OUR BODIES, OURSELVES, OUR SOUND PRODUCING CIRCUITS: FEMINIST MUSICOLOGY, ACCESS, AND ELECTRONIC INSTRUMENT DESIGN PRACTICES

Thesis

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by

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I.

Introduction:

Technological shifts in recent decades have allowed individuals working in electronic instrument design access to resources and information regardless of their affiliations with academia or other institutions. Women have historically had limited involvement in electronic instrument design due to a number of social factors; a few elements are crucial to supporting the endeavors of women and girls interested in contemporary electronic instrument design, including deinstitutionalized access to resources and information, supportive mentorship and the availability of role models, and the acknowledgement and deconstruction of social factors that hinder the progress of women in the field of music technology. Electronic instrument or interface, in the scope of this research, is defined as any sound producing circuit, sound generating or modulating interface, or sound generating and processing software interface.

Eschewing the notion of technological determinism while considering roles and uses of technology through the lenses of cyberfeminism and social role theory proves useful in the deconstruction of limiting social conventions of both gender and technology use. The intent of this research is to explore the social forces that serve to limit the involvement and achievement of women in the field of electronic instrument design by examining the practices of individual women involved in this discipline alongside sociological and psychological research on the implications of social constructions of gender, technology, creativity, and intelligence. My hope is that this research will serve

to further discourse and open a dialogue on the necessity of dismantling and examining social constructions of gender and technology.

It is crucial to my purpose in this project to be transparent and to note that the research herein serves a more than passing personal interest. My continuing practice in instrument design and music technology as well as my intentions of teaching involvement and advocacy in education, have been strengthened through this exploration and discourse. It has not been uncommon to find that I am the only woman in the room (or department, class, community, or group), and I have found it increasingly frustrating to feel silenced in this experience, and to feel incapable of articulating or understanding the social constructs I find myself navigating as I strive to further my practice. I cannot conscionably remain quiet and persevere, and my hope is that those who come after me may benefit from my active engagement in issues related to the support of women in electronic instrument design and music technology. I do not regard expressions of my femininity as negative or counterproductive, and feel that the freedom to express whatever aspects of myself-- socially gendered or basically human-- is crucial to my personal growth and creative practice. Examination of my own practice and use of music technology as it pertains to electronic instrument design contextualizes my current motivations in conducting this research; therefore it is valuable to elaborate on my history and intent.

II.

Autobiographical Information:

I was fortunate to have access to an introductory audio recording course through my high school, which taught the fundamentals of digital recording, mixing, signal flow, MIDI implementation, and Pro Tools basics. Most of my time was spent recording saccharine songs that friends had written for their significant others--and sung so quietly as to make it nearly impossible to create a decent mix. These early endeavors are, thankfully, lost to the digital aether. My choice of alma mater also proved fortuitous, as The Evergreen State College provided access to excellent material resources and supportive faculty. My prior education proved useful as I covertly executed house shows and benefit concerts using equipment intended only for academic use. I also began playing around with recording myself and making textural tape pieces with my voice and other manipulated sounds.

During my sophomore year at Evergreen I chose to enroll in an Introduction to Audio Recording course and a Physics course in order to learn about the physical nature of sound. The Audio course taught analog recording, digital recording, Foley, ADR, and sound design. I became fascinated with sound, particularly with sound design and field recording, and spent ensuing months voraciously capturing and experimenting with sounds. I learned the fundamentals of analog and digital synthesis and composition during my junior year through the Advanced Electronic Music course instructed by my mentor Peter Randlette (who was also my supervisor and advisor throughout my Senior year as the Music Technology Intern). Evergreen also allowed me to design my own

courses and carry them out independently with the support of a faculty sponsor. My independent and group contracts focused on hand drawn animation, ADR, exquisite corpse animation, live recording, basic electronics, Kinect and Max MSP/Jitter, and computer programming.

I spent some time in my youth attempting to open and examine various electronics, usually to their ultimate demise. I was not given access to a soldering iron, as my parents (probably rightly) believed I was too clumsy to safely wield one. I often watched my dad take things apart and repair them, which seemed at the time like some form of wizardry. I attempted to circuit bend things with paper clips and scrap wire and was moderately successful. My first soldering iron was a borrowed $15 Weller, probably better suited for wood burning. I upgraded shortly thereafter to a variable temperature station and began properly circuit bending children's toys and voraciously building kits, as well as repairing various pieces of Hi-Fi equipment. During my junior year, a handful of peers and I petitioned student activities to access funding for an electronics club and workshop series. I built a DI box and a contact microphone, but largely avoiding the formal electronics theory workshops because I believed that the other attendees (all men) were more advanced than I was (in hindsight, this was untrue). My electronics learning thereafter was mostly through kits and trusted peers, who I often spent time tinkering with.

During my senior year I began working with my mentor and dear friend, Don Johnson, who had previously taught the electronics theory workshops. Don has patiently supported a core group of my peers and I in our electronics learning and projects, generously donating his time, knowledge, and resources as we whiled away the hours

soldering in his well-appointed workshop. The Don Johnson mantra, "Mistakes are your friend, they teach you things," has been especially useful to recall in all ensuing projects--electronics or otherwise. In addition to my more formal pursuit of electronics knowledge, I also determined it would be useful to teach myself how to program. Over the course of my Junior and Senior year I used online and text resources to teach myself the C programming language, Max/MSP, Processing, and Arduino. This knowledge has proven useful in my continuing academic and creative work.

I began my studies at Mills College in August of 2013. My decision to apply was deeply influenced by my discovery of Tara Rodgers' seminal collection of interviews with women in electronic music, *Pink Noises*, as well as the support and encouragement of my mentor, Peter Randlette. My undergraduate experience at The Evergreen State College provided some sense of longing for more affinity with my peers, and frankly, a desire to no longer be the only woman in the room, if only for the sake of discovering whether gender parity really would make a difference in a learning environment. Mills College--as a woman-centric institution--seemed well suited to serve me in my desire to advance my knowledge of electronic instrument design, sound producing circuits, audio programming, and feminist musicology. The opportunity to work with individuals I considered role models in my creative practice and compositional strategies was also appealing. I have been humbled and honored in my studies with Maggi Payne and Pauline Oliveros, two individuals whose work deeply influenced my compositional approaches in my undergraduate coursework. During Fall 2013, I had the opportunity to reconstruct, perform, and compose with Oliveros' tape delay instrument (the predecessor

to her Expanded Instrument System), and to engage in a technical exploration of its functions and possible modification.

Ensuing work in analog synthesis, computer music, and instrument design with the guidance of John Bischoff served to strengthen my aesthetic goals. This work, alongside my studies of electronics and circuit design through James Fei's Advanced Electronics course, has provided a strong theoretical and practical background as I have proceeded to design my own sound producing circuits, interfaces, and instruments. Along with a number of software based instruments and microcontroller based interfaces, I've spent my second year constructing a number of electronic instruments with which I can generate sound with novel and interesting sonic qualities.

My Filament Synthesizer consisted of four filament light bulbs on a single base, each with single piezoelectric microphone positioned against the glass bulb. The contact microphone corresponding to each bulb is amplified through its own corresponding amplifier and sent to its own mono output. Each light bulb is controlled by a dimmer switch, allowing for control of the harmonics produced within the resonant glass bulb as the filament vibrates. The fundamental frequency, 60hz, remains unchanged. The signal from each amplifier is then taken into Max/MSP where I have constructed a patch that uses the sound of the filaments to modulate corresponding sine waves, to achieve FM synthesis. The signal from the filaments can also be used as a form of analog LFO to modulate other audio signals. I was driven by a prior experiment in which I recorded a filament bulb and discovered that it emitted not just the 60hz I expected, but also a series of higher harmonic frequencies as a result of the filament resonating within the glass cavity.

The installation piece I presented for Signal Flow consisted of a larger-than-standard Ouija Board I constructed out of hardwood, hand painted with conductive paint and connected to an Arduino Mega 2560 I had programmed to measure capacitance levels from each individual letter, number, symbol, and word. The conductive surfaces on the face of the board were connected to the back with copper nails where wires were then soldered and connected to the microcontroller. In order to increase the capacitance response of the touch sensitive side of the board a ground plane was also incorporated into the back of the board with copper tape. The installation, entitled *American Spiritualism*, explored the connections between Americana, superstition, memory, technology, and spiritualism. Found 16mm home movie footage from the Prelinger Archives was projected onto the surface of an eight-foot weather balloon suspended from the ceiling. I sifted through hours of footage and selected clips that I felt were representative or evoked a sense of nostalgia or memory. My intent was to create a vaguely voyeuristic immersive environment, in which participants would sense experiencing and randomly accessing the memories of strangers.

The Ouija Board's various touch points triggered corresponding video clips via serial communication from Arduino to Processing, as well as binary representations of each letter, number, symbol, and word generated using two harmonically related frequencies representing either 0 or 1 in SuperCollider. Each "Bit" (0 or 1) was 500ms in length. Each binary translation was sequenced in a pattern object and triggered via OSC messages from Processing. The interface was somewhat non-diegetic in response to triggers; if the Arduino detected more than one simultaneous trigger it seemed to simply create a stack of cues to send to Processing, so it was almost impossible for the user to

trigger specific clips or sounds on demand. The non-linear nature of control was well-suited to the content and nature of the piece as a whole. I have since individually calibrated each letter to respond uniformly so that the Ouija Board can be used as a MIDI controller.

III.

Research Methods:

While women have been historically underrepresented in the field of electronic instrument design, there are a few notable exceptions: Daphne Oram of the BBC Radiophonic Workshop and her Oramics Machine, which translated drawn sound symbols on 35mm film to electronic sound: Pauline Oliveros' Expanded Instrument System, originally a network of hardware and later a software application intended for performance situations: Jessica Rylan's inventive instrument designs sold through her company Flower Electronics: Laurie Anderson and her 'Tape Violin Bow' and a suit with embedded electronic sensors, utilized in *United States*: and the pioneering work of Laurie Spiegel in the field of computer music and her work at Bell Labs. There is, to my knowledge, no comprehensive study in the newly budding field of feminist musicology focusing specifically on the work of women in electronic instrument design. Information directly relating the practices or accomplishments of women in electronic instrument design was unavailable in either public or academic discourse. All information relating the practice apart from information shared during interviews was sourced from individual

documentation. Most research pertaining to women and music technology focused on performance and composition rather than instrument design and construction.

A number of interviews with women active in electronic instrument design were conducted in support of this study. Questions focused on education, access, and mentorship, as well as delving into design conventions and creative practice. The individuals interviewed are as follows: Brenda Hutchinson, Lori Napoleon, Afroditi Psarra, Carla Scaletti, Laetitia Sonami, Kaori Suzuki, and Cynthia Webster. All interviews conducted in the course of this research are included in the appendices. It is important to note that the focus of this research was on process rather than product, allowing exploration of *how* and *why* the individuals interviewed approached instrument design in certain ways, and how those methods affected their practice, rather than focusing solely on *what* was produced. Reference to music can be replaced with 'instrument' or 'interface':

> Studying the process focuses our attention on the creator's perspective; his or her thoughts, acts and understanding of the activity become the basis of their description. In contrast, studying the product implies a shift in focus where music is separated from its creator and is regarded as an independent object seen and analyzed from the perspective of the observer… Focusing upon the process instead of the completed product is to say that it is not the music itself that is the focus but the practice of ... creation. [1]

This approach inherently avoids the problematic tendency toward fetishization of technological artifacts--particularly music technology artifacts--by placing the products overtly in the sociological context of their designers. Discussion of individual instruments

[1] Göran Folkestad, "Musical Learning as Cultural Practice: As Exemplified in Computer-Based Creative Music-Making," in *Children Composing,* eds. Göran Folkestad, Gary McPherson, Bertil Sundin (Malmö: Lund University Press,1998), pp. 6.

or products is conducted for the sake of elaborating upon their conception, execution, and use in the scope of individual practice.

Music Technology, as discussed in the scope of this research, refers to any technology directly supporting or enabling the practice of audio engineering, audio synthesis, and electronic or computer music performance and composition. In contemporary practice, this includes hi-fi equipment, MIDI (musical instrument digital interface protocol), MIDI interfaces, digital audio workstations, modular synthesizers, linear synthesizers, digital modular synthesizers, software plugins, signal processors, and software environments designed for sound generation, sequencing, or processing (SuperCollider, Max/MSP, chucK, PureData, Csound, etc). The term "Music Technology" is not fixed, as the tools available or deemed necessary for the aforementioned processes are in constant flux.

For the sake of cohesion of the very vast and scattered concerns of discourse relating to the advancement and support of women in electronic instrument design, I have elected to break this research into three main sections. Section one will focus on the impact of social constructs of gender and technology on individual practice in electronic instrument design, and the availability of role models on creative growth and continuing practice. Section two will focus on education, and the impacts of social constructions of gender, effort, and intelligence on learning and teaching, as well as the benefits of mentorship and the adoption of self advocacy strategies. Section three will focus on deinstitutionalized accessibility of resources necessary for fostering engagement in electronic instrument design, and on the impact and benefits of supportive music technology communities.

IV.

Section I: Social Influence and Practice

Historically, very few electronic instruments or interfaces designed by women have been widely commercialized or manufactured, with a few notable exceptions. The pioneering purveyors of modular synthesizers--Donald Buchla and Robert Moog--were men, and the tradition has seemingly held, with most commercially available music technologies designed by men, and distributed by companies founded, owned, and run by men. By all appearances, this is also true of boutique companies specializing in Eurorack and other modular format designs. Exceptions to this norm include Jessica Rylan's synthesizer company, Flower Electronics, Cynthia Webster's modular company, Cyndustries, and Kaori Suzuki's synthesizer and instrument company, Magic Echo Music. In software development, there is Laurie Spiegel with Music Mouse, available online for Mac OS, and Carla Scaletti with Kyma, also available for purchase online with necessary proprietary hardware. Other notable companies are Monome, a programmable control interface designed and distributed out of a loft in rural New York by Brian Crabtree and Kelli Cain, and Adafruit, an online storefront and site run by Limor Fried, which sells microcontrollers, sensors, kits, and various other DIY technologies and tools, but does not focus specifically on music technology.

This begs the question: why don't more women start or run music technology companies, or make their designs commercially available? The 2014 NAMM Global Report estimates that the revenue of the US Music Industry as a whole was around $6.7 billion between 2013 and 2014.[2] The revenue for the Electronic Music Market was estimated to be around $226.7 million, up by around $11 million from 2012. The Electronic Music Market revenue on the whole has held relatively steady in revenue from 2004 to present. Many companies are privately held, so this revenue data may exclude a large proportion of the boutique and modular synthesizer market, as well as handmade instruments and interfaces available through smaller companies.

For the most part, the instruments described in the context of this research were developed for personal use rather than commodification. Examining individual practices and design decisions enables us to determine the motivations that drive those practices, whether those motivations are extrinsic or intrinsic, and what social forces may be influencing these motivations. One commonality that emerged was the interconnection between performance and compositional practice and the design process, each shaping the other in different ways. Design outcomes were allowed to evolve naturally, and remained malleable throughout the process, as opposed to a more linear process in which the circuit is designed first with specific functionality and control parameters in mind. Design driven by either experimentation or intuition with room for evolution rather than the pursuit of absolute control was commonly cited in discussion of individual practices. Many of the instruments profiled in the interviews intentionally incorporated some element of unreliability or instability, and these elements were almost unanimously

[2] 2014 NAMM Global Report

considered not only inevitable but also desirable. This commonality has been documented elsewhere, specifically in the scope of Tara Rodgers' feminist-centered exploration of electronic music *Pink Noises: Women on Electronic Music and Sound,* described by Annie Goh:

> In interviews with women composers, musicians, DJs, and sound artists, she is on the search for individual approaches and alternative methods and practices in the male-dominated world of sound and electronic music. On a more fundamental level, a sonic cyberfeminism would delve deeper. German physicist Hermann von Helmholtz made several huge contributions to science, and his work on acoustics laid the foundations for how most analogue synthesizers were and are designed and built, and how digital sound synthesis is generally undertaken today. However Rodgers takes issue with the unquestioned authority that Helmholtz's findings have had, resulting in homogenized synthesizer design practices up until today. The idea of a god-like creator, analyzing sound waves, breaking them down into constituent sine waves, and resynthesizing these to re-create any existing sound, rings like an all-too-familiar narrative.
>
> Rodgers refers to the synthesizers and instruments designed by Jessica Rylan at Flower Electronics, which actively incorporate chaotic and unpredictable systems. She could also have mentioned other synthesizer and electronic instrument designers outside of the mainstream who, although not women, have undertaken similar pursuits, for example Michel Waisvisz, Rob Hordijk, and Peter Blasser. Her focus on women is clear for obvious reasons, but there is space for a more nuanced discussion, namely as she is keen to emphasize that the perpetuation of dominant cultural practices can be enacted by individuals of any gender; being female doesn't necessarily make you a feminist, just as being male doesn't necessarily make you a male chauvinist. [3]

This more open, nonlinear design process stands as an alternative to more conventional electronic circuit and product design practices (define a problem; research; generate prototype; analyze prototype; implement design as product). It is, of course, important to avoid gender-based attributions, stereotypes, and other pitfalls of benevolent sexism in pursuit of this discourse. The intention of this research is to decipher how social constructions of gender influence electronic instrument design. Technological

[3] Annie Goh, "Sonic Cyberfeminism and its Discontents" (paper presented at the 2014 CTM - Dis Continuity Festival, Berlin, Germany, January 24- February 2, 2014), pp.4.

determinism embraces technology as neutral and posits technology as a process independent of social influence.

