of its elements. Each row displays the association between one survey question and each of the seven labels. In each cell (where the row of a survey question and column of a label cross) there are two values: the upper, bolded value is a coefficient of correlation that indicates the number of points the label (e.g. maker) tended to change based on 1 point of change in the survey question; the lower value in each cell, below the correlation coefficient, is a probability of significance (see section 4.1.3 for details on how this probability is calculated). A cut-off of > 0.6 was used to determine whether survey questions were significantly associated with labels, based on the recommendation of Viallefont (2001), and cells containing significant values are shaded grey for emphasis.

To read the table, choose a survey question, then look for the labels that it is significantly associated with (based on the shaded cells), for each shaded cell the correlation coefficient (upper value) indicates the strength of association. For example: The survey question “Play is an important part of my process” is associated with the label Artist, and the probability that these two variables is associated is 100%. The association coefficient is .3, so for every 3 points of change in the survey question you would expect about 1 point of change in the label. A simplified table, summarising the pattern of significant associations, is presented after the detailed results in table 4.4.

Table 4.4 BMA Results for questions associated with Self-Identification Labels



Survey Question	Self-report labels						
	Artist	Designer	Crafter	Maker	Tinkerer	Hacker	Engineer
I often keep a journal or list of project ideas that I think of	0.06 0.65	0.05 0.54	0.00 0.00	0.00 0.02	0.00 0.00	0.00 0.02	0.00 0.02
Inverse of: I work on projects during regular scheduled times	0.13 0.97	0.10 0.87	0.00 0.00	0.00 0.08	0.00 0.00	0.00 0.06	0.00 0.00
Play is an important part of my process	0.32 1.00	0.17 1.00	0.00 0.01	0.00 0.01	0.03 0.34	0.00 0.02	0.00 0.03
Gender: Female	0.97 1.00	0.00 0.00	2.51 1.00	0.01 0.03			
I often spend time reading about things I am interested in Online	-0.25 1.00	-0.19 0.97	-0.09 0.68	0.00 0.05	0.00 0.00	0.01 0.11	0.00 0.02
Inverse of: I usually only have one project going at a time	0.00 0.00	0.04 0.45	-0.06 0.66	-0.02 0.30	0.00 0.07	0.00 0.02	0.00 0.00
I have a well-equipped workspace at home	0.05 0.52	0.15 1.00	0.13 1.00	0.19 1.00	0.00 0.08	0.00 0.01	0.00 0.01
I often help other people by making things	0.01 0.14	0.11 0.85	0.19 1.00	0.21 1.00	0.00 0.06	0.00 0.01	0.12 0.86
I often work on creative projects for fun	0.31 1.00	0.21 1.00	0.34 1.00	0.31 1.00	0.19 1.00	0.10 0.73	0.00 0.01
If something doesn't work exactly the way I want, I try to modify it or build my own.	0.00 0.01	0.02 0.20	0.01 0.15	0.18 1.00	0.16 1.00	0.00 0.01	0.01 0.12

Survey Question	Self-report labels						
	Artist	Designer	Crafter	Maker	Tinkerer	Hacker	Engineer
Gender: Male					1.30 1.00	2.16 1.00	2.26 1.00
I am always taking things apart	0.00 0.03	0.00 0.00	0.00 0.03	0.00 0.03	0.36 1.00	0.41 1.00	0.21 1.00
If someone else built it, I can understand it	0.00 0.01	0.00 0.02	0.00 0.01	0.00 0.01	0.00 0.02	0.00 0.01	0.26 1.00
I have a social group where I feel I fit in and can talk about interesting things	-0.01 0.09	0.00 0.00	0.00 0.00	0.00 0.02	0.00 0.01	0.00 0.01	-0.07 0.67

Values shaded in gray have are significant using Villiafont et al.'s recommendations. All other survey questions were insignificantly associated with the labels. See Appendix D for full results.

To make the BMA results easier to interpret, I have reformatted the results in table 4.5. Survey questions are listed on the left hand side of the table and each label that they were significantly associated with is listed by name in the right column.

Table 4.5. Simplified table of BMA results

Survey Question	Associated Labels						
I keep an idea journal							Artist
I often work on multiple projects					Crafter		
Gender – Female					Crafter		Artist
I often spend time reading about things I am interested in online					Crafter	Designer	Artist
Play is an important part of my process						Designer	Artist
Inverse of: I work on projects during regular scheduled times						Designer	Artist
I have a well-equipped workspace at home				Maker	Crafter	Designer	
I often work on creative projects for fun	Hacker	Tinkerer		Maker	Crafter	Designer	Artist
I often help other people by making things			Engineer	Maker	Crafter	Designer	
If something doesn't work exactly the way I want, I try to modify it or build my own.		Tinkerer		Maker			
I am always taking things apart	Hacker	Tinkerer	Engineer				
Gender – Male	Hacker	Tinkerer	Engineer				
If someone else built it, I can understand it			Engineer				
I have a social group where I feel I fit in and can talk about interesting things			Engineer				

Most survey questions were highly associated with more than one label, but a pattern is evident in the table above, where survey questions tend to fall along a spectrum of labels organized in the following order: Artist – Designer – Crafter – Maker – Tinkerer – Hacker - Engineer. This spectrum tends to divide into two separate clusters that align with the results from the analysis of association between labels. The first cluster is Crafter-Artist-Designer and the second cluster is Tinkerer-Hacker-Engineer. The Maker label spans the two groups.

The only questions that cross over these clusters are: “I often work on creative projects for fun” (one of the most widely agreed upon survey question, which associates with all labels except Engineer) and “I often help other people by making things” (which associates with the label Engineer, as well as Maker, Crafter and Designer). It is also interesting to note that tending to read online is *negatively* correlated with being an artist, crafter or designers. This may reflect a negative reaction to “screen time”, or the fact that the activities tend to be done away from a computer.

4.3. Summary

Median scores from the survey were used to identify questions that were most highly agreed upon by survey respondents. This data addresses my primary research question: what common attitudes, habits and skills are shared by modern DIY practitioners? Results indicate that modern DIY practitioners:

- Find inspiration for projects by talking to friends and reading online.
- Start projects to customize items for themselves or make projects for others.
- Want to understand how the things they own work and want to solve their own problems.
- Learn new skills through online resources, like tutorials, and by asking friends in their social network
- Embrace failure as part of the learning process and learn through trial and error and play
- Consider themselves experts at troubleshooting and internet research, and are confident that they can solve their own problems
- Develop social groups that share their interests
- Prefer to be flexible with their DIY work schedule, working at irregular times and working on multiple projects at once

Demographic questions were also included on the survey that asked about participants’ educational background, gender and whether they associated with several DIY sub-communities. These questions addressed my second and third research questions: what are the demographics of the modern DIY community, and do any patterns emerge between different DIY sub-groups?

My results showed that overall the survey sample was well balanced for age (median age 33) and gender (51% female), but that females tended to associate with the "Artist" and "Crafter" communities and males tended to associate with the "Tinkerer", "Engineer" and "Hacker" communities. Gender was the only factor strongly associated with particular labels.

Nearly 40% of participants currently worked in a technical or design field, and 70% of participants had some kind of artistic or technical training (50% had training at a post-secondary level, and 20% at the high school level). However, 80% of participants also indicated that they were self-taught. This suggests that practitioners extend formal training through self-directed learning.

These results help to address a gap in the Interaction Design literature by providing a broad description of DIY practice from a large sample of practitioners. They also provide practitioners who are designing workspaces and programs with useful information about modern DIY practice.

Chapter 5.

Discussion

5.1. Modern DIY practice

I have divided this section into sub-sections based on the distinct elements of practice that I identified from my results. In each section, I summarize findings from the survey, augmented by quotes from the interview phase, and discuss ways that findings relate to previous research and can inform designers interested in and working for DIY practitioners.

5.1.1. Finding Inspiration

The findings of this study point to commonalities in the sources of inspiration for modern DIY practitioners. Almost all respondents indicated that they draw inspiration both from other people's work and from problems or frustrations they encounter in their everyday lives. Survey responses also indicated that participants often got inspiration from talking to friends and that participants cultivate a strong habit of online reading about DIY projects and skills. Interviewees also identified these as primary sources of project ideas. These findings align with previous research about internet use in the DIY community (Kuznetsov & Paulos, 2010; Torrey, Mcdonald, Schilit, & Bly, 2007; Tseng & Resnick, 2014).

These findings support the idea that tools and platforms for documenting and sharing projects are important for modern DIY practice. The difficulty of documenting physical projects and sharing them online is a complaint that I have often encountered in my experience with teachers and program facilitators, but designers and the modern DIY community are identifying ways to overcome this. In their work on museums, Petrich et al. discuss the need for display areas in the design of DIY workspaces (Petrich,

Wilkinson, & Bevan, 2013).. Online, media outlets like *Make Magazine* and DIY blogs routinely promote featured projects, and designers have created platforms for sharing user generated content, such as Instructables.com. Instructables.com has also created a mobile app to better facilitate project documentation. As well, some researchers have begun to look at documentation habits (Dalton, Desjardins, & Wakkary, 2014; Torrey & McDonald, 2007; Tseng & Resnick, 2014) but documentation remains a promising area for future innovation and research.

My findings also suggest that DIY practitioners often draw inspiration from everyday challenges and needs. At times they make projects for other people, and other projects are geared towards customize items or products that they use to better suit their needs or to remedy a frustration they have identified. The habit of customization is complemented by a desire to understand how the things around them work. These acts of customization and appropriation have been studied under the names of hacking and "everyday design" (Desjardins & Montréal, 2012; Rosner & Bean, 2009). They present an interesting challenge for designers: to create objects that can be appropriated for unintended uses. Paradoxical as this goal may seem, members of the modern DIY community have written guides about how it can be achieved, particularly with new technologies. One example is the "Makers Bill of Rights" (Jalopy, 2005), which lists a series of specific design recommendations aimed at making products and tools that are easy to disassemble, easy to understand, and easy to replace or swap parts into. The approach of open-source design is another approach to support customization and appropriation. Some highly successful businesses now release all of their design documents online in order to foster a community of developers who will customize designs for their particular needs and share them with the community (Andreson, 2012).

5.1.2. Learning

Once DIY practitioners have found inspiration, they often need to do further research or learn new skills to complete their project. The responses to survey questions relating to learning indicate that modern DIY practitioners are highly adaptive, creative, and independent learners who draw from diverse learning resources.

The DIY practitioners who participated in my study use both online and in-person learning resources. They frequently use online tutorials and consider themselves skilled at internet research, but they also are skilled at leveraging their social networks for information and frequently ask friends and fellow DIY practitioners when they need to learn something new. These findings align with research by Torrey & McDonald (2009) on 'search behaviour' in the craft community, and they underscore the importance of online resources for learning in DIY practice. Findings about social learning were more surprising and suggest that social networks are an important source of information. This aligns with ideas about information exchange in "communities of practice" as described by Lave and Wenger (Lave & Wenger, 1991).

Respondents also indicated that they often learn through trial and error or periods of play. One interviewee described his method of play, saying: "My model is I immerse myself in play without a clear objective, just with permission to play and try things and fail and not have a clear agenda. But just to try as many things as I can." The playful spirit of DIY is everywhere at events like Maker Faire, so it was no surprise to confirm that play is common in modern DIY practice. Playful experimentation is a primary goal of constructivist educators (Papert, 1980) and designers who espouse this theory have created many devices to facilitate play with technology (Asgar, Chan, Liu, & Blikstein, 2011b; Bdeir, 2009; J Silver et al., 2012). Some authors have written about design principles that support this style of playful learning. Resnick & Silverman (2005) detail some of these principles as they apply to electronics and robotics kits. A concrete example of a device that could benefit from these design principles is open-source desktop 3D printers. These printers have emphasized simplicity and low-cost to the point where many lack safety mechanisms that prevent users from sending commands to the machine that will damage the device. Adding additional safety mechanisms (even if they increase complexity) would help lower the cost-of-errors when using a printer and help support more exploratory, playful learning.

5.1.3. Problem Solving

Setbacks are inevitable in any DIY project. To explore commonalities in how modern DIY practitioners overcome challenges, several survey questions related to the theme of problem solving. Respondents reported that they considered themselves

experts at specific problem-solving skills, including technical troubleshooting and finding information online. They also reported several attitudes that support the problem solving process, such as: explicitly embracing failure, feeling confident that they can solve most of the problems they encounter, and wanting to solve problems for themselves.

Since independence and problem-solving lie at the heart of the DIY attitude, it is not surprising that related skills continue to be important for modern DIY practice. Perhaps more interesting are the attitudes that go along with these skills: survey results suggest that modern DIY practitioners develop a hard-fought confidence and sense of identity that support their problem-solving behaviours. While education researchers have long studied problem-solving (Jonassen, 2000) and the impact of confidence on performance (Bandura, 1994), it would be interesting for design researchers to more explicitly trace out design implications of problem-solving behaviours and attitudes within the DIY community . Designers seeking to cultivate and support DIY-like behaviours may benefit from the research and experience of educators on project-based learning, such as work by Patton (2012) which suggests that positive attitudes about problem solving can be supported by creating a culture of constructive critique and giving students enough time to work through multiple iterations of projects.

5.1.4. Motivation

Beyond strategies for solving specific problems, modern DIY practitioners also cultivate habits that help them stay motivated throughout a project. The commonalities that this study has identified concerning motivation are: the practice of working on projects at irregular times and of working on multiple projects at once.

It is interesting to compare these motivation habits of modern DIY practitioners to traditional formal education, which tends to emphasize completing one project at a time. Practitioners working in informal settings such as museums, libraries or after-school clubs likely find these settings more accommodating of their habits for maintaining motivation than classroom settings. The need for flexibility in DIY project schedules presents an interesting challenge for designers, especially those setting up workshop spaces. I have seen some spaces that use portable work surfaces, which can be stored on racks or in drawers, allowing users to archive their desktop and then return to it later.

This is an idea that has also been applied in digital settings, where programs often save and restore work sessions.

What I found most surprising about these results was the lack of a stronger pattern of motivational habits. While working at the science museum, I watched novices struggle to stay motivated through DIY projects, and this led me to suspect that established practitioners would have a strong set of motivational habits, especially because they frequently have no external deadlines or supervision (factors that contribute to motivation in more formal work or study settings). This may be true, but few habits were consistent enough across practitioners to appear in my results. It may be that each practitioner works out their own idiosyncratic habits for motivation, in addition to the results mentioned above.

5.2. Demographics

This study also explored two secondary research questions concerning the demographics of the modern DIY community and whether there are patterns in the demographics between different DIY sub-groups. The most notable findings from the demographic data collected concern the prevalence of technical training within the modern DIY community; the strong representation of distinct sub-communities, despite the lauded interdisciplinary nature of the movement; and gender patterns.