The theory of Social Construction of Technology (SCOT)[4] considers the social forces driving technology by examining how social constructions of gender and existing social hierarchies impact technological development, implementation, and use. In tandem with examinations of gender relations, SCOT is an effective means of analyzing technology use while deliberately eschewing technological determinism. This sociologically driven perspective on technology "helps us to uncover the discourses that often make it difficult for women to influence or participate in the development and use of technologies."[5] Examining how social constructions of masculinity and femininity influence and determine our interactions with technology enables us to challenge and dismantle existing social barriers that serve to limit women's access to technology. It is impossible to divorce existing patterns of technology use from social constructions of gender difference, and the power dynamics it reinforces:

> Gender difference is socially produced and often limiting to both sexes. Moreover, this social construction of gender difference holds important consequences in terms of power, because in the dichotomous construction of gender, power is located in the male, and the female is subjugated… The main point about discourses is that they carry power in their ability to position things and people as negative or positive, powerless or powerful. [6]

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[4] Wiebe E. Bijker, Deborah G. Douglas, Thomas P. Hughes, and Trevor J. Pinch, *The social construction of technological systems: new directions in the sociology of history and technology,* ed. 3 (Boston, MA: MIT Press, 1990).
[5] Victoria Armstrong, *Technology and the Gendering of Music Education* (Farnam, Surrey, UK: Ashgate Publishing Ltd., 2013). pp. 32
[6] Becky Francis, *Boys, Girls and Achievement: Addressing the Classroom Issues* (Taylor & Francis, 2000) pp. 19.

Technology already actively reinforces existing gender hierarchies, "an important consideration when we note that women are more traditionally users and consumers than designers or producers of technology."[7]

Self-assessment of competence at tasks perceived to be male-advantaging has been shown to be inflated in men and deflated in women, while tasks where gender is explicitly defined as irrelevant do not produce this effect.[8] In addition, when men are believed to be more competent at a task, they tend to be more lenient in their self-assessment of their competence and indicate that a lower measure of ability is necessary in order to convince themselves of high task ability; women tended to report a higher measure of ability as necessary in order to believe that they had high task ability at a male-advantaging task and assessed their own task competence as lower than men performing at the same level of competence.[9] This pattern of low self-assessment is readily applicable to the stereotypically masculine domain of technology use and mastery, and follows with pervasive cultural stereotypes that pit feminine identity against technology use, and ultimately shape the ways in which women engage with technology. It is important to note that none of the individuals interviewed in the scope of this research had an educational background in electrical engineering, so their approach to electronic instrument design is largely motivated by a desire to attain certain sonic and musical qualities they found intrinsically interesting.

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[7] Armstrong, *Technology and the Gendering of Music Education*, 7.
[8] Shelley J. Correll, "Constraints into Preferences: Gender, Status, and Emerging Career Aspirations," *American Sociological Review* Vol. 69 (2004): 93-113, 107.
[9] Correll, "Constraints into Preferences: Gender Status and Emerging Career Aspirations", 106-107.

In each interview, I asked questions about both the design process of each individual, and about how their instruments impacted or shaped their practice as performers or composers. Laetitia Sonami spoke about her interest in incorporating and exploring unreliability in her practice. She also elaborated on the importance of intention in technology use. Sonami began developing her instrument, the Lady's Glove, in 1991. The original interface consisted of a pair of rubber kitchen gloves with five Hall effect transducers glued to the fingertips and a magnet on the right hand. Touching the transducers to the magnet sent voltages to an interface where they were converted to varying MIDI signals. Sonami explains that this first glove was, "... somewhat of a joke, a response to the heavy masculine apparel used in virtual reality systems."[10] The glove evolved over time to include flex sensors, microswitches, pressure pads, ultrasonic receivers, and accelerometers which output data to Max/MSP where it was used to trigger, modulate, and generate sound. The Lady's Glove has evolved over time as Sonami has discovered performance gestures that suit her practice.

> In a way, for me, what makes art successful is this exposure of vulnerability. I think that that porousness is what actually allows people to come into the work... Because technology gives this idea of some kind of security, which is total lore, but it's still built around this idea that the computer is going to do exactly what you want. But actually when you expose that porousness of the system I think people can empathize… You have to have something to say. Even if it's not big, you still have to say something.[11]

Sonami also spoke candidly on how the instruments she designs shape her practice, explaining their inherent unpredictability allowed her to maintain a sense of curiosity about the ways technology use can be subverted, creating a platform for discovery:

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[10] Laetitia Sonami, lady's glove: a brief history, *Laetitia Sonami,* <http://sonami.net/ladys-glove/> (20 April 2015).
[11] Laetitia Sonami, transcribed interview with author, March 14, 2015.

> [The instruments] cannot be disassociated. They dictate the practice. They come out of a certain necessity, which is again this idea of [accessing] certain performative aspects. But they completely shape it, in the sense that even though I think I want [the instrument] to do this… But once the system is built it's a whole system that I hadn't really understood the implications of. So then I learn the implications. For instance, the Lady's Glove, it took 20 years to understand or to learn it, you know?... Suddenly it's an instrument talks back to you... I don't build things to "do" things in a certain way... I build things to reveal, hopefully, something about music or performance. More and more I would like to do things that allow me to find some kind of discovery… There's only so much time, but I wish I could invent crazy things... It's not revolutionary but it's kind of trying to create a platform where things can happen. So the instruments are essential. They become platforms for discovery... It started out with "what do I need to control?" Then you pretend that you wanted it to do the other tasks, like that's exactly what I wanted it to do. I want it to be unreliable. I'm really interested in unreliability. I was never interested in reliability, then with the glove I found unreliability was very interesting. It's just making something and then looking at where it's pointing. So they are completely tied to the practice, completely tied to how I view the world.[12]

When speaking with Kaori Suzuki she discussed how her instrument design practice and her performance practice are interconnected, and how the technologies available to her allow her to explore sound in relation to the world around her:

> It's played a large role, and sometimes the musical practice effects instrument design even more. Some of the focus of my musical practice has evolved into a systems-based approach where an idea is heavily influenced by the specific tool at hand... Sounds have so much physicality to them and it's another tool to connect me to a moment, an idea, or to other people--electronics and design is the best way for me to hone in more on that. Also, designing instruments constantly makes me want to hear and make something new. Even if I think that I understand an instrument well, I can put an idea for a patch together without hearing anything and then power it up to hear that it's ended up something totally unexpected. Sure it could be frustrating but other times it actually brings new design ideas to fruition or find a more efficient way to build that thing I wanted to do originally… It's a wildly different process for each design, but the constant so far is that they all interface with or produce sounds that are analog and are made in small runs. The production stage is another process to think about and I usually don't base an idea around whether it's easily reproduced or not. It can be tweaked for that at any point. I usually have stacks of paperwork and a notebook associated with each design as I draw most of the schematics out, then make an electronic schematic capture on the computer, and then make a breadboard prototype and start

[12] Laetitia Sonami, transcribed interview with author, March 14, 2015.

> tweaking parameters. It's all really hands on and it's nothing like making a robot or a computer program since all the parts are there and you can see everything. I like to incorporate a new challenge for every instrument and come to understanding something new with each design.[13]

Lori Napoleon emphasized, again, that her design process was nonlinear, and that the telephone equipment she incorporates as interfaces for her instruments played a large part in shaping the outcome:

> There is a strong interplay between what is possible with the circuits/modules in themselves and the discovery of what's possible within the repurposing of pre-existing controls. One of the most enjoyable times in the process is taking apart a switchboard and seeing how everything in the interface is routed. Often when you plug in a cable, 2 switches are closed and another 2 are open, and this inspires audio and visual ideas for how to route the circuits. I add far more LED indicator lights to my instruments than what is indicated in the schematics because the machinery lends itself more to it, and because it transforms the instruments into an environment that could light the room on its own.[14]

This more open approach to circuit design, in which the circuit remains flexible and expandable depending on evolving creative intentions, deviates from conventional circuit design procedures.

The design practice is inherently dependent on compositional efforts in Carla Scaletti's practice. Kyma is an evolving process, in which the tool itself shapes compositional outcomes, while compositional processes help to clarify necessary parameters and improve the software environment. Scaletti describes the impact of her instrument as "a continuous tight feedback loop" describing Kyma as her "native language… the way [she] thinks in sound."[15] Afroditi Psarra emphasized that her initial conceptions for wearable interfaces were motivated by "possibilities in performing with them and composing." Psarra also noted the importance of aesthetics and consideration of

[13] Kaori Suzuki, email correspondence with author, March 4, 2015.
[14] Lori Napoleon, email correspondence with author, March 17, 2015.
[15] Carla Scaletti, email correspondence with author, February 11, 2015.

form, explaining that, “in the case of the wearables, since the parameters of sound are controlled through the use of the whole body the performances need to have a more theatrical context. Collaborations with contemporary dancers enable her to more precisely dictate sonic outcomes, while ‘the dancer explore(s) the possibilities of the wearable-costume.”[16]

Cynthia Webster’s approach to modular design is driven in large part by performance and composition practices as well. Though her approach to circuit design is somewhat more linear, probably owing in large part to a more formal self motivated education in circuit design, aided by *ElectroNotes*.[17] She noted the importance of imposing initial design constraints, defining control parameters, and how circuit design correlates to panel design decisions and vice versa:

> As a design evolved I play with it and discover if the range of any parameter is too wide of too narrow. Usually it's a process of imposing controlled limitation to bring each control into a useful range. Oddly I find that there's more serious exploration into what an instrument can do by defining it, rather than leaving everything completely open ended… It's important to me to offer something not available elsewhere, or to do a new take on a familiar design, or else why put your name on just another 'me too' product? Front panel design is like a religion to me. I started by playing live electronic music and feel that I have a solid sense of what makes a good instrument. Eventually I learned that it's not always about putting every possible control or every circuit imaginable into your creation. A Minimoog keyboard synthesizer is a classic not just for everything that it's got, but also because of the choice of what was left out. A famous quote (by someone, perhaps Nietzsche) was that "without limitation, there is no art." I think it's a great saying. Imagine a violin, the “limitation” of its body cavity size and shape, and the length of its strings define it. Violins are incredibly expressive instruments in the right hands and no one complains “why can't it also sound like a tuba?”[18]

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[16] Afroditi Psarra, email correspondence with author, February 16, 2015.
[17] ElectroNotes is a newsletter on electronic music synthesis and instrument design started in 1972 by Cornell Electrical Engineering professor Bernie Hutchins. Early contributors to the publication include Robert Moog and Don Buchla. Issues of the newsletter are available online.
[18] Cynthia Webster, email correspondence with author, January 30, 2015.

Brenda Hutchinson's creative practice notably focused on the cultivation of social interaction and public engagement, and her instrument design process serves to produce interfaces that overcome social challenges and encourage engagement. Hutchinson emphasized that her interest was not so much in technology for technology's sake, but in the potential social platforms that technology enables. Below, Hutchinson discusses the impetus behind her Long Tube instrument, later augmented with sensors to provide gestural control of parameters in Max/MSP.

> I was at the Exploratorium and these guys from Bell Labs had come, and were talking about how they were putting electronic tones into long tubes, and how some of the tones that they played through the tubes disappeared, you didn't hear them, and I thought that was really interesting. So I went out to the shop and we had a metal rack with all these tubes on it, and I started singing into all these really dirty dusty ends of tubes. There was one tube where a lot of the tones that I sang, it was like somebody touching your throat and it cancelled it out. So I pulled it out and it was a nine-foot tube. It was a little high so I made a nine and a half foot one. So it just an experiment trying to sing those notes that you couldn't sing and it would do all this weird stuff to your voice. And I thought, wow this is really interesting and exciting, and like I said before I thought everyone would want to do this. I thought to maintain the transparency of that interaction and that practice was the most important thing about doing it. Again it was a social challenge, as sort of my desire to have people connect on that level, through personal investigation of something that was so accessible that was there all the time. That's sort of the underlying thing I think of everything I do.[19]

Again, the design process remained open ended throughout, and control parameters were determined through practice. Hutchinson's designs are intentionally accessible, and often invite interaction between multiple users. Hutchinson also spoke about the development of *SoundDrawing*, which she developed in response to her friend Anne Chamberlain, who developed brain cancer and lost memory and cognitive function.

> It got to the point where her memory was only three seconds long, and she was a really good friend. She was always incredibly articulate and liked to discuss things. So it got to the point where you couldn't have a conversation. It was

[19] Brenda Hutchinson, transcribed phone interview with author, January 31, 2015.

> frustrating for a second, because I remember, we were sitting somewhere, we were on the beach and we were watching kites or something, and she was looking up and she was starting to say something about some kite. I'm looking up and I'm following what she says and then all of the sudden she stops speaking, and I looked at her, and she looked really frustrated. But only for a second, and then it was gone. So I thought, well you know, if she can let it go I have to also. So I had to find a way. She liked to draw but she had always had a shake in her hand, and as she got older it just got more prominent. At one point she made these drawings, she called them her tremor drawings, she just tried to draw straight lines across a page and filled the page with parallel straight lines. But they were all shaky. They looked like seismographs. And I had said, these are so beautiful and they really remind me of sound, like you're looking at sound, we should do something with this. But we never did. So when she got to this point, I thought about those. So what I did is I got one of those Wacom drawing tablets and I developed a patch in Max/MSP that would track the motions of her hand, and what I did is I would record sounds, like if we were having tea, we would talk, and the tea kettle, just different things in our environment, I would record these different sounds then I'd break them up into smaller chunks and I would present them to her. Then she would select the ones that she liked, and then I would map these sounds onto the surface of the drawing tablet so that whenever she was in contact with the pen it was scrubbing through the sounds. It was wonderful. The amazing thing was, as soon as she touched the surface of the thing the sound would just grab her attention and she could focus. And she would draw for like an hour at a time. And the drawings are beautiful, they're like these line drawing maps of her attention.[20]

This practice of instrument design in response to or in pursuit of interpersonal situations and social engagement represents yet another largely unexplored alternative approach to electronic instrument design.

Laetitia Sonami also remarked on the importance of self-imposed boundaries in both design and composition, articulating that the nearly limitless nature of electronically generated sound is "just this kind of supermarket of sounds... That's why I think that live performance is interesting, in the sense that, what you can do live is very limited. There's the limitations of space, setting up all those limitations is very interesting, as opposed to being always editing."[21] In most cases, the instruments profiled in this research were

[20] Brenda Hutchinson, transcribed phone interview with author, January 31, 2015.
[21] Laetitia Sonami, transcribed interview with author, March 14, 2015.

designed with form following function, though the relationship between aspects of form and function were allowed to shape each other as necessary to remain useful or interesting.

Interviewees were quick to mention their experience with cultural role models. These cultural role models were not selected on the basis of gender, but rather based on their achievements or their alternative approaches to electronic instrument design and electroacoustic composition. Buchla--whose alternative approaches to instrument design have inspired and enabled many intrepid electronic music makers--was mentioned by a number of interviewees, including Webster, Suzuki, and Napoleon. Webster and Suzuki also pointed to Morton Subotnick as a role model that shaped their practice. The only female role models mentioned were Eliane Radigue and Delia Derbyshire by Psarra, both lauded as pioneers in the field of electronic music. The lack of female role models mentioned in the scope of study may be due in no small part to the fact that the work and achievement of women in music technology and electronic music has been largely unrepresented in public discourse until recently.

Role models serve crucial roles in the support of women in music technology and electronic instrument design. The research of Buck, Clark, Leslie-Pelecky, Lu, and Cerda Lizarraga expounds the importance of available role models, stating that, when the person observes others with similar characteristics perform skills successfully, or act in a manner that produces what they view as desirable results, their expectation about their own ability to perform the task and desire to act in a certain manner are reinforced[22] Sex-

[22] Gayle A. Buck, Vicki L. Plano Clark, Diandra Leslie-Pelecky, Yun Lu, Patricia Cerda-Lizarraga, "Examining the Cognitive Processes Used by Girls and Women Scientists in

stereotypical images of careers involving technology serve to limit women's career aspirations, making it especially important for women to have access to positive role models. Concurrent work in feminist musicology, particularly the work of Elizabeth Hinkle-Turner and Tara Rodgers, provides important documentation of the practices and achievements of women in music technology. There does lay some danger in raising the achievements of women based solely on their gender, and this method is widely rejected as both patronizing, tokenizing, and counterproductive by women in the field of music technology, as well as feminist musicologists.[23]

Some interviews also put emphasis on peer mentorship and support, and the importance of community in motivating and inspiring design practices. Carla Scaletti in particular spoke about her educational experience and the importance of peer role modeling and collaborations:

> I was greatly influenced by the atmosphere at the University of Illinois in the 1980s. All of my music professors were coding or building their own hardware instruments, so it seemed like a natural thing to do. I lived in a graduate dorm on the engineering side of campus so I also had a lot of friends who were electrical engineering students. Eventually I even started working with electrical engineering students at the CERL Sound Group; they were building digital synthesizers, computers, and new musical interfaces, and to them, coding came as natural as speaking English—maybe even more so! When you're surrounded by friends and mentors who create technology, it's natural to want to join in the fun.
>
> If you don't know anyone who creates things, you can easily get the impression that technology and music are "things" that you order online. But when you see people all around you making things, you understand that there's nothing more human than technology. It's what we humans do.[24]

Identifying Science Role Models: A Feminist Approach," *Science Education* 92:4 (2008): 688-707, pp. 689.