5.2.1. Technical training

Nearly 80% of survey respondents indicated that they were self-taught to some extent. However, 20% had formal training in high school and 50% had post-secondary training in some kind of artistic or technical field. These results emphasize the role of formal training in DIY. My educational categories were broad (respondents might have had formal training in physics then taught themselves woodworking) but these results suggest that in the DIY community, “self-taught” most often means extending your formal education, as opposed to starting from scratch.

5.2.2. Representation of Sub-Communities

Survey respondents also rated their level of association with seven labels that represent sub-groups in the DIY community. There was significant representation in the survey sample of each sub-group; the number of respondents by category was: Maker (341), Designer (282), Crafter (281), Artist (222), Tinkerer (168), Engineer (135), and Hacker (87). However, hackers and engineers were markedly less popular than the other labels. This is not surprising for Engineer, because it is strongly associated with a professional designation, but I found it surprising that so few respondents identified as Hackers. These findings suggest that the Hacker community is relatively small compared to the other groups.

5.2.3. Gender

Overall the survey sample was balanced for gender (49% male, 51% female), but there was a tendency for female respondents to associate with the labels of Artist or Crafter and for male respondents to associate with the labels of Tinkerer, Engineer and Hacker.

Gender diversity in the field of technology has long been an issue, and the prosperity of technology companies and technical work has motivated new waves of criticism who see the field as elite (Beede, Julian, & Langdon, 2011; Canada, 2010; Marwick, 2013). This data supports the idea that DIY is, generally, inclusive for women; women are attending Maker Faire and participating in online communities in equal numbers to men. However, my data suggest that females and males cluster into communities that fit gender stereotypes (female Crafter, male Hacker). It would be interesting to track the interaction of different sub-communities and different genders at DIY events. One of my regrets in designing this survey was the lack of questions about race and income, both topics that are worth investigating in future studies.

5.3. Limitations

5.3.1. Sampling

In this study I was interested in "modern DIY practitioners" whose practice includes some of the recent technological and social changes affecting DIY. To operationalize this definition, I sampled practitioners that attend Maker Faire and visit DIY websites. This operationalization limits how far my conclusions can be generalized, and introduces some sample bias. First, the results of my study do not necessarily apply to "traditional DIY practitioners", the knitters or woodworkers who have been practicing their craft for decades and do not participate in Maker Faires or online communities. Second, my sample is bias towards internet users because a large portion of responses were collected online, which is discussed along with findings about internet use. Third, the majority of my respondents came from Canada or the United States, so the findings in this study may not generalize to DIY practitioners in other countries.

Qualitative data collection and research also introduce some potential sources of bias. Although I followed the guidelines for thematic analysis laid out in Richards' Handling Qualitative Data (2010), the results from qualitative analysis flow from my personal point of view. My background also impacted the interviewees that I selected. This group was chosen to be as diverse as possible, but they were drawn from practitioners that were available to me, based on my contacts in the Vancouver DIY community.

5.3.2. Survey Construction

When constructing my survey, I converted common statements from interviews (e.g. "I have a dedicated work station at home") directly into survey questions. This differs from full instrument development methods because it does not use survey constructs. In more extended instrument development methods, sets of redundant questions are used to measure a latent variable or construct of interest (e.g. four different survey questions would all get at the idea of "curiosity", and their summed scores would be used as a measure of curiosity). These clusters of questions are tested in validation studies to make sure that they correlate with each other and get at the same

underlying concept. I avoided the use of these constructs for two reasons, first the full instrument development process would have been beyond the scope of my master's project, and second I wanted to keep my results as concrete as possible — the habit of having a dedicated workspace at home does not condense easily into an abstract construct, but that is just the type of common habit that I would like to capture in my results.

However, this choice made my survey findings less robust. Using just one question to get at a concept, instead of the sum of several questions, makes my measurements more sensitive to misinterpretation of questions. I piloted my study to get feedback about wording but, given the sensitivity discussed above, if I had this study to do again, I would spend more time on this step. This would have helped weed out questions with unclear wording. It also would have given me more confidence that respondents understood the survey questions as I intended, allowing for stronger triangulation between qualitative and quantitative results. Another consequence of building the survey based on interview themes (a purely "bottom-up" approach), was that I missed the opportunity to inject questions into the survey that would have more directly addressed theories from the existing literature. I wanted to keep my survey short, to increase response rate but, looking back, I feel that there would have been room to insert a few questions that would have yielded interesting results. Primary amongst these would be demographic questions about race and income.

Another element of the survey that I would change is the labelling on my Likert scales. I had read criticism of Likert scales suggesting that descriptive labels over response options (e.g. "somewhat agree" or "strongly agree") distorted responses, so that the perceived space between each point on the scale is not the same (Jamieson, 2004). With this criticism in mind, I used a Likert scale with many options (11) and no descriptive labels over responses. I used an odd number of responses so that the scale would have a neutral point, but labeled the options from 0-10 (see fig 4.1). Looking back, the 0-10 labelling may have changed the way people perceived the neutral point in the scale (it could have been perceived as "neutral" or "halfway agree"). Having used non-parametric statistics throughout my analysis, the distortions caused by descriptive labels would not have been a problem, and descriptive labels would also have helped

make scale scores easier to interpret (8 out of 11 is less meaningful than “strongly agree”).

Chapter 6. Conclusions

The primary goal of this study was to explore the common elements of modern Do-It-Yourself practice. The study progressed in two phases, first interviews were conducted with 13 local DIY practitioners and common attitudes, habits and skills were identified. These were then converted into a survey which was distributed to nearly 800 DIY practitioners at a local DIY event and online. Results indicate that modern DIY practitioners:

- Find inspiration for projects by talking to friends and reading online.
- Start projects to customize items for themselves or make projects for others.
- Want to understand how the things they own work and want to solve their own problems.
- Learn new skills through online resources, like tutorials, and by asking friends in their social network
- Embrace failure as part of the learning process and learn through trial and error and play
- Consider themselves experts at troubleshooting and internet research, and are confident that they can solve their own problems
- Develop social groups that share their interests
- Prefer to be flexible with their DIY work schedule, working at irregular times and working on multiple projects at once

Demographic questions on the survey asked about participants' educational background, gender and whether they associated with several DIY sub-communities. Information from these questions indicated that overall the survey sample was well balanced for gender (51% female), but that females tended to associate with the "Artist" and "Crafter" communities and males tended to associate with the "Tinkerer", "Engineer" and "Hacker" communities. Gender was the only factor strongly associated with particular labels. Nearly 40% of participants currently worked in a technical or design field, and 70% of participants had some kind of artistic or technical training (50% had training at a post-secondary level, and 20% at the high school level). However, 80% of

participants also indicated that they were self-taught. This suggests that practitioners extend formal training through self-directed learning.

These results help to address a gap in the Interaction Design literature by providing a broad description of DIY practice from a large sample of practitioners. They also provide practitioners who are designing workspaces and programs with useful information about modern DIY practice.

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Appendix A.

Informed Consent Forms

SIMON FRASER UNIVERSITY
INFORMED CONSENT FORM

Title: What Makes a Maker?
Principal Investigator: Andrew Milne
Supervisor: Dr. Bernhard Riecke
Investigators Department: School of Interactive Arts & Technology
Location: Varies
Study Ethics ID: 2013s0139

Goals of Study:
I (Andrew Milne) am interviewing members of Vancouver's hacker/maker community to explore their creative process and habits. I will compare the process of several makers to get an idea of what they have in common and how they differ. I also want to identify specific, useful strategies or tips that teachers can pass on to their students to make them more effective makers.

Ethical Conduct: The University and I are committed to the ethical conduct of research and to the protection of the interests, comfort, and safety of people who participate. This form is given to you so that you fully understand the risks and benefits of the study before you agree to participate. You can withdraw from the study at any time during or after the interview.