[23] Emily Sue Goldman, "Feminist Evasions: Susan McClary's Unacknowledged Debts," *Discoveries No.6* (2005): 1-14.

[24] Carla Scaletti, email correspondence with author, February 11, 2015.

Kaori Suzuki also emphasized the importance of peer role models, as well as cultural role models. Access to supportive communities strengthens and empowers individuals involved in electronic instrument design to see possibilities in technology, and to embrace alternative design approaches that suit their individual practices.

> As far as design goes it's been inspired by other DIY instrument makers and the works of contemporary and pioneering designers. I think that the story and process behind the Buchla Music Easel is pretty fascinating and my interest in building custom boxes came from a similar desire -- Morton Subotnick and others from the early SF Tape Music Center started discussing a hypothetical instrument system, then Don Buchla sort of took it up as a project and it slowly got funded from there! There are people like Madrona Labs in Seattle doing interesting software work and just getting to know a small grid of people with similar visions always inspires me. Engineers, pretengineers [sic] and developers who create work with integrity and keep the music and people at heart, that pretty much keeps me inspired.[25]

Learning to ask for or seek out support, resources, and access is crucial to the continuing creative practice of all individuals involved in music technology and instrument design. Women are often socialized in such a way that makes action in the interest of self-advocacy particularly challenging. The necessity and practice of asking for and receiving intellectual support runs counter to cultural expectations of intelligence when intelligence or ability is perceived as innate or fixed (entity theory).[26] Research suggests that the status of creative genius is perceived as masculine.[27] This would suggest

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[25] Kaori Suzuki, email correspondence with author, March 4, 2015.
[26] Sandra Graham, "A Review of Attribution Theory in Achievement Contexts," *Educational Psychological Review* 3:1 (1991): 5-37.
[27] Lucy Green, "Exposing the Gendered Discourse of Music Education," *Feminism & Psychology* 12 (2002): 137-144.

that when boys do well at creative ventures it means they are gifted, whereas when girls do well, it means they are working very hard. This bias is part of the gender stereotype around femininity and creativity.[28] Stereotypes about women's technological competence threaten their perceptions of task ability when encountering difficult situations in using technology, and particularly serve to confirm biases in perception of competence in women who view their intelligence as an entity rather than an ultimately malleable quality (incremental theory).[29]

In conducting interviews, perceptions of "effort" as vital to shaping intelligence and practical outcomes, rather than an indicator of lack of "ability" or competence, was emergent. Also relevant were perceptions of the importance of seeking necessary support when encountering unfamiliar or confusing information or concepts. Goal-oriented self-motivation seemed to correlate with self-advocacy in obtaining support and resources. When speaking with Sonami about whether or not the ability to seek support was necessary she explained, "I think it is. I think that getting that confidence, you know, especially for a woman, that you just don't give a shit if people think you're stupid, you just need information. I don't care what you think, I just need information and I'm going to get it. So that's what I did at the time." [30] Hutchinson offered similar advice, "We always need help. You just need to find people that are willing to help you. It's our job to do that, you know?"[31]

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[28] Jasmine Carey, "Talent Versus Effort: Effects of Gender Differences in Music Education," (Department of Psychology Honors Theses, Ohio State University, 2005), pp. 6.
[29] Graham, "A Review of Attribution Theory in Achievement Contexts," *Educational Psychological Review* 3:1 (1991): 5-37.
[30] Laetitia Sonami, transcribed interview with author, March 14, 2015.
[31] Brenda Hutchinson, transcribed phone interview with author, January 31, 2015.

Because electronic instrument design practices exist at various intersections of art, music, and technology, it is important to consider that gender stereotypes about technology use are not the only social force working against women in the field. Indeed, Cartesian dualism pervasive in Western culture presumes that masculinity is related to the mind, superiority and to "doing" or "having," while femininity is considered passive and inferior and equated with "matter" and "being." This dualism is also relevant to later discussions of cyberfeminist theory (see section 3), and to Donna Haraway's influential text on the subject, *The Cyborg Manifesto*, in which she remarks:

> Certain dualisms have been persistent in Western traditions; they have all been systemic to the logics and practices of domination of women, people of color, nature, workers, animals — in short, domination of all constituted as others, whose task is to mirror the self. Chief among these troubling dualisms are self/other, mind/body, culture/nature, male/female, civilized/primitive, reality/appearance, whole/part, agent/resource, maker/made, active/passive, right/wrong, truth/illusion, total/partial, God/man. The self is the One who is not dominated, who knows that by the service of the other, the other is the one who holds the future, who knows that by the experience of domination, which gives the lie to the autonomy of the self. To be One is to be autonomous, to be powerful, to be God; but to be One is to be an illusion, and so to be involved in dialectic apocalypse with the other.[32]

These dualisms are particularly relevant to contemporary attributions of 'creative genius' as masculine.[33] This attribution and related stereotypes not only impact self-assessment of competence in the creative domain, but is also reflected through attribution biases of educators in evaluating student ability (see section two). Attributions of creativity to masculinity or mental may seem counterintuitive to our perceptions of the arts, as creative output is generally correlated with emotions and grounded in the natural body

[32] Donna Haraway, "A Cyborg Manifesto: Science Technology and Socialist-Feminism in the Late Twentieth Century," in *Simians, Cyborgs and Women: The Reinvention of Nature* (New York: Routledge, 2013). pp. 313.
[33] Green, "Exposing the Gendered Discourse of Music Education," 142.

(feminine). This incongruous dualism is resolved when "feminine emotion" is supplanted by "rational masculinity," and that conceptions of "rational knowledge… transcend and subordinate… feminine emotions," and that "even though the male creative genius is allowed to take on these 'feminized' attributes, when applied to females these attributes are not accorded the same status."[34]

The opposition of "primitive" versus "advanced" technology echoes a number of hierarchically related dualisms, including oppositions between nature and culture, "low-end" and "high-end," user and designer, and crucially, femininity and masculinity.[35] A significant amount of feminist writing has expressed suspicious resistance and even phobic reaction to machines, since it is not difficult to associate many forms of modern technology with a "masculine pathos of domination, control, and destruction."[36] Perceptions of this masculine pathos by women engaged with technology may serve as some explanation and justification of their alternative approaches to technology use and design, and an emergent tendency to embrace system unreliability as desirable in design practices.

The culturally dominant form of masculinity in contemporary Western society is still strongly associated with technical competence and power.[37] The continuing material and social associations of technology with men and masculinity diametrically contributes to stereotypes that describe women as less capable and interested in technology--a common argument of essentialism used to justify women's lack of access to

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[34] Armstrong, *Technology and the Gendering of Music Education*, 6.
[35] Melodie Calvert and Jennifer Terry, *Processed Lives: Gender and Technology in Everyday Life* (London; New York: Routledge, 1997) pp. 3.
[36] Calvert and Terry, *Processed Lives: Gender and Technology in Everyday Life*, 6.
[37] Mary Fox, Deborah Johnson, Sue Rosser, *Women, Gender, and Technology,* (Urbana: University of Illinois, 2006), pp. 97.

technological resources. In regards to access, Women's basic access to technologies is significantly restricted "due primarily to their lack of money and their exclusion from technical training, and due to a socialization process that discourages women from thinking technology is theirs to invent and use."[38] Nearly three decades of government initiatives to get more girls and women into the traditionally male dominated areas of science and technology have been unsuccessful because there has been a failure "to critically examine the ways in which technology gets gendered in the eyes of would-be technologists."[39] Persisting stereotypes of who is in control of the directions of emergent technology continue to limit women's ability to effectively access technological resources.

Women are typically held to higher standards when performing male-typed tasks, and are expected to exhibit a higher level of task competence than male counterparts.[40] Victoria Armstrong posits that "feeling they have to adapt and conform to male norms and expectations is an issue for female pupils in the music technology classroom."[41] In relation to technology use, "men's conscious control of technology comes from a deeper motive to protect a masculine reality which has been secured in the symbolic significance of technology." Research on the sociological workings of computer science has argued that the "dominant discourse in computing is shaped by social practices which have institutionalized the power of experts, mostly male, to define what counts as computing

[38] Calvert and Terry, *Processed Lives: Gender and Technology in Everyday Life*, 8.
[39] Wendy Faulkner, "The Technology Question in Feminism: A View From Feminist Technology Studies," *Women's Studies International Forum*, 4:2 (2001): 79– 95.
[40] Martha Foschi, "Double Standards for Competence: Theory and Research," *Annual Review of Sociology* 26 (2000): 21-42, 28-9.
[41] Victoria Armstrong, *Technology and the Gendering of Music Education* (Farnam, Surrey, UK: Ashgate Publishing Ltd.: 2013.), p. 31.

in education," and that "these ideologies in turn shape the climate which women have to negotiate."[42] Acknowledging this continual male dominance of technology "helps us to uncover the discourses that often make it difficult for women to influence or participate in the development and use of technologies."[43] Again, the issue of attempting to succeed in a male gender-typed domain arises:

> Consequently, 'girls are set up for failure on some level as they confront technology and are measured by a male norm' (Caputo, 1994: 89). 'Fitting in' therefore not only requires women to adopt an identity that does not call attention to their femininity but also requires adapting to 'masculine' ways of working in a digital culture that privileges male ways of knowing… Whereas engaging with technology is affirmatory of masculinity, women's engagement with it marks an interruption to their femininity because technological expertise is not part of feminine identity.[44]

Research showing that women who participate and succeed in stereotypically masculine domains are stigmatized for engaging in activities and behaviors considered inappropriate for their social role correlates with concurrent research on the relationship between benevolent and hostile sexism and social role theories. This research is an important consideration when issues of access are involved, as prevailing cultural acceptance of sexism is a limiting factor to gender parity and thus to institutional access (bearing in mind that many institutions have historically privileged male access). Examining the correlation between hostile and benevolent sexism and its role in maintaining an existing structural power and privilege of masculinity in most cultures is useful in this discourse. Both hostile and benevolent sexism are viewed as "legitimizing ideologies," beliefs that help to justify and maintain inequality between groups.

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[42] Sue Clegg, "Theorising the machine: gender, education and computing." *Gender and Education* 13:3 (2001): 307-324, 308.
[43] Armstrong, *Technology and the Gendering of Music Education*, 32.
[44] Ibid, 31.

Benevolent (or ambivalent) sexism differs from hostile sexism in that the perpetrator feels subjectively positive toward the recipient:

> Hostile and benevolent sexism can be simultaneously endorsed because they are directed at different female subtypes. The complementarity of these ideologies (and their sexist tone) stems from how women are split into "good" and "bad" types; women who fulfill conventional gender roles that serve men are placed on a pedestal and rewarded with benevolent solicitude, whereas women who reject conventional gender roles or attempt to usurp male power are rejected and punished with hostile sexism.[45]

These particularly disarming gender-based attributions associated with benevolent sexism are subjectively favorable in characterizing women who prescribe to socially accepted feminine roles, while reinforcing gender differentiation exaggerating perceived (socially constructed) differences between genders.[46] Addressing the subtle and pervasive impacts of benevolent sexism is crucial to supporting goals of increased technological and creative access for women in electronic instrument design.

V.

Section II: Education

Academic institutions provide resources that are largely unavailable to the general public, including guided electronics construction, faculty mentorship, advanced electronic testing equipment, prototyping materials, and large synthesizer and electronic music systems. Access to academic institutions is largely limited to individuals

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[45] Peter Glick, Susan Fiske, "An Ambivalent Alliance: Hostile and Benevolent Sexism as Complementary Justifications for Gender Inequality," *American Psychologist* 56:2 (2001): 109-118, 113.
[46] Henri Tajfel, *Social Identity and Intergroup Relations* (London: Cambridge University Press, 1981).

financially able to access higher education, though some amount of aid is available in the form of scholarship and grant funds. My own access to music technology has largely been contingent upon access to academia and the communities surrounding various institutions. I recognize that this access to academic institutions is privileged, and believe that acknowledging those privileges, examining their impacts, and considering alternative means of access is crucial to supporting individuals for whom higher education is unattainable. It is also valuable to examine the ways in which educators can influence and support women involved in electronic instrument design and music technology use in the context of academic institutions.

Contemporary research on attribution biases theory and on models of intelligence and learning has resulted in examinations of the ways in which our own perceptions of intelligence, effort, and ability may impact achievement. This research has also shown that gender stereotypes and related attributions of effort and ability are implicitly imparted to students through benign interactions between teacher and student.[47] This implicit bias affects student performance:

> Pity following failure and praise for success at easy tasks is interpreted by students as a low ability expectation. It has also been shown that adults see effort and ability as compensatory; more effort indicates less ability, and more ability indicates less effort. If girls are perceived as putting in more effort, then their teachers would interpret that as a lack of ability and convey this belief to the student.[48]

In addition, stereotypes can lead to different attributions of a person's success or failure. When stereotypes contain information about a person's abilities, the stereotypical

[47] Graham, "A Review of Attribution Theory in Achievement Contexts," *Educational Psychological Review* 3:1 (1991): 5-37.
[48] Carey, "Talent Versus Effort: Effects of Gender Differences in Music Education," 5.

outcome is considered uncontrollable, and if the outcome is counter stereotypical then it is attributed to some controllable action.[49]

Seeking access to crucial social, professional, and academic support is often stigmatized by the knowledge of existing stereotypes around women's technological competence, highlighting the importance of dismantling these gender based assumptions through sociological examinations of technology and gender. Prescriptive and descriptive stereotypes of gender impact the ways in which women perceive themselves and are perceived. The concept of stereotype threat--the idea that stereotypes have very conscious and subconscious impacts on the social groups they describe--is well documented.

Gender stereotypes denote norms about behaviors that are typed as both masculine and feminine, as well as about how women and men "should be."[50] Not only do these gender stereotypes impact self image, but also perceptions of women in stereotypically male domains, and that "self-assertive and tough, achievement-oriented, agentic behaviors for which men are so positively valued are typically prohibited for women."[51] Negative reactions to successful women only occurred when the job was male gender-typed. Social penalties are placed on women who clearly succeed in male-typed domains.

Sociological research has proven that "when a belief exists that men are better at a task, men have higher aspiration than women for paths requiring some level of task

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[49] Christine Reyna, "Lazy, Dumb, or Industrious: When Stereotypes Convey Attribution Information in the Classroom," *Educational Psychology Review* 12 (2000): 85-110.
[50] Laurie Rudman, Peter Glick, "Prescriptive Gender Stereotypes and Backlash Toward Agentic Women," *Journal of Social Issues* 57:4 (2001): 743-762.
[51] Madeline Heilman, Aaron Wallen, Daniella Fuchs, Melinda Tamkins, "Penalties for Success: Women Who Succeed at Male Gender-Typed Tasks," *Journal of Applied Psychology* 89:3 (2004): 416-427.

ability."[52] Research has shown that when women are exposed to negative gender stereotypes, "over time, individuals may misidentify with domains in which their group is negatively stereotyped or unfairly treated so that their performance in that domain is no longer important to their self worth."[53] The theory of automatic stereotype activation and related behaviors is also relevant to this discourse. Awareness of stereotype contents can automatically lead to behavior that assimilates to those stereotypes due to associative links in memory and behaviors those stereotypes imply.[54]

The Imposter Phenomenon--a persistent inability to internalize accomplishment and accompanying belief that success is dependent on external forces[55]--in concurrence with social role theory and attribution biases, is a persistent challenge faced by many high achieving women practicing traditionally masculine-typed careers. Although some highly successful men exhibit aspects of Imposter Phenomenon, it tends to occur with much less frequency and intensity and most commonly in men possessing qualities that are socially perceived as feminine. According to early research on Imposter Phenomenon, "women who experience the Imposter Phenomenon maintain a strong belief that they are not intelligent; in fact they are convinced they have fooled anyone who thinks otherwise."[56] This imposter belief is rooted in family structure and early experiences, and is self perpetuated in a number of ways. In large part, the Imposter Phenomenon is reinforced by

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[52] Correll, "Constraints into Preferences: Gender Status and Emerging Career Aspirations", 109.
[53] Brenda Major, Laurie T. O'Brien, "The Social Psychology of Stigma," *Annual Review of Psychology* 56 (2005): 393-421, 405.
[54] Brenda Major, Laurie T. O'Brien, "The Social Psychology of Stigma," 397.
[55] Pauline Clance, Suzanne Imes, "The Imposter Phenomenon in High Achieving Women: Dynamics and Therapeutic Intervention," *Psychotherapy Theory, Research and Practice* 15:3 (1978): 1-8, 1.
[56] Ibid, 1.

attribution of success to "temporary" (external) causes, such as "luck" or "effort" while failure is attributed to "lack of ability" (internal). Attributing success to external factors, while explaining failure as evidence of internal factors results in lower expectancies for performance, perpetuating the societal stereotype of women being less intellectually able and competent. This confirmation bias begins as early as age ten.[57]

Four mechanisms serve to perpetuate feelings of phoniness in women exhibiting imposter phenomenon: diligence and hard work translate into feelings that extraordinary effort is necessary in order to maintain the illusion of ability; silence and intellectual flattery allow the perceived imposter to maintain the illusion of high intelligence, whereas expressing genuine thoughts and ideas would foil the pretense; charm and perceptiveness, seeking approval from authority figures, and discounting received approval from "charmed" authority figures as the approval is considered to be contingent upon social ability and charm; and fear of success, in which the perceived imposter maintains their own belief of phoniness is an effort to avoid embracing or internalizing achievements and praise.[58]

The clinical symptoms most frequently reported with imposter phenomenon are, "generalized anxiety, lack of self-confidence, depression, and frustration related to inability to meet self-imposed standards of achievement."[59] Social stereotypes relating to women's lack of technical competence serve to confirm and perpetuate attributional

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[57] John G. Nicholls, "Casual Attributions and Other Achievement-Related Cognitions: Effects of Task Outcome, Attainment Value and Sex," *Journal of Personality and Social Psychology* 31 (1975): 379-389.
[58] Clance, Imes, "The Imposter Phenomenon in High Achieving Women: Dynamics and Therapeutic Intervention," 5.
[59] Idem, "The Imposter Phenomenon in High Achieving Women: Dynamics and Therapeutic Intervention," 2.

biases in some women working in the fields of music technology and electronic instrument design. For individuals experiencing imposter phenomenon,

> Success does not mean happiness. Imposters often experience fear, stress, self-doubt, and feel uncomfortable with their achievements. Imposter fears interfere with a person's ability to accept and enjoy their abilities and achievements, and have a negative impact on their psychological well being. When facing an achievement-related task, Imposters often experience uncontrollable anxiety due to their fear of failure. Burnout, emotional exhaustion, loss of intrinsic motivation, poor achievement, including guilt and shame about success are reinforced by repetitions of the Imposter Cycle.[60]

Reinforcement of positive self-advocacy strategies, including incremental theory--the belief that intelligence is malleable rather than fixed--and related positive attributional patterns, are seemingly effective means of thwarting the imposter phenomenon. In speaking with Brenda Hutchinson about feelings of isolation relating to my own academic experience, and the nagging feelings of imposter-dom that I have experienced at times, she was quick to offer her experience:

> You know what, like in the 80's there was a little tiny period where funding opened up for women, people of color, this and that. I had that thought for about five seconds, and I thought, you know what, I don't care! I'll take it. I'll take it however I can get it because I need it, I can use it, and I deserve it. So don't even think about it, however it comes to you, you're totally deserving of it, and you're going to do something that only you can do.