Risks to the participant: There are no risks to participating in this study.

Benefits of study: This research will help make the academic world more aware of the maker community. Your input will also help teachers, outside of the maker community, understand the making process and support their students in becoming makers. I hope that the results from this study will also contribute to a conversation in the maker community about what making is and what it has to offer.

What the participants will be required to do: You will be participating in a semi-structured interview. I will be asking you questions about your background, your involvement in the community and your creative process. I will take an audio recording of the interview so that I can review it later.

Privacy and Data: For your privacy, all interview data collected during this study will be anonymized. It will be labeled with a participant number, instead of your name, and any reference to the things you say will be done using a pseudonym (unless you explicitly approve of your real name being used). Recordings and notes will be kept on encrypted drives, and in a locked-cabinet when in storage.

Results: If you are interested in the results of this study, you can obtain a copy of the results when they are complete by contacting Andrew Milne at amilne@sfu.ca, or Bernhard Riecke at ber1@sfu.ca.

What signing means: Your signature on this form will signify that you have read this document, which describes the possible risks, benefits and procedures of this research study. Your signature indicates that you have received an adequate opportunity to consider the information in this document, and that you have agreed to participate in this study.

Page 1 of 2

I understand the procedures to be used in this study. I know that I have the right to withdraw from the study at any time, and that any complaints about the study may be brought to Dr. Bernhard Riecke, Associate Professor, School of Interactive Arts and Technology (Email: ber1@sfu.ca Phone: 778.782.8432 Address: 250 -13450 102 Avenue, Simon Fraser University, Surrey, BC, V3T 0A3) or Dr. Hal Weinberg, Director, Office of Research Ethics (Email:hal_weinberg@sfu.ca Phone:778-782-6593 Address: 8888 University Drive, Simon Fraser University, Burnaby, BC, V5A 1S6).

I understand that I may obtain copies of the results of this study, upon its completion by contacting the principle investigator, Andrew Milne (amilne@sfu.ca).

I have been able to get clarification about any aspects of the study that were unclear to me. I have read understand, and agree with the above and I understand that I can request a copy of this consent form for my own records.

First and last name	Contact (optional)

Signature

Check if:

☐ I approve the use of my real name in publications
(leave unchecked if you would rather use a fake name)

Date

SIMON FRASER UNIVERSITY

INFORMED CONSENT – PARENT/GUARDIAN

Note: There are two parts to this form. One for you and one for the young person under your care. They will need to fill out the other half of this form (stapled together) to complete a survey and be entered into the draw.

Title: Common Practices in the Maker Community
Principal Investigator: Andrew Milne (amilne@sfu.ca)
Supervisor: Dr. Bernhard Riecke (ber1@sfu.ca)
Investigators Department: School of Interactive Arts & Technology
Location: Maker Faire, July 1-2 @ the Pacific National Exhibition, Vancouver, Canada
Study Ethics ID: 2013s0292

Goals of Study:
We are interested in the common habits and attitudes of Vancouver's Maker community. The responses to this survey will help researchers and teachers get a better understanding of the Maker community. This will help researchers develop better theories about learning and help teachers develop better education programs.

Ethical Conduct: As members of Simon Fraser University, we are committed to the ethical conduct of research and to the protection of the interests, comfort, and safety of people who participate. This form is given to you so that you fully understand the risks and benefits of the study before you agree to allow the minor under your care to participate. After you've finished reading this form and asked any questions you have about the study, you can choose whether or not to sign on the back of the form.

What the minor under your care will be required to do: Study participants will fill out a short (~5 minute) survey about their experiences and attitudes towards do-it-yourself and creative projects.

Risks to the participant: There are no risks to participating in this study.

Benefits of study: By filling out a consent form you will be entered into a draw for one of three Amazon.com gift card ($150, $100, $50). We hope that you will share this prize with the minor under your care who filled out the survey! The research generated from their responses will also help make researchers more aware of the Maker community and help teachers support their students in becoming better Makers.

Privacy and Data: The survey will be anonymous. These informed consent forms will be kept separate from surveys, so there will be no way to connect a specific name to a survey. All survey data will be kept in locked storage at the university, and any digital files associated with the research will be kept on secure storage devices.

Results: If you are interested in the results of this study, you can obtain a copy of the results when the research project is complete by contacting Andrew Milne at amilne@sfu.ca, or Bernhard Riecke at ber1@sfu.ca.

What signing means: Your signature on this form will show that you have read this document, that you understand the goals of the study, what participants will need to do and any risks involved. Your signature shows that you understand the information on this page and that you have had enough time to read it, understand it and ask questions about it.

See back of page for signature…

By signing below I certify that:

- I understand the goals of the study and the procedures involved
- I know that participants have the right to withdraw from the study at any time
- I understand that I may obtain copies of the results of this study, upon its completion by contacting the principle investigator, Andrew Milne (amilne@sfu.ca).
- I have been able to get clarification about any aspects of the study that were unclear to me.

Any complaints about the study may be brought to:

Dr. Bernhard Riecke,
Associate Professor,
School of Interactive Arts and Technology
Email: ber1@sfu.ca
Phone: 778.782.8432
Address: 250 -13450 102 Avenue, Simon Fraser University, Surrey, BC, V3T 0A3

Dr. Dina Shafey
Associate Director
Office of Research Ethics
Email: dshafey@sfu.ca
Phone: 778-782-9631
Address: 250 -13450 102 Avenue, Simon Fraser University, Surrey, BC, V3T 0A

I consent to the participation of the minor under my care in this research study. I have read and agree with the above and I understand that I can request a copy of this consent form for my own records.

First and Last Name

Contact for Prize Draw (optional)

Signature

Date

SIMON FRASER UNIVERSITY

INFORMED ASSENT – UNDER 19

Note: There are two parts to this form. One for you and one for your parent/guardian. They will need them to fill out the parent/guardian version of this form so that you can complete a survey and be entered into the draw.

Title: Common Practices in the Maker Community
Principal Investigator: Andrew Milne (amilne@sfu.ca)
Supervisor: Dr. Bernhard Riecke (ber1@sfu.ca)
Investigators Department: School of Interactive Arts & Technology
Location: Maker Faire, July 1-2 @ the Pacific National Exhibition, Vancouver, Canada
Study Ethics ID: 2013s0292

Goals of Study:
We are interested in the common habits and attitudes of Vancouver's Maker community. Your response to this survey will help researchers and teachers get a better understanding of the Maker community. This will help researchers develop better theories about learning and help teachers develop better education programs.

Ethical Conduct: As members of Simon Fraser University, we are committed to the ethical conduct of research and to the protection of the interests, comfort, and safety of people who participate. This form is given to you so that you fully understand the risks and benefits of the study before you agree to participate. After you've finished reading this form and asked any questions you have about the study, you can choose whether or not complete a survey.

What you will be required to do: You will fill out a short (~5 minute) survey about your experiences and attitudes towards do-it-yourself and creative projects.

Risks to the participant: There are no risks to participating in this study.

Benefits of study: After filling out a consent form you will be entered into a draw to win one of three Amazon.com gift cards ($150, $100, $50). The research generated from your responses will also help make researchers more aware of the Maker community and help teachers support their students in becoming better Makers.

Privacy and Data: The survey will be anonymous. Consent forms will be kept separate from the survey you fill out, so there will be no way to connect a specific name to a survey. All survey data will be kept in locked storage at the university, and any digital files associated with the research will be kept on secure storage devices.

Results: If you are interested in the results of this study, you can obtain a copy of the results when the research project is complete by contacting Andrew Milne at amilne@sfu.ca, or Bernhard Riecke at ber1@sfu.ca.

What signing means: Your signature on this form will show that you have read this document, that you understand the goals of the study, what you will need to do, and any risks involved. Your signature shows that you understand the information on this page, and that you have had enough time to read it, understand it and ask questions about it.

See back of page for signature…

By signing below I certify that:

- I understand the goals of the study and the procedures involved
- I know that I have the right to withdraw from the study at any time
- I understand that I may obtain copies of the results of this study, upon its completion by contacting the principle investigator, Andrew Milne (amilne@sfu.ca).
- I have been able to get clarification about any aspects of the study that were unclear to me.

Any complaints about the study may be brought to:

Dr. Bernhard Riecke,
Associate Professor,
School of Interactive Arts and Technology
Email: ber1@sfu.ca
Phone: 778.782.8432
Address: 250 -13450 102 Avenue, Simon Fraser University, Surrey, BC, V3T 0A3

Dr. Dina Shafey
Associate Director
Office of Research Ethics Email:
dshafey@sfu.ca
Phone: 778-782-9631
Address: 250 -13450 102 Avenue, Simon Fraser University, Surrey, BC, V3T 0A3

I have read and agree with the above and I understand that I can request a copy of this consent form for my own records.

First and Last Name

Date

Signature

SIMON FRASER UNIVERSITY

INFORMED CONSENT – ADULT

Title: Common Practices in the Maker Community
Principal Investigator: Andrew Milne (amilne@sfu.ca)
Supervisor: Dr. Bernhard Riecke (ber1@sfu.ca)
Investigators Department: School of Interactive Arts & Technology
Location: Maker Faire, July 1-2 @ the Pacific National Exhibition, Vancouver, Canada
Study Ethics ID: 2013s0292

Goals of Study:
We are interested in the common habits and attitudes of Vancouver's Maker community. Your response to this survey will help researchers and teachers get a better understanding of the Maker community. This will help researchers develop better theories about learning and help teachers develop better education programs.

Ethical Conduct: As members of Simon Fraser University, we are committed to the ethical conduct of research and to the protection of the interests, comfort, and safety of people who participate. This form is given to you so that you fully understand the risks and benefits of the study before you agree to participate. After you've finished reading this form and asked any questions you have about the study, you can choose whether or not complete a survey.

What you will be required to do: You will fill out a short (~5 minute) survey about your experiences and attitudes towards do-it-yourself and creative projects.

Risks to the participant: There are no risks to participating in this study.

Benefits of study: If you choose to enter your contact information on this consent form, you will be entered into a draw to win one of three Amazon.com gift certificates ($150, $100, $50). The research generated from your responses will also help make researchers more aware of the Maker community and help teachers support their students in becoming better Makers.

Privacy and Data: The survey will be anonymous. Consent forms will be kept separate from the survey you fill out, so there will be no way to connect a specific name to a survey. All survey data will be kept in locked storage at the university, and any digital files associated with the research will be kept on secure storage devices.

Results: If you are interested in the results of this study, you can obtain a copy of the results when the research project is complete by contacting Andrew Milne at amilne@sfu.ca, or Bernhard Riecke at ber1@sfu.ca.

What signing means: Your signature on this form will show that you have read this document, that you understand the goals of the study, what you will need to do, and any risks involved. Your signature shows that you understand the information on this page, and that you have had enough time to read it, understand it and ask questions about it.

See back of page for signature…

By signing below I certify that:

- I understand the goals of the study and the procedures involved
- I know that I have the right to withdraw from the study at any time
- I understand that I may obtain copies of the results of this study, upon its completion by contacting the principle investigator, Andrew Milne (amilne@sfu.ca).
- I have been able to get clarification about any aspects of the study that were unclear to me.

Any complaints about the study may be brought to:

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Dr. Dina Shafey
Associate Director
Office of Research Ethics Email:
dshafey@sfu.ca
Phone: 778-782-9631
Address: 250 -13450 102 Avenue, Simon Fraser University, Surrey, BC, V3T 0A

I have read and agree with the above and I understand that I can request a copy of this consent form for my own records.

First and Last Name

Contact for Prize Draw (optional)

Signature

Date

Online Consent Form

DIY Community Research Survey

0%

Simon Fraser University - Informed Consent Form

Principal Investigator: Andrew Milne (amilne@sfu.ca)
Supervisor: Dr. Bernhard Riecke (ber1@sfu.ca)
Department: School of Interactive Arts & Technology
StudyEthicsID: 2013s0292

Goals of Study: We are interested in the common habits and attitudes of the do-it-yourself community. Your response to this survey will help researchers develop better theories about learning and help teachers develop better education programs.

Benefits of the study: At the end of the survey, you will be redirected to a separate page where you can enter into a prize draw for one of three Amazon.com gift cards ($150,$100,$50). Your responses will also help to make researchers more aware of your community and understand how people in your community learn and create.

Ethical Conduct: As members of Simon Fraser University, we are committed to the ethical conduct of research and to the protection of the interests, comfort, and safety of people who participate. This form is given to you so that you fully understand the risks and benefits of the study before you agree to participate. After you've finished reading this form you can choose whether or not to continue with the survey.

What you will be required to do: You will fill out a short (~5 minute) survey about your experiences and attitudes towards do-it-yourself and creative projects.

Risks: There are no risks to participating in this study.

Privacy and Data: Prize draw information is stored in a separate database from survey response. The survey itself is anonymous (no personal information or IP addresses will be kept with the survey). The survey is collected through secure servers, hosted in Canada, and any digital files associated with the research will be kept on secure storage devices. Data related to the survey will be kept for five years at the university and then destroyed.

Results: If you are interested in the results of this study, you can obtain a copy of the results when the research project is complete by contacting Andrew Milne at amilne@sfu.ca, or Bernhard Riecke at ber1@sfu.ca.

Concerns and complaints: Any concerns or complaints about this study can be directed to: Dr. Dina Shafey, Associate Director, Office of Research Ethics at dshafey@sfu.ca or 778-782-9631.

Continue to survey?