It is important to consider the effects of women's self-assessment in the presence of imposter phenomenon in relation to technology use, and to take requisite steps, if possible, to avoid perpetuating the cycle.

Research on growth (incremental theory) versus fixed (entity theory) intelligence models (mentioned in section one) also provides interesting directions for engagement in music technology curriculum design in support of women. Studies have shown that

[60] Jaruwan Sakulku, James Alexander, "The Imposter Phenomenon," *International Journal of Behavioral Science* 6:1 (2011): 73-92, 86.

students who view their intelligence as a malleable quality that can be developed "affirmed learning goals more strongly and were more likely to believe that working hard was necessary and effective in achievement, than were students who thought that their intelligence was fixed." This belief resulted in learning goals and positive correlations between effort and achievement, as well as fewer ability-based attributions when faced with intellectual and academic challenge. Students adopting incremental theory were less likely to attribute failure or potential failure to lack of ability, and more likely to "invest more effort or change strategy in response than were students who held an entity (fixed) theory."[61] Belief in the potential for intellectual growth alone improves academic and intellectual outcomes for women and girls, particularly in disciplines where negative gender stereotypes persist.

Students that hold an entity theory have also been shown to receive praise negatively, even when the praise was subjectively earned.

> In a series of studies, we have shown that praising students' ability (even after a job truly well done) has undesirable consequences (Mueller & Dweck, 1998). First, it conveys to them that their ability is a gift and makes them reluctant to take on challenging tasks that hold a risk of mistakes. Next, when these same students hit a period of difficulty, the ones who had been praised for their ability tended to lose their confidence. If their success meant they had a gift, their struggles now told them they didn't… So, plainly, covering females with praise for their level of ability is not the answer. Rather than instill lasting confidence, it does just the opposite. So what would work? The answer, we found, is to get at the root of the vulnerable confidence by addressing students' beliefs about the nature of ability.[62]

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[61] Lisa Blackwell, Carol Dweck, Kali Trzesniewski, "Implicit Theories of Intelligence Predict Achievement Across an Adolescent Transition: A Longitudinal Study and an Intervention," *Child Development* 78:1 (2007): 246-263, 253.

[62] Carol Dweck, "Is Math a Gift? Beliefs That Put Females at Risk," in *Why aren't more women in science?: Top researchers debate the evidence,* Stephen J. Ceci (Ed); Wendy M. Williams, (Ed), (Washington, DC, US: American Psychological Association, 2007).

Reinforcement of positive effort based attributions and incremental theory has the potential to create supportive learning environments and curricula that thwart problematic conceptions of ability and competence, particularly relating to gender and technological competence.

The issue of mentorship, and particularly of same gender mentor-protégé pairs, has been researched to some extent. Formal and informal mentorship relationships have been shown to benefit both mentors and mentees.[63] Typically, mentors tend to associate with protégés who are similar to themselves in terms of gender, race, and social class.[64] Women are at a particular disadvantage in many institutions, as few same gender potential mentors are available due to the shortage of women in business, academia, and technical fields. Research on the organization of formal mentorship programs highlights the need for more formal mentorship programs:

> While shifts in gender composition are becoming apparent in the workplace, European-American males still surpass all other groups; therefore, females are less likely to be in situations where natural mentoring takes place. Thus, planned or formal mentoring programs must be developed to ensure that females are receiving increased opportunities for professional development.[65]

Cross-gender mentorship pairs have also been shown to be beneficial, though not without challenge. Additional social pressures are presented in cross-gender pairings, including stereotype threat, stereotype role collusion, limited role modeling functions, public scrutiny, sexual and intimacy concerns, and peer resentment.[66] Mentor

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[63] Jennifer de Vries, Claire Webb, and Joan Eveline. “Mentoring for Gender Equality and Organisational Change,” *Employee Relations* Vol. 26 No. 6 (2006): 573-587.
[64] Christy Chandler. "Mentoring and women in academia: Reevaluating the traditional model," *NWSA Journal* (1996): 79-100, 82.
[65] Sonja Feist-Price. “Cross Gender Mentoring Relationships: Critical Issues,” *Journal of Rehabilitation* (1994): 13-17, 13-14.
[66] Feist-Price, “Cross Gender Mentoring Relationships: Critical Issues,” 15.

relationships offer both professional and psychosocial support, with greater emphasis on psychosocial functions when the relationships involve women. This effect was especially pronounced in female mentor-female protégé pairs.[67] Some mentorship research attributes the larger role of psychosocial support in mentorship relationships involving women to women's socialization as caretakers, the perception that women may be more likely to require this form of support, and possibly feelings of camaraderie developing in the face of common obstacles faced by professional women.[68] Mentorship and role models were a key focus of the interviews I conducted. Only two of the individuals I interviewed, Sonami and Hutchinson, reported having experienced a female-female mentorship pairing in their music technology learning.

Sonami spoke at length about her mentor, Eliane Radigue. Sonami noted that her ability to access music technology equipment was initially somewhat restricted, and that the only other potential institutions through which she could access requisite music technology in France in the early 1970s were radio stations which stipulated that she possess a conservatory education. Radigue provided crucial equipment access and synthesis tutorials, as well as professional support and role modeling. Sonami emphasized that Radigue was rather hands off in her approach, and that her guidance in terms of composition consisted mostly of critique.

> I was very lucky that someone said that they knew of this composer in France, in Paris, who had equipment--an ARP 2500--which was Eliane Radigue. So they introduced me to Eliane. At the same time there was a weird pilot program at a University where they had a couple of classes on computer programming, but

[67] Ronald J. Burke, Carol A. McKeen, Catherine S. McKenna. "Sex Differences and cross-sex effects on mentoring: Some preliminary Data," *Psychological Reports* 67, (1990): 1011-1023.
[68] Chandler, "Mentoring and women in academia: Reevaluating the traditional model", 82.

> they didn't really have a studio. So mostly it was through Eliane, and I was very, how do you say? Admirative, and shy, because she was beautiful, and she had a studio in her room, she had the big ARP synthesizer, and she had art everywhere. The place looked so high culture. Anyway, she said, why don't you come four times and I'll just show you how the synthesizer works, and we'll see. She wasn't really into having students. It was in her place, she lived there, so there was no way for her to isolate herself. Anyway, she ended up letting me [work there] the whole year, one day a week.
>
> So I really had a mentor, and I really had a woman mentor, which is very rare in electronic music. I was talking to Marina Rosenfeld who I teach with at Bard and she was saying, "You know I never had a woman mentor." I was extremely lucky, because I think that I was rebellious, and I was very against authority of any kind, and even though she was very strong I guess that I did not envision her as this kind of… male culture that I had encountered at radio stations… I think she had a big influence, and she's the one who actually said you're not going to be able to do anything in France; you have to go to America. She introduced me to Robert Ashley and to David Berman, and that's how I ended up at Mills in 1978. Eliane had very little interest in technology, she hated anything digital. But she knew that's where it was going to go, so she said if you go to America you're going to have to learn computers, because I think the future--it was not there yet--but she said the future is going to be in the computer.
>
> Yeah, so I think that was huge, to have a woman that I admired, even though I had so many mentors, and I would not be anything if I didn't have people who influenced me. I was lucky. I was actually talking to my daughter, because she didn't have mentors, she felt, and we were thinking about how do these social platforms change, maybe, the idea of mentorship. Which would be really an interesting study to do. I had Eliane, but I also had male mentors: like Robert Ashley was a huge influence on me, and David Behrman even though I didn't really study with him that much. People just made me. I was just extremely lucky to encounter people who I really loved.[69]

Discussing the differences between cross-gender and same gender mentorship pairings, Laetitia's experiences closely followed with the findings of my research. Psychosocial support functions and alternate approaches to technology use were emphasized. Sonami also noted that, having experienced a same gender mentorship pairing, she did notice differences in later cross-gender pairings. The issue of affinity and role modeling was also raised.

[69] Laetitia Sonami, transcribed interview with author, March 14, 2015.

> In my experience working with men and women, it's very hard to generalize, but usually I've noticed that men are more interested in convincing you on the right way to do things. Women tend to have less of a mission, so there's more of an openness... I've found that through tech stuff... if you use a piece of software or a piece of technology in a certain way the engineer--if it's a guy--usually they'll say "well you're not using it the right way because this is how it has to be done because this is how it works," while I've found that women will usually be interested and more like "oh I hadn't thought of the system working that way, let me see if I can implement that." There's more curiosity; the system is less closed. So I think that, as far as for mentorship--[and] it's the same with like race and gender--you need to have people that are part of your group of people to make it feel like it is possible. It's like if you have only white people teaching, which is the case in many art schools, then people complain that there [are] no African Americans, you go well yeah, because there's nobody at the heads. There are no mentors. Even if they're not mentors, they're still role models. So I think that having a woman, even though I wasn't thinking it at the time... was special. I wasn't looking for one. I think that there was a certain generosity in allowing me to be what I needed to be, and I think that from what I hear and what I experienced later that it would be a little different with guys. Robert Ashley was totally like that. Ashley was not interested in having you do something. I think that a lot of people were like that [at Mills], were not interested in having you perform in a particular way. I've learned that it was really important, and now that I have [done] a few more workshops with women, I have a few that have continued in sound art. I'm trying to create more of a confidence. I'm interested in a way to see women do it, because first it's needed, and also because I'm a woman and I've experienced it and I feel more committed to encouraging women.[70]

Hutchinson also experienced a same gender mentorship pairing in her relationship with Pauline Oliveros at UC San Diego. Hutchinson and I spoke at length about the importance of emotional intelligence, empathy, and social connection.

> I didn't realize at the time, I was so lucky, I didn't even know what a mentor was until I had one, and how lucky that is. I guess guys have lots of mentors, but women have few… Because in a way, I mean at first, not even realizing that you have a mentor because there's so much connection and similarity in the really important things that you need to be supported in. It's not like a conscious act of support; it feels really different. You can start somewhere much further along… It's so fluid... Sharing personal things is very intimate, and when you are in that really intimate and vulnerable space, that's kind of the most sacred and special place to come from, creatively and in every other way. To be able to go there. And you just don't go there as easily with a man with that… Then comfort level is

[70] Laetitia Sonami, transcribed interview with author, March 14, 2015.

> the other thing about it. So you know, you figure that out and you just don't go there with those people. With anybody, male or female.[71]

Sonami, Psarra, and Hutchinson all mentioned work with male mentors. Psarra mentioned her mentor, Jamie Munárriz, and Sonami mentioned Robert Ashley and Behrman, but neither elaborated on those connections. Hutchinson spoke about her work with Allen Strange, with whom she traded babysitting for electronics lessons.

Academic and educational institutions face a number of challenges in terms of gender and technological engagement. Gender based attributions of ability and effort driven by cultural stereotypes relating to gender and technological competence perpetuate and reinforce prescriptive gender roles. Acknowledging and dismantling gendered stereotypes and their impact is vital to supporting the involvement of women in electronic instrument design. The development of formal mentorship programs within academic institutions would also provide crucial support to these individuals.

VI.

Section III: Resource and Community Access

Access to the tools, information, and support necessary to persevere and succeed in the field of electronic instrument design has historically been largely confined to institutions possessing social and economic resources unavailable to groups or individuals working outside of institutions. Institutions, in the scope of this research, include academic institutions, corporations, and private research facilities funded in corporate or government interest, while "deinstitutionalized" refers to collectively run

[71] Brenda Hutchinson, transcribed phone interview with author, January 31, 2015.

spaces, non-profits, public spaces, cyberspaces, member based spaces and individual practices not generally privy to corporate or government interest. Access is either public or private. Institutional access to music technology resources is often unattainable, making it difficult for many individuals interested in electronic instrument design to effectively begin or advance their practice. Social and financial barriers limiting women's access to higher education and other forms of institutional access remain an important consideration in supporting individuals in this discipline.

Many of the resources utilized in the design and construction process--including information, mentorship, electronic components, computers, microcontrollers, prototyping tools, electronic test equipment, and manufacturing processes--are becoming increasingly affordable and widely accessible. The recent proliferation of Maker Culture has also resulted in an increase in public or membership accessible workspaces--such as TechShop[72] and other locally run hacker and maker spaces--often possessing material resources and financial support beyond the reach of an individual. These spaces are open to the public, and the inclusion of workshops and learning opportunities in their execution make them appealing to individuals of all skill levels. Many maker spaces also host "ladies night" in hopes of providing a safe space for women to engage with technology, hacking, and maker culture.

Online spaces dedicated to the discussion of music technology present persistent challenges for women as they are consistently male-dominated and exhibit a veritable layer-cake of hostile and benevolent sexism. The potential appropriation of various elements of cyberfeminism in pursuit of safe and supportive online spaces is a worthy

[72] TechShop are member-based workspaces and prototyping labs that offer classes, tool, and space access for a monthly or annual fee.

pursuit. The term 'Cyberfeminism' has been used to describe contemporary feminist philosophies specifically interested in technology, cyberspace, digital networks, and the Internet. Australian media art collective VNS Matrix (Venus Matrix) was among the first to adopt the term "cyberfeminist" in their 1991 work, *Cyberfeminist Manifesto for the 21st Century,* to describe the work and ethos of feminists interested in subverting, exploiting, and critiquing emergent Internet cyberculture and cyberspaces.[73] Networked Feminism, which takes advantage of more advanced, accessible, and widely distributed forms of online communication and social media to empower and mobilize feminists on a global scale, is considered to be an offspring of the Cyberfeminist movement.[74]

Cyberfeminist theory embraced the utopian view of cyberspace and the Internet as a means of emancipation from social constructs of gender and sex difference, viewing technology as a means for the dissolution of essentialist constructs of the body and of incorporating or augmenting the corporeal form with machines. Donna Haraway's 'A Cyborg Manifesto' elaborates on the possibilities of the cyborg.

> The cyborg is a creature in a post-gender world; it has no truck with bisexuality, pre-oedipal symbiosis, unalienated labor, or other seductions to organic wholeness through a final appropriation of all the powers of the parts into a higher unity.[75]

In contemporary cyber and Internet culture, this utopian dream of a cyborg existing and acting beyond the social constraints of gender has largely been shattered.

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[73] VNS Matrix, Cyberfeminist Manifesto for the 21st Century, *Sternek.net,* 1991, <http://www.sterneck.net/cyber/vns-matrix/index.php/> (20 April 2015).
[74] Susanna Paasonen, "Revisiting Cyberfeminism," *Communications* 36 (2011): 335-352.

[75] Haraway, "A Cyborg Manifesto: Science Technology and Socialist-Feminism in the Late Twentieth Century," 292.

The unspoken tendency of early Cyberfeminist rhetoric to uncritically embrace certain aspects of technological determinism--namely that technology and more specifically cyberspace held the potential for empowerment of all users.

There are a number of forum-based online communities that revolve around music technology. The largest of these communities are MuffWiggler, GearSlutz, and Electro-Music. Demographic information is not available from these communities so it is impossible to accurately determine the gender distribution of their membership. Forum content serves as the best possible means of estimating how many women or non-men are involved.