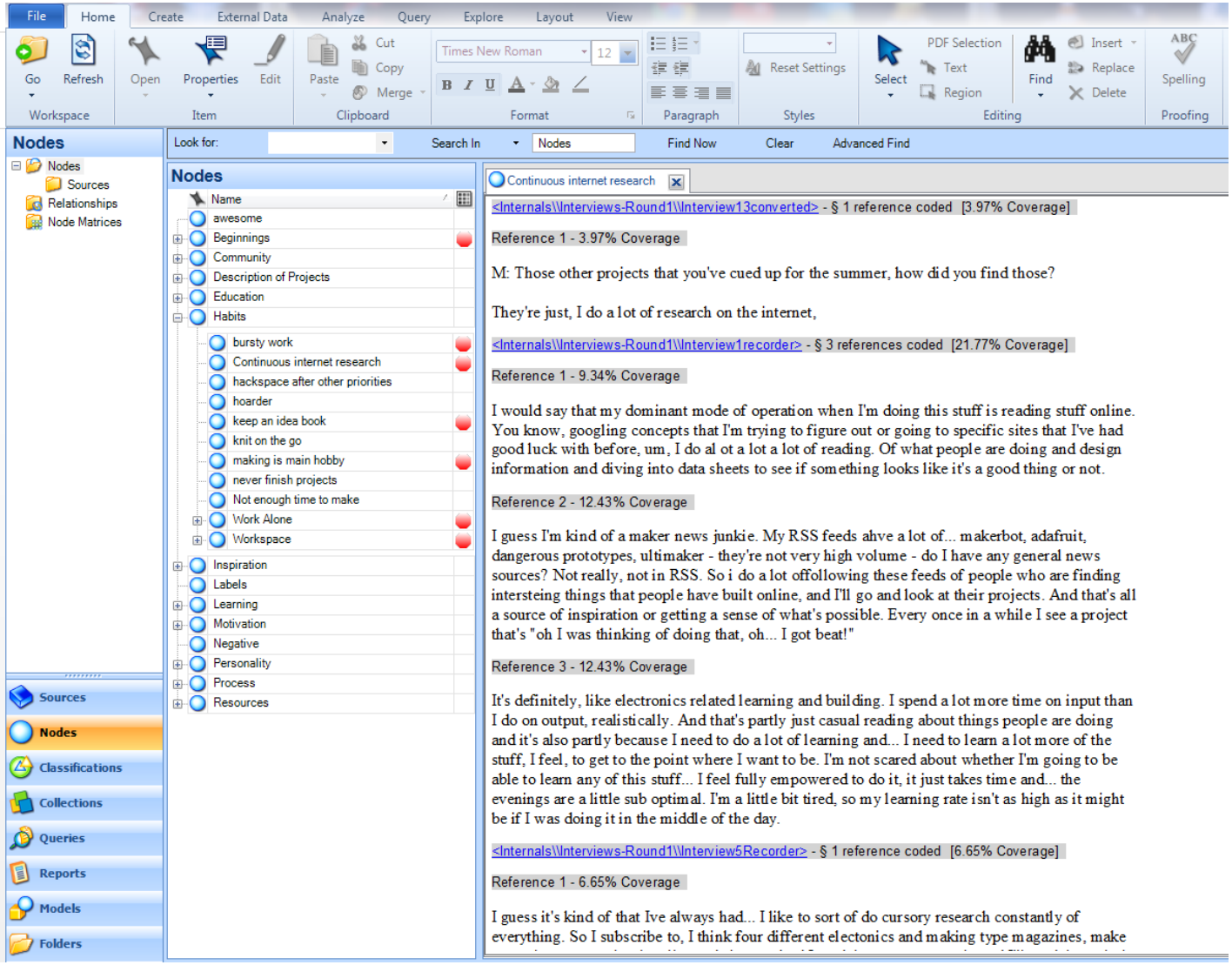
You must be at least 16 years of age to participate in the survey. If you are younger than 16 please click "No" below, and you will exit the survey. Clicking "Yes" below confirms that you are 16 years or older.

- ○ Yes
- ○ No

Appendix B.

Sample Data from Qualitative Analysis

The following data is from NVivo software. It shows a sample of quotes from interview transcripts, which correspond to the “continuous internet research” theme, selected from the list of themes (indicated by blue dots). This is a typical screenshot of data analysis in NVivo, where coding themes are built up based on interview data.


File
Home
Create
External Data
Analyze
Query
Explore
Layout
View
Go
Refresh
Open
Properties
Edit
Paste
Cut
Copy
Merge
Times New Roman
12
Reset Settings
Select
PDF Selection
Text
Region
Find
Insert
Replace
Delete
Spelling
Workspace
Item
Clipboard
Format
Paragraph
Styles
Editing
Proofing
Nodes
Nodes
Sources
Relationships
Node Matrices
Look for:
Search In
Nodes
Find Now
Clear
Advanced Find
Nodes
Name
awesome
Beginnings
Community
Description of Projects
Education
Habits
bursty work
Continuous internet research
hackspace after other priorities
hoarder
keep an idea book
knit on the go
making is main hobby
never finish projects
Not enough time to make
Work Alone
Workspace
Inspiration
Labels
Learning
Motivation
Negative
Personality
Process
Resources
Sources
Nodes
Classifications
Collections
Queries
Reports
Models
Folders
Continuous internet research
<Internals\\Interviews-Round1\\Interview13converted> - § 1 reference coded [3.97% Coverage]
Reference 1 - 3.97% Coverage
M: Those other projects that you've cued up for the summer, how did you find those?
They're just, I do a lot of research on the internet,
<Internals\\Interviews-Round1\\Interview1recorder> - § 3 references coded [21.77% Coverage]
Reference 1 - 9.34% Coverage
I would say that my dominant mode of operation when I'm doing this stuff is reading stuff online. You know, googling concepts that I'm trying to figure out or going to specific sites that I've had good luck with before, um, I do al ot a lot a lot of reading. Of what people are doing and design information and diving into data sheets to see if something looks like it's a good thing or not.
Reference 2 - 12.43% Coverage
I guess I'm kind of a maker news junkie. My RSS feeds ahve a lot of... makerbot, adafruit, dangerous prototypes, ultimaker - they're not very high volume - do I have any general news sources? Not really, not in RSS. So i do a lot offollowing these feeds of people who are finding intersteing things that people have built online, and I'll go and look at their projects. And that's all a source of inspiration or getting a sense of what's possible. Every once in a while I see a project that's "oh I was thinking of doing that, oh... I got beat!"
Reference 3 - 12.43% Coverage
It's definitely, like electronics related learning and building. I spend a lot more time on input than I do on output, realistically. And that's partly just casual reading about things people are doing and it's also partly because I need to do a lot of learning and... I need to learn a lot more of the stuff, I feel, to get to the point where I want to be. I'm not scared about whether I'm going to be able to learn any of this stuff... I feel fully empowered to do it, it just takes time and... the evenings are a little sub optimal. I'm a little bit tired, so my learning rate isn't as high as it might be if I was doing it in the middle of the day.
<Internals\\Interviews-Round1\\Interview5Recorder> - § 1 reference coded [6.65% Coverage]
Reference 1 - 6.65% Coverage
I guess it's kind of that Ive always had... I like to sort of do cursory research constantly of everything. So I subscribe to, I think four different electonics and making type magazines, make

Appendix C.

Survey

Instructions

This survey is anonymous. It will be stored separately from your consent form and will not be connected with your name in any way.

I am a...

- ○ Maker Faire Attendee
- ○ Maker Faire Organizer/Volunteer
- Maker Faire Exhibitor
- Other, please specify... _____

The following labels apply to me:

Please rate the following labels based on how much you feel they represent you from 0 – disagree completely to 10 – agree completely.

	Disagree										Agree
	0	1	2	3	4	5	6	7	8	9	10
Maker	○	○	○	○	○	○	○	○	○	○	○
Hacker	○	○	○	○	○	○	○	○	○	○	○
Tinkerer	○	○	○	○	○	○	○	○	○	○	○
Crafter	○	○	○	○	○	○	○	○	○	○	○
Designer	○	○	○	○	○	○	○	○	○	○	○
Artist	○	○	○	○	○	○	○	○	○	○	○
Engineer	○	○	○	○	○	○	○	○	○	○	○
Other	_____										

Are you a member of a makerspace or hackerspace?

- ○ Yes
- ○ No
- ○ Not sure

How often do you...

Please rate the following activities based on how often you do them from 0 – never to 10 – very often.

	Never										Very Often
	0	1	2	3	4	5	6	7	8	9	10
ask friends or acquaintances advice when trying to learn new skills	○	○	○	○	○	○	○	○	○	○	○
use online tutorials when learning new skills	○	○	○	○	○	○	○	○	○	○	○
get ideas for your own projects from talking with friends	○	○	○	○	○	○	○	○	○	○	○
work on creative projects for fun	○	○	○	○	○	○	○	○	○	○	○
spend time reading about things you are interested in online	○	○	○	○	○	○	○	○	○	○	○
help other people by making things	○	○	○	○	○	○	○	○	○	○	○
keep a journal or list of project ideas that you think of	○	○	○	○	○	○	○	○	○	○	○

When you were young, how often did you...