Apart from somewhat eyebrow raising names, the general culture of the forums reflect their male and largely heteronormative user base, with a smattering of photos of nude or near nude female bodies, the tendency toward reducing female electronic artists to "synth babes" and commenting on their physical appearance in an objectifying or derogatory manner, innuendo, and outright misogyny. The fetishization and sexualization of gear and technological artifacts, apparent in frequent threads calling for members to "show us your racks" or for the sharing and discussion of "gear porn" also reveals a great deal about the social status and cultural norms relevant to users.[76] Another telling trend is the occasional thread topic along the lines of "any women on here?" or "where are the modular ladies?" which inspires responses from befuddled, dismissive, to intentionally offensive.

[76] Allen Farmelo, Show Us Your Racks!--The Sexualization of Audio Gear as Exclusionary Ritual, *Pink Noise Magazine,* 26 October 2014, <http://pinknoisemag.com/essays/show-us-your-racks/> (20 April 2015).

There is also the concept of "outing" yourself as a woman on the forum, which many members acknowledge as a calculated risk. Backlash is generally swift when concerns or complaints are raised about the male-centric nature of the forums, and the user in question is subject to all measure of ire, the most common advice being, "It's a very, very big Internet, and there's lots of other places they can spend their time." [77] This dismissive advice would be innocuous were it not obvious that most online spaces dedicated to music technology discussion are largely male dominated and generally centered on the interests of heterosexual men.

These online music technology spaces, while problematic in many ways, have the potential to be incredible resources for individuals interested in DIY electronics, and in connecting with other passionate individuals and artists involved in electronic music. The myriad sections of these forums offer everything from free schematics to lively discussion of the latest and greatest music technologies. Online spaces are especially useful for individuals unable (financially, geographically, socially) to access academia or other institutions possessing the resources and support necessary to pursue an interest or practice in music technology. When speaking with individuals in interviews about online forums, most reported that they were either unaware of, or did not use online music technology spaces. Lori Napoleon was the only individual I interviewed that mentioned using an online music technology forum, electro-music.com, for research supporting her practice.

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[77] Asha Tamirisa, Muff Wiggler: Sexism in Audio Cultures, *bluestockings Magazine,* 17 April 2014, <http://bluestockingsmag.com/2014/04/17/muff-wiggler-sexism-in-audio-cultures/> (10 January 2015).

> I did quite a bit of research on electro-music.com and also went to one of their conferences to learn more. At this time I spoke to everyone I could about my project and how I should go about doing it, and brought all these stacks of paper with schematics... The decisions I made when first designing my own modular system were inspired by a very percussive patch I saw during a demo at the Electro-Music conference. A musician named Kevin Kissinger demonstrated a very percussive noise patch that I wanted to recreate at home.[78]

The reason for this lack of female participation on online music technology forums is multifaceted, and more research is necessary in order to decipher elements which may encourage women to become beneficially involved in online music technology communities.

As maker culture proliferates, a number of collectively run electronics and maker spaces separate from any formal institutions have emerged. Though not solely focused on music technology, these spaces provide access to electronics components, tools, and learning materials useful in the process of electronic instrument design. Deinstitutionalized access to learning opportunities is also crucial to supporting individuals interested in electronic instrument design and music technology. Many collectively run, public, and member based workshop spaces host workshops on a wide range of subjects relating to music technology. Other organizations, like Women's Audio Mission (WAM) and Women Who Code, provide gender specific learning opportunities for women interested in audio and music technology and computer science. Women's Audio Mission, based in San Francisco, offers a number of workshops centering on audio engineering, DIY electronics, and music technology. These workshops are generally free to members of the organization (membership is contingent upon a nominal yearly fee and provides access to conferences, a job and internship board, workshops, and online

[78] Lori Napoleon, email correspondence with author, March 17, 2015.

learning tools). WAM also hosts and teaches workshops for middle school aged girls. Women Who Code offers a variety of free workshops and study groups in most major cities. Although these workshops do not focus specifically on music technology, software development and application design are useful skills in pursuit of contemporary electronic instrument design. Further development of workshops centering on audio and DSP coding are relevant to increasing access for women in electronic instrument design.

Conclusion:

Much work is still necessary in order to increase and encourage participation of women in electronic instrument design. Through this research, I have discerned a number of directions in which I may continue to investigate. Further research is needed on the subjects of designing supportive online music technology communities, formal mentorship programs in support of individuals interested in music technology and instrument design, creating and managing public and member-based work spaces and workshops with specific emphasis on music technology and gender, feminist musicology and technological determinism, and on the efficacy of incremental theory in music technology curriculums. From interviews with practicing instrument designers and research on feminist musicology, technology, and gender I have determined a number of sociological factors that serve to either support or inhibit the participation of women in electronic instrument design and music technology. Persistent acceptance of technological determinism, particularly in the disciplines of cyberfeminism, feminist

musicology, and STEM advocacy continues to limit the advancement of women in the field.

In addition, wider cultural issues of sexism, both in physical and cyberspace, must also be addressed in the context of contemporary music technology and audio culture. Encouraging research on the benefits of mentorship, role models, and incremental intelligence theory provide opportunities for development in institutional settings. Further examination and documentation of electronic instrument design practices through the lens of social construction of technology (SCOT) in the context of feminist musicology will also serve to acknowledge achievement and develop discourse around alternative approaches to electronic instrument design.

Appendices:

Appendix A:
Brenda Hutchinson:

Brenda Hutchinson is a sound artist, composer, and educator whose work centers on the cultivation of public engagement. She currently lectures and teaches an introduction to electronic music course at San Mateo Community College in San Mateo, CA. Her instruments include the Long Tube Instrument, a 9.5-foot tube outfitted with various sensors to control parameters in Max MSP as sound is vocalized into the resonant cavity of the tube, and a generative sound application for iPhone entitled 'SoundDrawing', intended to assist individuals with memory and cognitive impairment.

Brenda Hutchinson, transcribed phone correspondence with author, January 30, 2015.

Brenda Hutchinson: The questions were so specific as far as they related to the technology, and really my interest or engagement has not been that, like I've made things, but really what's important to me is all the social issues around it. All these other things. So for me it was just a tool, one I really enjoy working with and have always worked with, but have never really been that interested in creating technology, or creating something else from technology. It's always been more for some other fundamental issues about human beings. But even going through your questions I ended up going in that direction.

Chloe Stamper: Well that's good. The questions were really intentionally neutral as far as socially or gender. That was intentional.

B: You don't want to lead people somewhere.

C: People get upset.

B: I would imagine you're going to end up in all these other places anyway. I mean, I also teach a course, an intro course to electronic music, and it's like, I thought you know, it takes so long, I thought you know I used to be the only one, and now there's maybe two or three, or four if you're lucky. But it's like, I thought we'd be way past this by now. You know what I mean? I'm so discouraged and disgusted, but on the other hand it's like well there are a few.

C: It's a small handful.

B: It took three generations. Three generations of women to get women the right to vote, and the only reason that it happened is that there was such strong continuity from generation to generation. Otherwise you have to start all over again with every generation. So I don't know, I don't know this is going to work out.

C: Yeah. I've definitely been frustrated with it too. And there's this disconnect between generations. I've talked with Pauline Oliveros a few times about the issue of gender in music tech and she used to be a really big advocate, but now she's just like it's not a big deal, whatever. And you're just like, uh, it's still a big deal.

B: Well and she is a generation before me. She's entered another phase of her life too. So in a way, more important for her, she's looking at age, and legacy, and all this other stuff. She's able to use her position of prominence and influence as a way to-- she doesn't have to talk about those things-- she can enter that world with the upper hand and just move from there. That's a position of power that not a lot of women ever really get access to. Like, last Indian standing, like if you last long enough, you might get there. But that's really hard.

C: Yeah, definitely. It's hard to be a woman in her 20's and you're the only woman in the room in a lot of these spaces and you get this imposter syndrome, like am I only here because of my gender, because I'm an anomaly.

B: You know what, like in the 80's there was a little tiny period where funding opened up for women, people of color, this and that. I had that thought for about five seconds, and I thought, you know what, I don't care! I'll take it. I'll take it however I can get it because I need it, I can use it, and I deserve it. So don't even think about it, however it comes to you, you're totally deserving of it, and you're going to do something that only you can do.

C: Yeah. I've just encountered that viewpoint so many times from people, of just like this frustration. Then there's this other generation of people who came before us, and some people are very strongly saying, yes it's a problem still, and others are like, well we've come so far, so why are we still talking about this? And it's like, if we stop talking about it, what's going to happen?

B: Nothing is going to happen. I don't know, "we've come so far", I don't know who says that in relation to what, but from my viewpoint, yeah we have come far in a lot of ways, but not far enough. Not far enough for the amount of time it's taken. I'm 60 years old now; I thought we'd be well beyond this.

C: At least equal anyway.

B: You know what the thing you can do now, and I do it automatically, I just can't help it. Anytime there's any kind of awards or anything like that I'm always counting, how many men, how many women, and it's like, when there's some parity of it, you think okay this is interesting, and the ones that are way out, now you can actually say something about it, it's like hey, there's something wrong with this picture and it's your fault, you're not looking in the right places. Before you could never say anything like that, so that's something.

C: That's a good start.

B: That's a good start. People do say things. Mostly women say things.

C: I've had a number of mentors over the years and many of them have been men, which is interesting because they want to help in a lot of ways but they don't know how, and in trying they just kind of undo themselves.

B: They can do what they can do and it's up to you to figure out what it is they can help you with. I was just talking to somebody about this; I'm dealing right now with an elderly parent. That's the way it is. I've been in New York now, I'm here for an indeterminate amount of time because the whole thing just kind of blew up and accelerated. I'm happy with it, I'm happy to spend this time with my father. However, there's really no one to talk to about it, and I was thinking, you know, my husband, I would like to talk to him about it, but he can't. All I want is for someone to understand what I'm feeling, what I'm going through, and some of the issues that are involved, and the cognitive and emotional navigation that you have to do with it. This is like Twilight Zone reality here. And it's like, he would be able to give me advice, tell me what I'm doing wrong or right, nuts and bolts kind of stuff, and it's like, I don't need that, that's not what I want. Really, the people that I think of that I could talk to about it, they're all women, because women do this, this is what we do. It's part of the world, and guys mostly have never had to, so they don't. It's a more sure bet that you're going to find a community of women that you can actually discuss these things as they are; very complex, high level discussion, you know what I mean? So, you go with men with what they know how to do, and then you go elsewhere for the other stuff.

C: There's just this disconnect of emotional intelligence there.

B: So there was a time, when I first started studying music. There was like this whole of program notes, that everything needs to stand on its own. And it was like, I'm sorry, but you need to be very explicit about it, this needs to be part of the conversation. So that's another area where I find, like the idea that things should be abstract, and the whole issue of subjectivity. I feel like that's something that's moved more into the conversation, and you cannot insist anymore that the only valid thing is the abstract thing. That's not even an argument anymore.

C: Certainly not, maybe in very small circles.

B: Right, and that used to be the status quo. So there's been change, in that way.

C: It's an interesting time be in academia as a student, because there's this older generation of people that are teaching now that are kind of the originators of this technology that we are working with and a lot of the craft that we are practicing. So it's interesting to have their perspective along with very outspoken peers. The number of women in the department at Mills is pretty small; I think there are three of us right now.

B: It's a women's college! I find that amazing.

C: Isn't that absurd? The Electronic Music program is something like twenty men and three women.

B: Do you remember, what's his name, I really like him, Allan something. I'll think of his name in a minute, but anyway they had him there and he was teaching the history of women in music, and I thought, are you serious, you can't find a woman to teach that course at Mills College? It's a funny little blip of a mindset. I really liked him, and I liked him, but I thought…

C: It's not that hard, is it? I read an article recently kind of relating to what you were saying about taking care of your father. It was about 'Maker's Spaces', it was written by a woman, she was talking about how she doesn't identify as a maker because a lot of the things she does revolve around caretaking and emotional connections and social connections and not the physical.

B: Who was the person?

C: I don't recall the name. I'd have to look it up. But it was an interesting thing, because she was like, there's this whole technoculture that people are engaging in in these spaces that I don't feel my contributions are valued because the ways that I am socialized to be don't fit with this culture.

B: Well part of it, it's not only that it doesn't fit, but it's so ephemeral in a way, that people don't see it. That you don't even recognize it. You don't realize what you are an expert in.

C: Yeah, it's just kind of underlying everything.

B: Yeah but it's like, all the stuff of social practice and the relational aesthetics, and all of those things that have sort of branched out since the 80s have sort of led to more visibility for work that focuses on relationships and connections. Even those sorts of things are still pretty heavily object based, it's still a recognized field of activity now. So did you want to go through the questions at all?

C: Yeah, we could go through the questions, I feel like the ensuing questions maybe could be more useful, but we could see where it goes. I'm definitely interested in the education aspect of it, and your roots, and how you got started with music technology and who you've used it.

B: Okay, yeah.

C: What is your background in music technology?

B: Well, for me, I got little plastic Sony reel to reel recorder from Santa Claus when I was like five. That was it for me. I used to go in the bathroom and just record stuff, and it had a really crappy little microphone so it distorted everything you record. So I would make up games, like can you identify this sound? If you hung the microphone in the toilet bowl, it was all metallic sounding, remember I was five years old, so it was like oh this is a goat kicking through a junkyard. Or I would tell stories, like I would turn the water on in the sink, and I would knock the microphone against the side of the sink and then I would say like "one dark stormy night", cause it would sound like a horse going on cobblestones through puddles. My beginnings were with recorded sound. I have always loved just sound in the world. I played the piano and the violin and all, but when it came time to go to college, the only way you could really study the aesthetic side of recorded sound was to go into music. So I did. I didn't really want to go into engineering. So I went to an undergraduate school at Carnegie Mellon and then I went to UC San Diego for graduate school, that's where I met Pauline. So when you talked about mentors, I didn't realize at the time, I was so lucky, I didn't even know what a mentor was until I had one, and how lucky that is. I guess guys have lots of mentors, but women have few.

C: Yeah, and I feel like having a female mentor, as a woman is something that's really valuable It doesn't happen often but it can be really life changing.

B: Yes! Yes. Because in a way, I mean at first, not even realizing that you have a mentor because there's so much connection and similarity in the really important things that you need to be supported in. It's not like a conscious act of support, it feels really different. You can start somewhere much further along.

C: It's an interesting thing. My first audio engineering teacher was a woman, and that was really great, and then after I had a series of men that I was working with. It's such a different experience. Not to generalize. Then coming to Mills was really nice because I've worked with Maggi a lot. It's just nice, we can go from talking about Filters and the various assets of different filters and then go immediately from that to like talking about our childhoods.

B: It's so fluid. I was talking about personal, sharing personal things is very intimate, and when you are in that really intimate and vulnerable space, that's kind of the most sacred and special place to come from, creatively and in every other way. To be able go there. And you just don't go there as easily with a man with that.

C: I mean I've had male advisors at Mills and I've definitely cried in front of them. I had Chris Brown as an advisor for a while and I cried in front of him for some reason, and he just didn't know what to do. He just kind of stood there. There's definitely men that have a higher degree of emotional intelligence, but for the most part, most men just aren't socialized or raised in a way that allows them to explore that side of themselves.

B: Then comfort level is the other thing about it. So you know, you figure that out and you just don't go there with those people. With anybody, male or female. You know it's your education and it's your life, you can be in charge of how that works.

C: It's a weird thing.

B: It's a lifelong thing. It's an interesting thing. You know, I had a neighbor, I live in the Sunset when I am in San Francisco, and when I first moved into my house, my neighbor next door, our house was in terrible shape and we had to fix it up, so like the outside of the house was the last thing we were going to get to. And my neighbor came and she knocked on the door and she said you know everyone on the street is complaining about how horrible your house looks. She says, I'll help you, we had these two bushes in front, she says I'll help you; we can trim your bushes. So I'm like okay, alright, and I'm working and I look over and she had chopped that bush within and inch of its life, to little stubs, and I was so appalled, and I was so upset. And then I thought, you know what, this is my neighbor, if you can't along with your neighbors, how are people going to get along? Like wars and stuff, really, that's what I thought of instead of strangling her. And I worked at it. You know? It's so true; you have to navigate all that stuff. You have to make it work.

C: That's something that I encounter in music technology spaces a lot, there's just this kind of social ineptitude that is really frustrating to deal with. Like if a confrontation arises, no one will do anything about it for a very long time until it just fester into this weird thing.

B: I know!!!

C: They just get away with it! They're just like, well I just don't know how to deal with this, and it's like, you have to figure it out.

B: The avoidance of confrontation, and it's like, you know confrontation, and I don't even think of some of the things that people think of as confrontation as confrontation, I think of it as problem solving. But some people will go to great lengths to avoid entering that space. That's another thing.

C: Oh, you cut out...

B: Oh, Darren emailed me today! I told him I'd say hello.

C: Yeah he's in Europe.

B: He's in Rome. Yeah Darren is a special guy, he's in a whole other league.

C: He really is. I go and hang out with him and work on Buchla stuff sometimes, which is a real treat, for a poor grad student it's really exciting to get to touch really cool synthesizers.

B: Oh that's so good!

C: Yeah he's a good friend of one of my professors up at Evergreen, Peter, and that's how I met Darren.

Evergreen was an interesting place too, it was a similar demographic, maybe even more of the audiobro culture up there, which was interesting to me. It was just kind of a saturated program. I think I was the only woman in my year. Then I came to Mills and I was like oh my god it's going to be so amazing it will be so different and then I was just like, oh, nevermind. It's not.

B: Oh! But the bay area is a really good place, there's a lot of really interesting women doing things there with music technology. So as far as the community goes it's wonderful.