	Never										Very Often
	0	1	2	3	4	5	6	7	8	9	10
spend time with parents or mentors who made things	○	○	○	○	○	○	○	○	○	○	○
spend time with peers who liked to make things	○	○	○	○	○	○	○	○	○	○	○

How much do you agree or disagree with the following statements:

Please rate the following statements based on how much you agree with them from 0 – disagree completely to 10 – agree completely.

	Disagree										Agree
	0	1	2	3	4	5	6	7	8	9	10
Problems or irritations from my daily life often inspire me to start a project	○	○	○	○	○	○	○	○	○	○	○
I am always taking things apart	○	○	○	○	○	○	○	○	○	○	○
I usually only have one project going at a time	○	○	○	○	○	○	○	○	○	○	○
I like to learn by trial and error	○	○	○	○	○	○	○	○	○	○	○
I have a well-equipped workspace at home	○	○	○	○	○	○	○	○	○	○	○
If someone else built it, I can understand it	○	○	○	○	○	○	○	○	○	○	○
I get the most work done when I'm working in a group	○	○	○	○	○	○	○	○	○	○	○

	Disagree										Agree
	0	1	2	3	4	5	6	7	8	9	10
Failure should be avoided	○	○	○	○	○	○	○	○	○	○	○
I feel like I can solve most of the problems that I encounter	○	○	○	○	○	○	○	○	○	○	○
If something doesn't work exactly the way I want, I try to modify it or build my own.	○	○	○	○	○	○	○	○	○	○	○
People should know how the things they own work	○	○	○	○	○	○	○	○	○	○	○
I am good at troubleshooting problems	○	○	○	○	○	○	○	○	○	○	○
I do not need to know how a tool works, as long as I can use it	○	○	○	○	○	○	○	○	○	○	○
When I get stuck, I can usually figure out a way around it	○	○	○	○	○	○	○	○	○	○	○

How much do you agree or disagree with the following statements:

	Disagree 0	1	2	3	4	5	6	7	8	9	Agree 10
Play is an important part of my process	○	○	○	○	○	○	○	○	○	○	○
I have a social group where I feel I fit in and can talk about interesting things	○	○	○	○	○	○	○	○	○	○	○
I work on projects during regular scheduled times	○	○	○	○	○	○	○	○	○	○	○
If I don't get something figured out in a few minutes, I ask for help or leave it until later	○	○	○	○	○	○	○	○	○	○	○
I would rather solve a problem myself than have someone else do it	○	○	○	○	○	○	○	○	○	○	○
I like to know how the things around me work	○	○	○	○	○	○	○	○	○	○	○
I am good at internet research	○	○	○	○	○	○	○	○	○	○	○

Gender ○ Male ○ Female **Age** _____

Education & Training

Please check any courses you have taken that help with your personal projects

☐ **High school shop classes**

High school art classes

Degree/diploma in Technical Field (technician, engineering, electronics, **programming, etc.)**

☐ **Trade school**

Degree/diploma in Art or Design

Self-taught

Other: _____

Field of Work

What field/industry do you work in?

○ **I have not yet worked in industry (student, parent, etc.)**

My main field/industry of work is _____

○ Prefer not to answer

Appendix D.

Qualitative Themes and Survey Questions

Interview Theme	Qualitative Finding	Survey Question	Median
good at internet research	Effective researcher	I am good at internet research	9
use online tutorials	Effective researcher	I often use online tutorials when learning new skills	9
ask friends when trying to learn	Effective researcher	I often ask friends or acquaintances advice when trying to learn new skills	7
failure is an important way to learn	Embrace Failure	Inverse of: Failure should be avoided*	9
learn through trial and error	Embrace Failure	I like to learn by trial and error	7
often work on creative projects	Keep projct work enjoyable	I often work on creative projects for fun	9
incorporate play into their process	Keep projct work enjoyable	Play is an important part of my process	8
work on multiple projects at one time	Keep projct work enjoyable	Inverse of: I usually only have one project going at a time*	8
work on projects in irregular bursts	Keep projct work enjoyable	Inverse of: I work on projects during regular scheduled times*	7
believe people should understand the things they own	Desire for control over environment	People should know how the things they own work	8
desire to customize the world to fit your needs exactly	Desire for control over environment	If something doesn't work exactly the way I want, I try to modify it or build my own.	7
adaptive	Good at troubleshooting	When I get stuck, I can usually figure out a way around it	8
good at troubleshooting	Good at troubleshooting	I am good at troubleshooting problems	8
tenacious	Good at troubleshooting	Inverse of: If I don't get something figured out in a few minutes, I ask for help or leave it until later*	6
frequently read online for inspiration	Continually search for inspiration	I often spend time reading about things I am interested in online	10
talk to friends to get ideas	Continually search for inspiration	I often get ideas for your own projects from talking with friends	7
use projects to help others	Continually search for inspiration	I often help other people by making things	7
use projects to solve daily problems	Continually search for inspiration	Problems or irritations from my daily life often inspire me to start a project	6
keep an idea journal	Continually search for inspiration	I often keep a journal or list of project ideas that you think of	6
want to solve problems yourself	Sense of Empowerment	I would rather solve a problem myself than have someone else do it	8
feel you can overcome problem you encounter	Sense of Empowerment	I feel like I can solve most of the problems that I encounter	7
can understand how anything works	Sense of Empowerment	If someone else built it, I can understand it	6
desire to understand the word around you	Curiosity leads to understanding	I like to know how the things around me work	8.5
desire for deep knowledge	Curiosity leads to understanding	Inverse of: I do not need to know how a tool works, as long as I can use it*	5
always taking things apart	Curiosity leads to understanding	I am always taking things apart	5
currently have a peer group that shares interests	Have a peer group	I have a social group where I feel I fit in and can talk about interesting things	7
had adult DIY mentors when young	Have a peer group	When I was young I spent time with parents or mentors who made things	6
had a peer group with shared interests when young	Have a peer group	When I was young I spent time with peers who liked to make things	5
get the most work done when alone	Productive work environment	Inverse of: I get the most work done when I'm working in a group*	6
have a workspace at home	Productive work environment	I have a well-equipped workspace at home	6

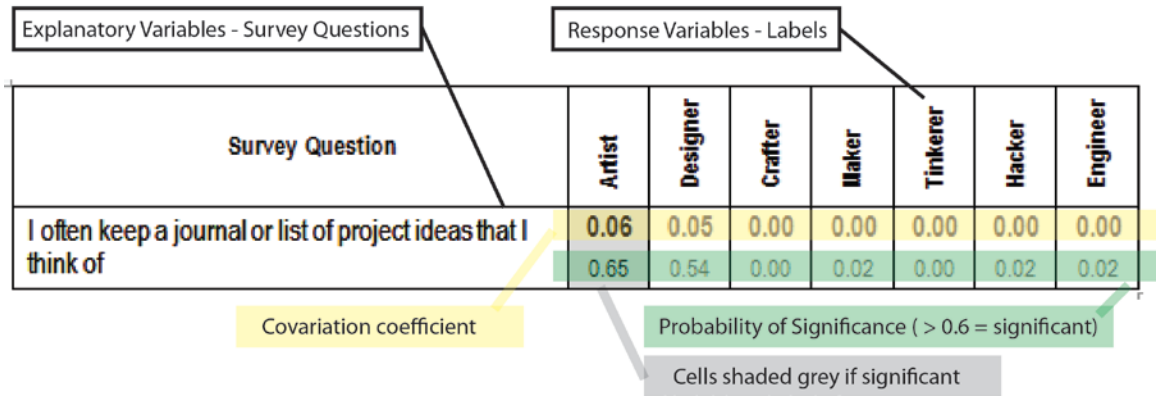
Appendix E.