C: Yeah! Then there's the composition and the performance programs as well, so we all kind of band together, and for the most part, the men that are in the program are really great and they understand where we are coming from when we get frustrated.

B: I've noticed that in the children of women in my generation, the men are different than the men of our peers.

C: It's a slow progression. Masculinity can be such a toxic thing. Just this hyper-masculinity that's constantly reinforced, especially by American culture. It's so limiting, in what you are able to express, so it's nice to see it changing and breaking down a little bit.

B: Although I just saw a thing, probably on Facebook, and it was international mandatory lengths of time for women to have maternity leave, and the United States was zero. Zero! Somewhere in Scandinavia was like three years. It came up in conversation with my father and he's like, yeah that's right! You're gonna have a baby you should just get on with it, it's like oh for god's sake, and remember he has dementia. But still, you know, come on! Zero! Absolute zero. So that's the culture we live in. It's a militaristic, fascist, crazy; you know that kind of dominating thought.

C: It's disturbing to see. It's not hard to see where it comes from; it's hard to undo it, more than anything. That's the frustrating part is trying to figure out how to change it.
B: Sort of what I've come to is you just change your thing and you be really clear about it and you just do it. As artists, we're not social workers, we're not politicians. We have special ways that we look at things and things that we can do and we just need to get really good at it.

C: A lot of the reading that I've been doing has been on gender and technology. Electronic music and music technology and instrument design kind of exists at this intersection of Technology and Art, which is a weird intersection for a lot of women to exist in because there's a lot working against you. There's stereotypes working against you, maybe even more than if you were just on one side or the other. That's something I've been starting to put together.

B: Well it depends which kind of technology you're interested in. As someone who has always been interested in a very primary way in real sounds, sounds coming as they exist in the world. Then once you start recording people then you have all these other things to consider having to do with permission and how much do you engage with what you're actually doing. If you follow that it leads to all this other stuff that really is part of that conversation.

C: That doesn't always get acknowledged.

B: No. So like 1996, that's like 20 years ago, that's when I drove my piano around the country. Someone had asked me to write a piano piece, and I thought well, this is what I'd like to do; I'd like to hear what other people have to say about their experiences with the piano. So I got my piano, I put it in a U-Haul and I drove around the country and I asked people to play my piano and tell me piano stories. Almost universally across the board for the first 1000 miles, people were like no, no thank you, nobody wanted to do it, and I thought well, this is a problem but it's also really interesting. Because, why don't people want to, what is this knee jerk reaction, and how do you create a little space or a moment where people will stop long enough to engage. Ever since then, that's sort of where my work with technology has led me. It's not an area that has much to with technology in terms of engagement but I would have never gotten here had it not been for that work.

C: Well the piano is such a fraught instrument, socially. I feel like it's a starting and ending point for a lot of people with music. Because you've got this intersection of effort and ability that can be really frustrating for people. They feel like oh I'm just not good at this, and the more effort you put in, it's like, well I'm trying really hard because I'm not good at this. It's this whole fixed intelligence model that's part of our education system, especially music education. It's starting to break down.

B: Well I would hope! Because it's really about practice, and the value of practice, that goes beyond music. It's so much of what makes things possible is the adoption of a practice. Of maintenance. Just doing things a little bit at a time, over and over and over again. The idea that it doesn't require some enormous effort, a once in a lifetime effort, but you can achieve just about anything if you just do a little bit at a time. That would be a better approach as a pedagogical thing of teaching someone how to do something. It's not based on ability at all, it's all effort, and in fact that's the thing that unites us all. Of course people have different abilities, but like, if the piano isn't your thing all that practice is going to hold you in good stead for something that you do accel in or that you really love.

C: And the piano, I see so many people that are just afraid to even go near it.

B: I know! People would sit down to play and their hands would shake, and I was like, oh god I'm really sorry. I'm sorry that I'm the instrument of this sort of anxiety but it's amazing how deep it runs.

C: It's across generations too. It would be easy to think that people today just have technology that gives them instant gratification, but with the piano it's such a cross generational thing. So many people of all ages have this trauma around music making.

B: Well they get you when you're a child! You're so vulnerable.

C: You've got the cross piano teacher smacking a ruler down or something.

B: Not me! Oh god, that would be horrible.

C: I got lucky. I would say that anyone who stayed in music probably got lucky and had at least one good teacher that really didn't teach in that traumatizing way.

B: Or you just had enough of a passion that you just kept at it.

C: Okay, moving forward. Have you ever built an electronics kit?

B: I did once for fun. Allen Strange who wrote like the first book, that's part of why I came out to California in the first place, is I thought I would like to study with him. I did it in exchange for babysitting. In exchange for babysitting I would get free lessons with Allen, and he gave me some kind of electronic kit for my birthday one year, I don't even remember what it was, it might have lit up and put out a few bleep bleep sounds.

I also worked at Atari, for a very short period of time. On the Atari factory line when they made the first home Pong games. I got hired to solder pots and it was so boring. I found out that they had a rework department at the end of the line where they would fix games that were broken. So I said I knew how to do that-- but I didn't really know how to do it, not at all. So I went back there. You had a little monitor and it had like sixteen paddles and eight balls and I'd say to the guy next to me oh look at this, have you seen this before? And he'd be like oh yeah that's this part of the board and he'd show me. All I could really do was fix cold solder joints or pull components out, I couldn't really do anything and I certainly couldn't dive nose anything. So I got fired after like three days. Everybody else could do a lot of games; I'd do three games on an eight-hour shift and think I was doing really well. But I remember, I wanted to take the job, because you know, on the resistors, the color coding on resistors, that the saying had something to do with like raping Violet. Do you remember that? The colors. It was a saying about, duh duh duh rape Violet. I thought, that is so disgusting, that I thought, I wanted to learn the color coding on resistors in a way that didn't involve that saying. I still don't remember it.

C: Thank goodness that's not normalized anymore!

B: See! Some things change.

C: That's a good change. I don't think we would tolerate that now, by any means.

B: That was the thing. That was just how it was. Nobody gave it a second thought, even though it was so horrible. And you were supposed to, as a women then, you were supposed to memorize that.

C: And just internalize that idea.

B: Not quite the same as "Every Good Boy Does Fine".

C: Quite. I'm glad that didn't stick. Okay, code languages…

B: Any code languages. When I came out to study with Allen Strange I also knew there was a computer music course at Stanford, and I wanted to take it, and I got here too late to take it the first year. So I took it the next year, and it was the last year before they went real-time. I can't remember what we did, but I think it was like C or C++ or some language like that, and it's just a vague memory now. You know, you'd write and write and write and write and then you'd leave and then the next day you'd hear like bleep bleep bleep. It was just like, oh god; this is just not a good use of my time.

C: We've come a long way since then, at least in computer music, thank god. I don't think anyone would do it if it was still that way. Except… people who had time for that sort of thing.

B: And people who had access to that! That was a really kind of defining moment for me, you know I realized that, well I could beat my head against the wall and try to gain access to the few places in the world that had these kind of facilities and really powerful computers, like IRCAM or Stanford or MIT, and if I was lucky I'd get there once in awhile. Or I could just figure out something else to do that I had access to and make that the stuff that I would make my work about. And I thought well what I have is my everyday life, so that really was a turning point for me. It was because of the challenge of getting access to those male bastions.

C: Even if you can get access to the resources, actually educating yourself about them is such a challenging and frustrating process. You need to have at least some form of institutional access in order to really utilize that stuff.

B: That's right. Well STEIM, you know about STEIM. Same thing. They say yeah come on, but we only have one or two people here and they're too busy to help you. It's like, well then what's the point.

C: Exactly. It's like, I can't use any of this stuff, I don't know how, and there are no resources here to really teach me. There seems to be this intentional mystification around some technologies. It's just like, well you can use this but I'm not going to tell you how, I'm not going to explain how this even works to you, I don't have time, you can figure it out.

B: You're right. That is a model that's still in existence.

C: It's starting to change now. There's more information available online now which is really great. Kind of the processes of working with technology are being broken down into pieces that are palatable for people who have never worked with it. That's encouraging to see. It's becoming decentralized, it's deinstitutionalized, you don't have to have access to an institution because the technology is now accessible financially, and resources to back it up are available to you.

B: And there are many communities.

C: That's a really great thing. I think that if that continues, things will change, hopefully faster.

B: There's an anonymity as well, with online. Which is great, it's not even a factor.

C: The preachings of cyberfeminism at its very best. I think that gender still does assert itself online, especially in music technology spaces. I'm a member on a couple of different forums and it's kind of this frat boy humor that you encounter a lot, it's sort of repugnant. It's like why are you saying this awful thing where people can see it, and people sort of know who you are and now know you have said this awful thing.

B: People forget. It's like driving a car. You're actually hurling down the road super fast in this big giant heavy killing machine and you just feel like you're sitting in your living room. There's a disconnect.

C: Yeah, and the anonymity of it. Nobody can see your face unless you choose to present your face, so you can kind of move unseen in a lot of ways. Which is a beautiful thing and a dangerous power to give someone. Like, now you can say awful things and no one will know! It's like, no, it still hurts people. That's something that I feel like will change over time. The Internet is such a weird place right now. I don't know if you've been following the whole 'GamerGate' thing, that's the less encouraging part.

B: 'GamerGate'? Let me write that down.

C: Oh prepare to be afraid!

B: I love how all these scandals are always 'Something-Gate'.

C: Yeah after Watergate.

B: I love it!

C: It's pretty lovely. Something culturally stuck in our minds. It's just these women speaking out about misogyny in gaming culture, and they just get proven right over and over again. Like they say, hey maybe we shouldn't have sex workers being killed in

whatever game because it's awful. Then there's a bunch of these GamerGate people who are like, no you're wrong, and now I am going to harass you, and expose all your personal information, and threaten to bomb your events. It's just like, okay, you proved them right. Good job.

B: You know I went for a job interview, a really long time ago at Atari when the only tools you had for creating sound were like four oscillators. So you could use them as like FM or AM so it was really pretty primitive. And a woman, who worked on Sesame Street, Mayer, Nancy Mayer or something, interviewed me. Anyway, they described this game to me, and it was about catching an Indian Squaw, and pursuing her and tracking her down and then eventually raping… I don't know. And I was like, is this for real? Is this for real? They were like, what kind of sounds would you use? I just didn't really know how to react, and so after the interview I wrote to them and said, that was appalling, were you really serious? So I'm really surprised at what you just said that these things are still concepts, that people are feeding energy into.

C: Yeah. Now it's like this incredibly graphic violence. I used to play video games back in grade school and college, and then at a certain point I said I can't deal with this anymore. The groups of people that I was hanging out with, the culture around, all of the games that I had access to. It became a thing of, "this isn't fun."

B: No. I worked for this company one time. It was when Xerox Park had a ton of money, and they decided at one point, actually for research, they wanted to create a project. So they made an offshoot company called 'Purple Moon' and Brenda Laurel was in charge of it. And we were to develop games for girls, CD-ROM games for girls, this was like the mid-90s. So I was the sound designer for it. The thing was, we did all of this testing. It was like, alright, girls like to do things together. The target age of the games was like 7 to 11 year old girls, but the culture of game itself-- there were two games, one was an adventure game where you'd hunt stuff out and find things, and then the payoff would be a story. Then the other game was set in a Junior High School, so the age of the characters in the game was older than the target age of the girls who were playing the games. So they weren't totally realistic kinds of issues that Junior High School girls, they were more on the level of what the target audience was. But I remember at one point they did some kind of testing out in the Midwest so the girls would be in a room with two-way glass and people would observe them. And they decided that the main character, she was made to wear like striped socks, that she needed to have more conservative clothes to wear in the game. I thought, this is such a drag, this is *such* a drag. To make it marketable you still have to bow down to the lowest common denominator. However, the games were fun, and girls really did like to play them, and it was totally a different model than the games that were out there. Then Mattel bought it and buried it.

C: Technology use has always been kind of skewed masculine in a lot of the ways in the media. But there was this shift as gaming culture emerged, creating the stereotypical gamer in our culture. This isolated character that is kind of antisocial and likes to be by himself and doesn't always relate easily to others. Then they kind of clung to this stereotype that's not flattering at all.

B: No not at all. It's basically kind of a sociopath who sits at home and who engages with the world through online relationships rather than people.

C: That's such a false reality too.

B: I guess it's a good one to market to, if they're home all the time.

C: Yeah. It's interesting. Gaming culture today is such a weird thing. There's also some really creative game design happening. It's great, it's beautiful--kind of the art world and gaming coming together in new ways now that the graphics have progressed so much.

B: Yeah and sound!

C: I've found some games where the sound is absolutely incredible.

B: Isn't that nice?

C: It's nice! It's nice to create these really immersive sound worlds. You can achieve them through performance or recording, but to have something that interactive, that's a medium that has a lot of potential.

B: Yes! Yes. That was like your last question about a particular innovation in technology that exciting. For me it's, what is possible on the Internet? As a way to engage. It's really hard to document work where the core action is so ephemeral, like a relationship or a certain kind of intimate exchange, and the only way to really document it is to re-experience it. Or to re-enact it. So the Internet, it seems to me to be a place where you can do that. Where you can set these things up and once you experience something you can't unexperience it. I'm really excited by that. All I've done so far is create Facebook pages as repositories for things that happen and issue invitations for people to participate, and it's not very effective but that's as far as I've gotten in my thinking so far. That's for me the most exciting place for the kind of things that I'm interested in. Again, I'm a user, I'm not really a technological innovator, I'm more of a user and a synthesizer. Although, Max MSP would be the place where I actually put together anything.

C: I think Max is a really powerful tool. A lot of the people that I'm speaking to for this project also use Max. I use it too. It's just such an accessible way to work with technology. It's kind of limitless. What has your experience been working with Max?

B: I like it because you start out with-- you know it's like the building block thing-- my interest was in the long tube instrument. When I first started with the tube, I didn't want to use any electronics at all, because I thought it would obscure what was important to me and what was interesting about the tube, which was, anybody could do this, it's really these weird and interesting and unpredictable sounds. It's a bionic relationship between the user and piece of a tube. All you need is your attention and a tube, and you can change your life. I thought like, this is an amazing thing; everybody should want to be

able to do this. But after a few years of doing it I realized nobody really cares, nobody wants to do this, nobody is really interested. So then I thought, well I would like to have a more interesting performance situation for myself to improvise in. So then I started to add electronics. So the first thing I added was six little piezo disks that I just stuck on the tube, and some rolling block to trigger. Then I build a Max patch to store sounds to trigger them, and then I would sing into the tube and I would trigger these sounds. So I did that for a while. Then I thought, well, these two worlds are so separate, like what I'm actually doing in the tube and these sounds from the world that are coming in, so I built a little patch that would do record and playback buffers with tables of probability of when and how long it would record and then play something back. So I didn't really know what was going to happen so it was kind of a more fluid situation to play with. So I did that for a long time. Then I thought well it would be nice to have just a more elegant kind of interface. So I worked with Stephan Moore, he was at RPI for a while; he was also the music director for the Merce Cunningham dance company. He helped me use a basic stamp and force sensing resistors, you hold onto the tube and it has like four FSR's for continuous voltage control, and four switches that I can pattern like a trumpet and come up with sixteen different triggers. Like the binary thing that you use with four fingers. Then that hand also has a rotation sleeve that sits on the outside of the tube that has a rubber belt that turns a pot, so I can use that as well. The rotating pot would generally be assigned to like, pitch change, and certain things would be volume, and certain things would trigger certain buffers. So after awhile it was like learning to play the piano. I didn't have to think about it, I knew if I did certain things with certain fingers I would activate different parts of the patch. It just got more and more complicated; I just kept building on it. Honestly I go in there sometimes and I don't know how to fix something because I don't remember how I made it happen. I have to go back up to where I was just making that little piece.

C: I think that's true of most programming. You come back and you're like, wait what did I do?

B: Then you do that thing like Control+E and then you're like, oh I don't know! I don't know! It's a nest. It's sort of like the days of patch cords. Like you'd build your thing and you'd get it and then you sit back and you're like oh my god, I would never be able to recreate this. It's an interesting thing to realize. You work on something and then you sit back and realize you don't know how you got there, and it becomes something else.

C: It's so easy to get carried away in Max. It's infinite! Like, I'm going to make more things that do this and more things that do this to this!

B: Yeah! It doesn't fit on the screen anymore. It's like but I need access to all those things.

C: The only way I survive in Max is just a very complicated series of comments. Adding so many comments to everything that I do. It feels like it slows you down, but it helps so much when you come back and something is broken.

B: I color code things. I make different kinds of geometric shapes then color-code them, for different things so that I know where to look.

C: That makes a difference. It becomes such a nest.

B: And I have little prayers in my comments, I have little prayers all over the place.

C: Like, please work!

B: Ha. (Sigh)

C: I like Max, it's a really amazing piece of software.

B: It's amazing it's been around so long and it just continues to develop and be useful to people.

C: Well Cycling74 as an entity, they're not afraid to evolve their product to actually suit people's needs.

B: That's why they're still in business.

C: Yeah. It's not like Pro Tools or things like that where they're just like, no, we're making this, this is what you need. They actually listen to people. If people are like, "I wish I had an object that did this," they sometimes make that object. It's nice to have that kind of responsive product development. I think that's why it's such a special thing to work with.

B: Yeah! You know and there's so much stuff in there. The majority of stuff in there I'm never going to touch. Basically you have your things and you introduce new little things if they're tangential in some way, but most of the time you could spend your life in there and not even go very far.