Full results from Bayesian Model Averaging

Below are the results from the Bayesian Model Averaging (BMA) analysis for every survey question. Most survey questions were omitted from the truncated graph displayed in the Survey Results section because they did not associate significantly with any DIY labels (Artist, Designer, Crafter, Maker, Tinkerer, Hacker or Engineer).

Each row displays the association between one survey question and each of the seven labels. In each cell (where the row of a survey question and column of a label cross) there are two values: the upper, bolded value is a coefficient of correlation that indicates the number of points the label tended to change based on 1 point of change in the survey question; the lower value, below the correlation coefficient, is a probability of significance (see section 4.1.3 for details on how this probability is calculated). A cut-off of > 0.6 was used to determine whether survey questions were significantly associated with labels (based on the recommendation of Viallefont (2001)), and cells containing significant values are shaded grey for emphasis.

To read the table, choose a survey question, then look for the labels that it is significantly associated with (based on the shaded cells), for each shaded cell the correlation coefficient (upper value) indicates the strength of association. For example: The survey question “Play is an important part of my process” is associated with the label Artist, the probability that these two variables is associated is 100%, and the association coefficient is .3, so for every 3 points of change in the survey question you would expect about 1 point of change in the label.



Survey Question	Artist	Designer	Crafter	Maker	Tinkerer	Hacker	Engineer
I often keep a journal or list of project ideas that I think of	0.06 0.65	0.05 0.54	0.00 0.00	0.00 0.02	0.00 0.00	0.00 0.02	0.00 0.02
Inverse of: I work on projects during regular scheduled times	0.13 0.97	0.10 0.87	0.00 0.00	0.00 0.08	0.00 0.00	0.00 0.06	0.00 0.00
Play is an important part of my process	0.32 1.00	0.17 1.00	0.00 0.01	0.00 0.01	0.03 0.34	0.00 0.02	0.00 0.03
Gender: Female	0.97 1.00	0.00 0.00	2.51 1.00	0.01 0.03			
I often spend time reading about things you are interested in online	-0.25 1.00	-0.19 0.97	-0.09 0.68	0.00 0.05	0.00 0.00	0.01 0.11	0.00 0.02
Inverse of: I usually only have one project going at a time	0.00 0.00	0.04 0.45	-0.06 0.66	-0.02 0.30	0.00 0.07	0.00 0.02	0.00 0.00
I have a well-equipped workspace at home	0.05 0.52	0.15 1.00	0.13 1.00	0.19 1.00	0.00 0.08	0.00 0.01	0.00 0.01
I often help other people by making things	0.01 0.14	0.11 0.85	0.19 1.00	0.21 1.00	0.00 0.06	0.00 0.01	0.12 0.86
I often work on creative projects for fun	0.31 1.00	0.21 1.00	0.34 1.00	0.31 1.00	0.19 1.00	0.10 0.73	0.00 0.01
If something doesn't work exactly the way I want, I try to modify it or build my own.	0.00 0.01	0.02 0.20	0.01 0.15	0.18 1.00	0.16 1.00	0.00 0.01	0.01 0.12
Gender: Male					1.30 1.00	2.16 1.00	2.26 1.00
I am always taking things apart	0.00 0.03	0.00 0.00	0.00 0.03	0.00 0.03	0.36 1.00	0.41 1.00	0.21 1.00

Survey Question	Artist	Designer	Crafter	Maker	Tinkerer	Hacker	Engineer
If someone else built it, I can understand it	0.00 0.01	0.00 0.02	0.00 0.01	0.00 0.01	0.00 0.02	0.00 0.01	0.26 1.00
I have a social group where I feel I fit in and can talk about interesting things	-0.01 0.09	0.00 0.00	0.00 0.00	0.00 0.02	0.00 0.01	0.00 0.01	-0.07 0.67
I like to learn by trial and error	0.03 0.30	0.00 0.01	0.00 0.00	0.00 0.04	0.01 0.09	0.00 0.01	-0.02 0.20
I do not need to know how a tool works, as long as I can use it	0.00 0.02	0.00 0.00	0.00 0.00	0.00 0.07	0.00 0.01	0.00 0.01	0.00 0.04
I like to know how the things around me work	0.00 0.00	0.00 0.00	0.00 0.01	0.00 0.02	0.04 0.33	0.00 0.03	0.00 0.03
Age	0.00 0.00	0.00 0.03	0.00 0.04	0.00 0.01	0.00 0.02	0.00 0.04	0.00 0.02
I often spent time with parents or mentors who made things	-0.01 0.09	-0.02 0.24	0.00 0.04	0.00 0.06	0.00 0.00	0.00 0.01	0.00 0.00
I often spend time with peers who liked to make things	0.01 0.16	0.04 0.36	0.00 0.05	0.00 0.03	0.00 0.00	0.00 0.02	0.00 0.05
People should know how the things they own work	0.00 0.00	0.00 0.00	0.00 0.05	0.00 0.03	0.05 0.54	0.00 0.01	0.00 0.01
Problems or irritations from my daily life often inspire me to start a project	0.00 0.02	0.00 0.04	0.00 0.01	-0.01 0.18	0.00 0.00	0.00 0.07	0.00 0.00
Inverse of: I get the most work done when I'm working in a group	0.00 0.00	0.00 0.00	0.00 0.02	0.00 0.03	0.01 0.09	0.00 0.02	0.00 0.01
Inverse of: Failure should be avoided	0.00 0.00	0.00 0.00	0.02 0.30	0.00 0.01	0.00 0.01	0.00 0.01	0.00 0.01
I am good at troubleshooting problems	0.00 0.00	0.04 0.31	0.00 0.00	0.00 0.02	0.00 0.03	0.03 0.30	0.08 0.55
I feel like I can solve most of the problems that I encounter	0.00 0.00	0.00 0.00	0.00 0.00	0.00 0.03	0.00 0.06	0.00 0.02	0.00 0.01
I would rather solve a problem myself than have someone else do it	0.00 0.00	0.00 0.00	0.00 0.01	0.00 0.01	0.00 0.00	0.00 0.02	0.00 0.00
If I don't get something figured out in a few minutes, I ask for help or leave it until later	0.00 0.00	0.00 0.00	0.00 0.01	0.00 0.01	0.00 0.00	0.00 0.01	0.00 0.01

Survey Question	Artist	Designer	Crafter	Maker	Tinkerer	Hacker	Engineer
When I get stuck, I can usually figure out a way around it	0.00 0.03	0.05 0.32	0.00 0.01	0.00 0.02	0.00 0.00	0.00 0.02	0.02 0.12
I often ask friends or acquaintances advice when trying to learn new skills	0.00 0.00	0.00 0.01	-0.01 0.07	0.00 0.06	0.00 0.01	0.00 0.01	0.00 0.03
I often use online tutorials when learning new skills	0.00 0.03	0.00 0.00	0.00 0.00	0.00 0.02	0.00 0.00	0.00 0.01	0.00 0.01
I am good at internet research	0.01 0.05	0.00 0.00	0.00 0.02	0.00 0.01	0.00 0.00	0.00 0.05	0.00 0.00
I often get ideas for your own projects from talking with friends	0.00 0.00	0.00 0.00	0.01 0.16	0.00 0.01	0.00 0.06	0.00 0.03	0.00 0.01