C: There are so many possibilities. Everyone is going to use it in a different way, which is really wonderful.

B: Yeah! So, that Max MSP, the other instrument or interface is the 'Sound Drawing', the app. I worked on the app with Darren. But the app really came from a project I did called 'SoundTracks'. I developed that project in response to my friend Anne Chamberlain, she was a visual artist, she taught at the Art Institute, did a lot of public artwork, and she brain cancer. When it got to the point where her memory was only three seconds long, and she was a really good friend. She was always incredibly articulate and liked to discuss things. So it got to the point where you couldn't have a conversation. It was frustrating for a second, because I remember, we were sitting somewhere, we were on the beach and we were watching kites or something, and she was looking up and she was starting to say something about some kite. I'm looking up and I'm following what she says and then all of the sudden she stops speaking, and I looked at her, and she looked

really frustrated. But only for a second, and then it was gone. So I thought, well you know, if she can let it go I have to also. So I had to find a way. She liked to draw but she had always had a shake in her hand, and as she got older it just got more prominent. At one point she made these drawings, she called them her tremor drawings, she just tried to draw straight lines across a page and filled the page with parallel straight lines. But they were all shaky; they looked like seismographs. And I had said, these are so beautiful and they really remind me of sound, like you're looking at sound, we should do something with this. But we never did. So when she got to this, I thought about those. So what I did is I got one of those Wacom drawing tablets and I developed a patch in Max MSP that would track the motions of her hand, and what I did is I would record sounds, like if we were having tea, we would talk, and the tea kettle, just different things in our environment, I would record these different sounds then I'd break them up into smaller chunks and I would present them to her. Then she would select the ones that she liked, and then I would map these sounds onto the surface of the drawing tablet so that whenever she was in contact with the pen it was scrubbing through the sounds. It was wonderful. The amazing thing was, as soon as she touched the surface of the thing the sound would just grab her attention and she could focus. And she would draw for like an hour at a time. And the drawings are beautiful; they're like these line drawing maps of her attention. Eventually, Max, you have to dig in there awhile to find these little objects and you tell people and you tell people, and they tell you about other objects. So there was a multitrack tape recorder and you could record anything, so I could set her gestures as X, Y coordinates over time and then I could feed them back into the system and it would redraw the drawing. So it wasn't a movie it was more like a player piano, it was her actual movements being redone on the thing. And you could put in the same sounds or different sounds or whatever, so we made like 42 of these live interactive drawings. And you know, I thought this is so beneficial, and I tried, I talked at Stanford, I went to England, I went to some neuro-disability conference for music therapists and I went a lot of place to try to find other people who might be interested in using this in a therapeutic way, and people were just mildly interested. Because the Max MSP thing and computer, that's a clunky setup. Stanford people, it's like, it's not that interesting musically. You know what I mean? So then I contacted Darren, and said hey, what if we just made an app? What if we just figured out a version of this to make as an app and put it out there? 99 cents is nothing. So that's how that came out, the SoundDrawing thing. I realize that if I was young person starting out in this world, I would probably go make apps because I really like them, and they're fun. But I don't know how to do that. But Darren does, so we worked together on it for a long time. There are still things that I would like to do with it that it doesn't do that the original one did. But I've only sold like 70 of them. It has to be worthwhile. But I'd like to revisit it. That way people will look at it again, when you change it, whereas now it's just sitting there.

C: The app market is so saturated. It's interesting what sticks out to people. I haven't figured out the formula that seems to get people's attention, you're scrolling through all these little squares, so it's like, what sticks?

B: I was scrolling through someone's Ipad the other night that had a lot of different apps, and as I was scrolling I was thinking about that too. There were a certain few that caught

my attention and made me go, "oh I wonder what this is?" It was a combination of the name and icon. That's it.

C: I'm really obsessed with this site, Meetups. When I first moved I was going to a lot of meetups in the city. I go to the Women Who Code meetups, and they have app building workshops, and you start from the ground up. They're free and you get free pizza! It's awesome.

B: Oh! I'll have to do that when I get back, because I've got an idea for another app, which would be pretty simple because all the parts are already kind of out there.

C: Yeah, they are pretty cool. They have them all over the country, Women Who Code meetups, where women get together and learn or teach coding.

B: That would be so perfect! Like you said, you can't just do it yourself.

C: As someone who is just learning how to ask for help, it's such a good thing to realize early.

B: Yes. That's a good lesson.

C: It's a good lesson to learn fast. Otherwise you just struggle with yourself for a long time.

B: Yeah and you know what it never changes, we always need help. You just need to find people that are willing to help you. It's our job to do that, you know?

C: To make those connections. To ask for what you need.

B: Yeah! You've got to start somewhere. That's good. See, that's changed!

C: It's something that's deinstitutionalized, again, I think there's so much power in, well there's also power in academia and other institutions, but there's also power in people. People meeting together and sharing skills. I think that's going to change things a lot.

B: Totally! Yeah, that's a really big one.

C: Not just online. There's something so different about meeting in person.

B: Yeah. Being in a space. The physicality of it. That's the other big thing. As I've gotten more and more away from working with actual technology, and gotten more and more into the direct engagement part, I've realized that that's something that's become more and more important. As the sort of online, and all these virtual ways people can gather become more prominent, you need both. People forget how to do that. When I'm teaching-- I teach at San Mateo College--you look out there, people pull their phones out or they're on the computer and you're like, hello!? I'm here now, we're here now, are you serious?

C: It's so easy to not be present.

B: I think it's also an impression people have that they can multitask. There is really no such thing as that. Your brain just switches really quickly between things. So you end up doing lots of things but nothing very well in that moment. You missed stuff that you would be able to get by just concentrating and going very deeply into something. So I've noticed that. I stopped trying to multitask, I thought I was really good at multitasking but then I realized, wow, I really blew it, and I'm never going to do that again.

C: I definitely also have been coming to that realization. There was a time when I thought that I was really good at multitasking, and then I realized that I wasn't retaining anything that I was trying to absorb. I see it in a lot of my peers too. It seems like people feel incapable of stopping, like they have to look at their phone even when they're sitting in the library reading a book.

B: You're connected to this thing that's not even part of the space you are in.

C: Even if you're not looking at it, you're sitting there thinking about it, like oh I wonder what so and so is up to. It's not that important all the time, to be constantly connected.

B: And you've left the building. You've left the current place where you're at. Even if it's just for a second.

C: It is nice to have that sometimes, the ability to disconnect from the present moment. I'm on public transit a lot. That's a necessity in my life right now, and I get the creepy people that come up to me and try to talk to me. But if you look at your phone, even if you're just staring at the home screen, it's this instant barrier.

B: It used to be that people would have a book.

C: I wish I could do that instead. I can't read well in motion, motion sickness.

B: Me neither, but it was the same way to ward off unwanted attention.

C: Yeah. So, I don't know. I feel like people forget to take that wall down too often.

B: Well if that's what you practice then that's what you end up with. That becomes your habit. So it's really hard, you have to be vigilant.

C: That's definitely one of the dangers of technology that people are starting to acknowledge and think about. Like wait, maybe it isn't so great to constantly be connected on so many levels. I don't think our minds are really ready or ever will be suited to that sort of thing.

B: It's interesting though, because when you say to be connected, your minds are connected but your bodies are not. To do one to the exclusion of the other is ultimately

detrimental because we are physical beings. Public space has suffered enormously, real space, because people don't know how to act, you know? Unless you know the person, unless you know people, people don't know how to act with people that they don't know, or that they're not connected with. That's most of the world, really. So that's an important skill, to have, or to practice. Or to be sort of engaged with.

C: I think that the way things are going, if technology is going to be such a big part of our culture, we need to find ways to actually utilize it in a physical space to make new connections and to relate to people on new levels. That would actually be a useful function of technology.

B: Yes! And it goes back to the days when people would make tape pieces or you sit in the dark and you listen to something. There's a big difference between that and a live performance, or being a live performer. I made that shift as well, from just making sound things to then performing and then to improvising. It's like, those are all really different skillsets, and they all feed one another. It's really important to do them all.

C: It's important to have those skills and to be versatile with them. I think people forget to diversify.

B: Yeah you know you get something you like to do and that's what you want to do. But it's all related really, and I think it's good to be uncomfortable, actually.

C: Necessary discomfort.

B: Yes! If we do nothing else as human beings but grow, then that's a great goal. My sister just came into town to help with my dad, and I had been there for like a month. So you know that story about the frog jumps into boiling water it will hop right out but if you're in it you just go along with it. So my sister came, and the whole first day all she did was cry. I was just like oh I'm sorry, in a couple days you'll get used to this, but she says, I don't want this much personal growth! I don't want to do it now.

C: To jump into a situation like that is really challenging.

B: Any situation that makes you grow and change, generally it's uncomfortable and hard. But what else would you rather be doing?

C: What's the point otherwise? Stay the same and never progress in yourself?

B: Yeah, well especially for an artist. That should be an important thing.

C: Otherwise your work is just kind of static.

B: Well it speaks to less and less people as time goes on.

C: Hmm. Okay. Well I think we talked about your instrument design…

B: Yep, we talked about instruments; we talked about challenges, innovations. You know the one we didn't, you asked about mentors or role models…

C: Yeah, you talked a little bit about working with Pauline.

B: Yes, yes, Pauline. Definitely a lifetime mentor and supporter. John Cage for me was, when I first learned about John Cage in college, I was like wow. For me it was permission. Permission to do what I'd already been doing, and been interested in. Which was like sound in the world, and that that might be a viable thing for music. That was a huge thing. You know what I mean? Because I felt really isolated in terms of the things I was interested and in terms of being in music school. The other was Nellie Bly. I guess she was like the precursor to investigative reporters. She was always an inspiration to me. I actually did a two-year project at a psychiatric hospital, but I didn't want to be embedded or invisible, I wanted everything up front, that's always my thing, people should know and be willing participants. But she was definitely an inspirational person to me. The other one I thought of was this woman Merle Uchayles, and in the late 70s she had gone, she was a big artist, she had gone to like Barnard College or something. Then she graduated you know, got married, had a baby. Then she finds herself changing diapers and all this other stuff and she's like well what the hell was that expensive education for? Just the whole thing of the invisibility of people who do maintenance, and how crucial that stuff is to making the wheels go round. So one of her really early projects… well she did a couple things. One of the early pieces she did was she just scrubbed the sidewalks in SoHo in front of some place, and people would come out and give her rags and different things. So it was like the beginning of this socially engaged sort of feminist performance art-- that is largely absent from the conversation on socially engaged art. But then she did this project, and she's been doing this ever since now, working with the New York Department of Sanitation. She went around and she made a maintenance manifesto and then she personally shook the hand of every single sanitation worker in New York and had them sign the document, then gave them an award and acknowledgement of the work that they do. Then she worked with the department of sanitation. They had a mirrored garbage truck that went around, and then they figured out some whole new system for disposing of waste, and now she's working with the Staten Island landfill. She's an amazing person, and she's still active an artist. But I really like that early work that she did in terms of direct engagement and personal connection, and very direct action. So those would be the people I would mostly say have influenced me. That comes to mind right away. Or you know, they're the people you feel solidarity with, or you're crossing paths with them in some way.

C: That's interesting. The devaluation of maintenance work.

B: The invisibility. It's not even devaluation, it was like nonexistent.

C: People didn't consider it at all.

B: That's right, and the people who did the work were, because the work was not valued, and then the people themselves were not valued. You can find more of her stuff online.

C: I'll definitely look her up.

B: So I guess the last thing would be what I am working on now?

C: Yeah!

B: So I've started doing this project. Now I have started dating my projects by the inception date rather than the date they are completed. I have these ongoing projects that sort of evolve. I have two sort of active ones are 'What Can You Do?' I even made a little book called 'Reclaiming Public Space Through Direct Engagement With Strangers'. Basically I get a team of people and we go out and we all have tags, so you can see on the street that something's going on, and you work in a pair. So say you and I were to do it-- and I've done it in a lot of different places: Detroit, Golden Gate Park, in the Tenderloin, at the Exploratorium-- you go out and you just walk up to somebody and you ask them "What can you do?" and you want them to teach you something. One of you is the person who learns how to do it, and the other person is the witness. The witness is just the person there to hold that space and to acknowledge that it's going on, then by the way, since you're just the person standing around you can document it (draw a picture, write a poem, take a video, whatever). Then you just kind of keep moving on. You make it very clear because most people will say, "Oh, I can't do anything, I'm really boring." and you need to make it very clear that it's not about talent, you know? Everybody has something they can do. Once you approach somebody you cannot let them leave without showing something or else they'll be worse off than they were when they met you. Then you pass out cards, then after an hour and a half or so, everybody is invited to some area to share the stuff, everyone, the people that you meet, and the people that are doing it. And I really like doing this. The next place I'm going to do it is at Oberlin. Oberlin, I don't know if you, have you ever been there?

C: I have not.

B: So it's this really elite school in the middle of this very small town, and never the twain shall me. There's a definite sort of separation going on there. So I'm thinking this is the perfect piece to do in a place like that. To do it with the school and the town. So that's sort of the challenge in that situation that I'm just thinking about now.

The other piece that I do, it's called 'The Daily Bell', and it started in 2008, so this is like the seventh year? The thing is, you observe every sunrise and sunset and you find someone to share it with by ringing a bell, and you try to get other people to do it with you. So the first year I documented every single sunrise and sunset, and since then I've tried to find different ways to mark the passing of time and invite other people to do it. So I have a subscription, and the subscription is, you make the contribution. You document. You can sign up for daily, weekly, monthly, intermittent whatever. I had some people sign on like they were going to do it but nobody has really done anything. But I created a blog; I've added it to the Facebook page. I really like… I'm at a block and a standstill, and I'm like okay this doesn't really work this way, only to an extent. So that's the next

challenge for me with this particular kind of piece. Like how do you move into an arena where people actually-- you know there's so many successful projects where a lot of people engage in very personal and interesting ways. So it's like how do I navigate that terrain with this project?

So those are my two current projects. It's interesting because this premise of the projects is the same in a way, but as you do each one, new challenges arise, and I haven't exhausted the challenges from doing that work yet, enough to move onto something else quite yet. And I play the tube. I play with Krys Bobrowski, she and I and two other people, we have a performance ensemble called Forticella that we improvise in, it's just four women. You know and, things come up. I'm writing an article, I'm writing, that's something that I'm not used to doing very much. It's called 'Sound Listening and Direct Public Engagement' or something like that. It's for an online thing, and as I was sort of researching the article and trying to write something I realized, well hey, I have a book. I have a book, one book that I need to write. Especially with regard to the documentation of really ephemeral things. I just left that out of the article entirely. So I'm going to write a book. Spring is my semester off-- I had all these plans but then this happened with my dad. Anyway, so those are what I'm working on now. So, like you talk about Pauline, and a certain point she was very gung-ho in a feminist way and really promoting that, and now she's sort of in a different place. I'm at a place now in my life where I'm sort of trying to take stock and put things in perspective because my work is so under documented because I just was more interested in doing it. It's like Laetitia, when you talk to her, her thing is similarly undocumented. If you're pursuing something that's not a thing, and that doesn't even result in… you know video documentation of something is so far removed from the thing. Whereas an audio recording is pretty close, actually. So really there is nothing yet that can take the place of an actual interaction. I think it's a really interesting area to sort of explore and talk about. So that's kind of the direction that I'm sitting in right now. Plus I'd like to make a 'Daily Bell' DVD and I had people that were wanting to do it but then they split up and the company folded and I had my whole little KickStarter thing ready to go and you know. So those are the sorts of project that I'm working on right now.

C: Awesome! Sounds like a lot of different things at once.

B: Well they're all related and you have to do them all at once. There's no point in talking about something if you're not doing it.

C: You're engaged in the process.

B: One more thing here, let me find our little Skype window, I was going to send you the games for girls thing. That was Paul Allen's thing. Purple Moon. It was an interesting thing.

C: Yeah I wonder why that doesn't happen more, or maybe it does but the gaming market is just so saturated.

B: But you were talking about gaming culture and how it's kind of solid now. This was an organization that had a lot of money, and Brenda Laurel was a very strong advocate for girls and was also involved in a lot of the early virtual reality stuff. So it was a fortunate confluence of money and interest that allowed that to happen at that time. Who knows now?

C: I know there are a few female game developers, but they're mostly working at intersections of psychology and art and gaming. It's not really tailed specifically to girls or women most of the time.

B: One more thing, the question of how do I design an instrument, like what my process is. I designed a giant music box for an exhibit at the Exploratorium, while I was developing the long tube. It's not there anymore though. But I think what propelled me was, the year after I started performing, I think there was something about doing the live performance thing, and the challenge of that. I was always really terrified. But with the giant music box, it was the social challenge really that propelled me to make instruments. I always liked music boxes, but the Exploratorium's idea of an interactive instrument that different numbers of strangers could perform on together had to have like a common denomination of like a pentatonic scale. Because that was the only scale that would sound good no matter what people played. I just was so repelled by that idea. So I made a giant music box that was quartertones, just to be really obstinate, but these little brass bars were so high, it was really beautiful, it was a really beautiful sound. And to have it as a way for people to work together or alone in this situation to create some sound thing that they liked. You could make a picture, I had little template on there, or you could do little scale things. So again it was this social situation and institutional challenge that really propelled me to develop that. I think with the long tube, I was at the Exploratorium and these guys from Bell Labs had come, and were talking about how they were putting electronic tones into long tubes, and how some of the tones that they played through the tubes disappeared, you didn't hear them, and I thought that was really interesting. So I went out to the shop and we had a metal rack with all these tubes on it, and I started singing into all these really dirty dusty ends of tubes. There was one tube where a lot of the tones that I sang, it was like somebody touching your throat and it cancelled it out. So I pulled it out and it was a nine-foot tube. It was a little high so I made a nine and a half foot one. So it just an experiment trying to sing those notes that you couldn't sing and it would do all this weird stuff to your voice. And I thought, wow this is really interesting and exciting, and like I said before I thought everyone would want to do this. I thought to maintain the transparency of that interaction and that practice was the most important thing about doing it. Again it was a social challenge, as sort of my desire to have people connect on that level, through personal investigation of something that was so accessible that was there all the time. That's sort of the underlying thing I think of everything I do.

C: I think that's a pursuit that is really necessary. With any sort of instrument design that is collaborative, like more than one person playing it. Because often you see instruments that are designed just for one person to play. That's the norm. So to have these instruments that interactive for multiple people, finding ways to make it engaging is an interesting challenge.

B: Yes exactly. Also that you have to make it so that it's really transparent, so that it's easy for people to figure out. That you can look at it and you can say, "oh, I see how that's done, I could do that." Instead of people just saying, I'd like to do that! That doesn't always follow. You just made me think of something, there was this guy who does these workshops, he just won some award, I wish I could remember his name. They build these things, they're like these long pieces of wood, and then you have these little twangers, and then you have another person and each of you bite on one end of this thing. So your faces are close to one another, then the sound is transmitted through the bones in your teeth into your ear, so you can only hear what each other does. Nobody else can really hear. So you can have a room full of people playing these things and it's silent in the room but everyone is engaged in making this really intimate kind of music.

Appendix B:
Lori Napoleon:

Lori Napoleon is a sound artist, composer, and educator based in Brooklyn, NY. She performs and practices under the moniker 'MERIDIAN7'. Napoleon's instruments appropriate and expand vintage telephone switchboards and related interfaces to generate and modulate sound. She teaches classes and workshops for youth aged K-12 on robotics, video game design, programming, and basic electronics.

Lori Napoleon, email correspondence with author, March 17, 2015:

My background originally has been in drawing and painting and I was pursuing a BFA in studio arts at University of Illinois in Champaign-Urbana. During that time, I was exposed to electronic music and I bought turntables and began collecting and mixing records soon after. Upon graduation, I returned to Chicago and embraced the DJ and vinyl culture there, performing and continuing to collect records. I think electronic music influenced my preferred visual art medium and I started working more with electric lighting and holography as a medium – something that I felt had the immersive quality and, literally, the "electricity" that the music I loved could evoke. Eventually my drive to make my own electronic art led me to explore further education; without any background or training in electronics it was difficult for me to experiment with some of the ideas I had of creating interactive sound and lighting environments. I discovered that there was a graduate school program at NYU called the Interactive Telecommunications Department – in the TISCH School of the Arts – that would accept artists who had ambition to learn technology even if this was not their background. Going in, I didn't exactly know what form my interests would take and I was inspired by light artists such as Dan Flavin, James Turrell and Olafur Eliasson. I viewed myself as a visual artist who sought to create lighting environments as evocative as the music I collected and DJed – a bit like the visual counterpart to electronic music.

On one of the summers in between my two years there, I went on a road trip to the upper peninsula of Michigan to visit a friend. It was in this area that I saw a telephone switchboard at a really small museum that was nestled inside a lighthouse. There, I immediately thought it would be a great interface for a modular synthesizer. Even though I had never played one, I had a general awareness of hardware by way of DJing. I could see that switchboards, like analog synths, were manually patched and seemed to embody a similar way of "performing" and the idea of the blurred line between the operator, technician, and performer. It was later on that I would learn that the reason the switchboard reminded me of a synthesizer is because the actual interface (jacks, knobs, cables) essentially pre-dated and influenced musical designs and connectors since then. This surprise encounter really changed my thinking around; this combined with a general longing to be more closely involved with music after a bit of a break from DJing shifted my goals closer to where I am at now in building and creating instruments.

Guided by an inner voice to follow this hybrid switchboard-synth interface I dreamed of, the following semester I cancelled several courses I'd previously enrolled in and instead,

chose several courses in music technology so that I could learn analog synthesis. The first synth I learned to play was the Buchla 100e system there. I also took some basic analog circuits classes so that I could become adept at soldering, understanding schematics and building circuits. I took a Max/MSP and MIDI class as well, which was incredible helpful for the general knowledge of how to interface a MIDI controlled synth to an CV system.

My main project in this class was using Max to scramble up system exclusive MIDI commands to form a randomizer button on a hardware synth, and I also created a MIDI-controlled light sequencer, which I would love to revisit one day. I recall from the NYU studio that the first moment I controlled the Buchla with a Roland TR-606 drum machine (because the Buchla sequencer was out for repairs) was one of the happiest and most magical moments of the year! I was so excited that I needed to go outside and take a long walk. Knowing that my time at NYU was going to end, this experience further edified that I needed to recreate this experience for myself, at home. So, I decided that my final semester would be devoted to making a modular sequencer / synth system adapted inside obsolete telephone equipment. I started researching and buying manuals of switchboards and visited rural museums, accepting donations of dusty, unused telephone equipment from friends and museum owners. I did quite a bit of research on electro-music.com and also went to one of their conferences to learn more. At this time I spoke to everyone I could about my project and how I should go about doing it, and brought all these stacks of paper with schematics. The first modules I ever got– and made– were electronic kits. These came from places like Music From Outer Space and Elby Designs and included a ring mod, noise cornucopia and sample and hold, plus several sequencers (because it's great to have more than one sequencer!). The decisions I made when first designing my own modular system were inspired by a very percussive patch I saw during a demo at the Electro-Music conference. A musician named Kevin Kissinger demonstrated a very percussive noise patch that I wanted to recreate at home.

There is a strong interplay between what is possible with the circuits/modules themselves and the discovery of what's possible within the repurposing of pre-existing controls. One of the most enjoyable times in the process is taking apart a switchboard and seeing how everything in the interface is routed. Often when you plug in a cable, 2 switches are closed and another 2 are open, and this inspires audio and visual ideas for how to route the circuits. I add far more LED indicator lights to my instruments than what is indicated in the schematics because the machinery lends itself more to it, and because it transforms the instruments into an environment that could light the room on its own. I also have worked with mods – for example, I created various interactions between two of the MFOS 10 step sequencer kits, and added lots of routing options to the TR-606 and MC-202 – thus welcoming them into my new modular "family!"

Regarding innovations in technology that have really inspired / enabled my work: The widespread availability of resources, PCB kits and schematics, and community that modular and electronics enthusiasts are seeing today has enabled people who were new to it like me to jump into a project like this without having had a previous background in neither electronics, audio, or synthesis at the technical level. It's really because of the

open-source resources on the Internet and collective knowledge that could allow me to make progress little by little – many pitfalls and failures happened along the way (I already ruined 2 filters and a power supply) but having places to ask questions was very helpful. More recently, I think that being able to record the modular excursions in multiple channels (such as with Ableton) has made it possible to overcome what was once a limitation to those who wished to have more freedom to create pieces of music, with overdubs and such. I am at a point where I feel I have built enough gear to focus on making music for a while, and don't have a compulsion to "collect as much as I can" which is kind of the assumption that people who go modular have (: I plan to work in stages – the first would be a heavy build stage, followed by composition. Once I have several pieces that I am content with, I build expand upon my installation, and the switchboard "exchange" will grow. I am currently working on my first compositions, which should see their first releases to the public in 2015 – early 2016.

Regarding role models, mentors and inspirations:
I am mostly inspired by the emotional intensity of sound and its ability to unlock memories, to calm, to motivate, to move and connect people to each other and themselves. I am inspired by the way that the sounds coming from my "noise cornucopia" open up a vast space in their similarity to winds, the sea, etc. There is a certain nostalgia and wordless feeling that I am trying to express in sound. My library of vinyl records is an inspiration as well – each one really comes down to the impression of making a personal epiphany, sharing a mood, a time-stamp in whatever bedroom or studio in the world their creator was working with at the time. A real beauty I find in techno / generally instrumental electronic music specifically is how one can really intimately express their feelings through some pieces of gear that you can simply have in your home, rearranging recordings or samples, burying sounds into a type of collage… this music creates a very inviting space to think (or dance) to. Coming back to the switchboard "installation" that my studio has become, I am also inspired by the many telephone operator "demoiselles" who operated such machinery with precision and dexterity, living within a world of rhythm, voice, light, and manually connecting cities, countries, eventually the whole world. I have had many teachers and mentors – some would simply be friends or family who aren't involved in music, physicists who find parallels in art and science, etc.

I've had some great teachers directly in my new field, though. Besides the faculty at NYU, I also was able to learn a lot about audio – specifically RECORDING and EQ techniques – at Harvestworks Digital Media Center where I was a resident last year. Early on, a fellow synth builder named Leon Dewan of Dewanatron became an excellent friend and a very patient advisor at times, when I was in the process of building my new circuits or envisioning a particular mod.

Re: Challenges!
[To be honest, I'm just getting started with the "publishing" process of the work and while it looks to be going well and I have lots of gratitude, I have more experiences that are based on personal challenges of learning and soul-searching as opposed to what happens "after" i.e. trying to get the work out there.]

At first, finding resources to even discover if electronics was for me, and in what capacity, was difficult. At the time (mid-2000s) there were not really any "maker spaces" available to me to even try out a medium which I imagined I could really love. I would have had to enroll in a matriculated program. I decided to take 6 weeks to go to New York and study interactive art at Harvestworks and I also did a Holography internship, but after those weeks passed I felt that I just needed more of a daily practice – longer than a 6 week intensive self-journey, I'm currently over 6 years now!

Learning an unfamiliar medium will introduce a whole spectrum of feelings in order to see it through – from wonderful curiosity and discovery to the dread of being "stuck" via having feelings to express in the moment that may become thwarted by an unknown technical issue, or just needing to experiment enough to achieve a certain feeling. This is why I have found it is good to try and adopt certain constraints, spend an ample amount of time on less, but intentionally selected pieces of gear and processes – and then just explore and explore until you feel the most right, and the most "you."

Appendix C:

Afroditi Psarra:

Afroditi Psarra PhD. is a multidisciplinary artist based in Athens, Greece who works primarily with DIY electronics, e-textiles, and sound. Psarra's wearable interfaces detect magnetic fields and other atmospheric and environmental data, as well as gestures and biometric information.

Afroditi Psarra, email correspondence with the author, February 16, 2015.

Chloe Stamper: What is your background in music technology? How did you start?

Afroditi Psarra: Actually my background is in fine arts, but music is something I was always passionate about. I started playing in various bands, playing the bass and singing, but only four years ago, when I first started working with e-textiles (electronic textiles) that I was really drawn into sound. My first sonic experiments began through prototyping with digitals electronics and creative coding.

CS: Have you ever built an electronics kit?

AP: Yes, but always in a workshop context, not for sale.

CS: What programming languages do you work with? Has programming affected your practice?

AP: I usually work with Arduino, but I have also worked with SuperCollider. In my case, I feel like both prototyping with e-textiles and programming provides me with the basic tools for composing. There are a bit like oils and brushes in order to compose a painting.

CS: When did you first become interested in designing instruments?

AP: I do not feel like an instrument designer. I consider my work textile and sonic experiments that only work for me. I don' t think that if I gave them so someone else, he/she would find it easy to compose or improvise with them.

CS: Tell me about your instruments?

AP: I create embroidered synthesizers embedded with Arduino microcontrollers and other electronic components (both conventional, as unconventional). Also I create wearable controllers that interface with SuperCollider via wireless antennas.

CS: How do the instruments you design affect your practice (as a performer/composer/artist)?

AP: In the beginning the instruments were seen merely as a "fun challenge", but after a while I started seeing the possibilities in performing with them and composing. Each synthesizer or controller dictates the performance context. In the case of the embroidered synthesizers that the sound is controlled through conventional knobs and gesture, I feel that the performance needs to be more like a concert, but in the case of the wearables, since the parameters of sound are controlled through the use of the whole body, the performance need to have a more theatrical context. Many times, I collaborate with contemporary dancers and the result is an improvisation between myself controlling the mixer and adjusting the volumes, and the dancer exploring the possibilities of the wearable-costume that I have created.

CS: How do you realize an instrument design? What is your process?

AP: It generally starts from a concept idea. In the case of Lilytronica (the embroidered synthesizers) the idea was to juxtapose the pop iconography of well-known synths (like the MicroKorg, the MonoKorg and the TR-909 drum machine) with the fragile nature of textiles and traditional embroidery techniques, by creating conceptual associations and disassociations to the public. In the case of the Idoru() or Divergence wearables, the concept was evolving around the use of the body as an interface and the sound the feedback parameter for creating a sci-fi immersive experience.

CS: Has your practice been influenced by mentors or role models? If so, how?

AP: Yes, I have been immensely influenced by women pioneers of experimental music like Delia Derbyshire and Eliane Radigue, my professor in Madrid Dr. Jaime Munárriz (one of the pioneers of Madrid's experimental music scene) and also by my fellow sound artists in Athens and the KSYME (Center for Contemporary Music Research) founded by Iannis Xenakis.

CS: Have you encountered any particular challenges in music technology spaces?

AP: Not really. In Athens I am surrounded by men in the experimental music scene. Big guys with big modulars... But they accept me for what I do, and I always try to come up with a very sense indulging set in my performances, so being loud and creating interest sonic textures works for my case.

CS: What are you working on now?

AP: I am currently working on a proposal for a residency at the European Southern Observatory and the Ars Electronica FutureLab regarding the possibility of creating a wearable cosmic ray detector that will provide the human body with feedback of the invisible universe that surrounds us and my intention is to present the outcome of project through a series of sonified performances of the cosmic radiation data.

CS: Is there any particular innovation in music technology that you are really excited about right now?

AP: I could never afford any good instruments or synths and stuff, so what really excites me right now is the open software and hardware that we have in our hands, that provides us with the tools to create whatever we can imagine!

Appendix D:
Carla Scaletti:

Carla Scaletti is a software designer and sound artist best known for her software application, Kyma.

Carla Scaletti, email correspondence with the author, February 11, 2015.

Chloe Stamper: What is your background in music technology?

CaS: Doctorate in music composition & a masters in computer science from the University of Illinois—plus about 30 years of experience coding, composing and performing with computer-generated sounds.

ChS: Have you ever built an electronics kit?

CaS: I once tried to build what I called a "MIDI cloud switch" from a Paia kit for my installation called Public Organ (commission for the ICMC in Vancouver in 1992). The kit never worked correctly, most likely due to my amateur soldering skills, so I instead ended up eviscerating an old Casio keyboard and hooking it up to a pad with a switch under it that I placed on a piano bench. Whenever someone sat down on the bench, the MIDI trigger caused the desktop camera to snap a photo of them to add to the collection of images (and started a state machine running).

In the CERL Sound Group, I spent many hours with a wire-wrap gun routing twisted pairs of wires from point to point on the Platypus signal processor. That wasn't a kit, though, that was a digital signal processor designed by my friends Lippold Haken and Kurt Hebel.

ChS: What programming languages do you work with? How has programming affected your practice?

CaS: Smalltalk! Programming hasn't affected my practice; it *is* my practice.

ChS: When did you first become interested in designing instruments?

CaS: The kind of work that I do might be better described as designing a Meta instrument. Kyma is a language that others use to create their own instruments. I first became interested in designing a language for creating and manipulating sounds when I was a graduate student. I wanted to find a way to combine what I loved about analog modular synthesizers, computer music languages, and the actual physical manipulation of tape in the studio.

ChS: Tell me about your instruments/software?

CaS: Kyma is a language for creating, manipulating, combining and performing sounds in real time. It's used by a wide range of people who are fanatical about sound—ranging from Hollywood sound designers to experimental music composers to scientists who use Kyma to do data sonification.

ChS: How do the instruments/software you design affect your practice (as a performer/composer/artist)?

CaS: It's a continuous tight feedback loop. Whenever I work on a new composition it results in improvements and additions to the Kyma language. And Kyma is my "native language" so it's the way I think in sounds.

ChS: How do you realize an instrument/software design? What is your process?

CaS: It's always iterative. It starts with an abstract idea. Then you realize it. And through the process of making it, you begin to fully understand the details of the problem and all of its ramifications. At that point, you can start over again from the top and get it right.

ChS: Has your practice been influenced by mentors or role models?

CaS: I was greatly influenced by the atmosphere at the University of Illinois in the 1980s. All of my music professors were coding or building their own hardware instruments. So it seemed like a natural thing to do. I lived in a graduate dorm on the engineering side of campus so I also had a lot of friends who were electrical engineering students. Eventually I even started working with electrical engineering students at the CERL Sound Group; they were building digital synthesizers, computers, and new musical interface, and to them, coding came as natural as speaking English—maybe even more so! When you're surrounded by friends and mentors who create technology, it's natural to want to join in the fun.

If you don't know anyone who creates things, you can easily get the impression that technology and music are "things" that you order online. But when you see people all around you making things, you understand that there's nothing more human than technology. It's what we humans do.

ChS: Have you encountered any particular challenges in music technology spaces?

CaS: To me, it's the continued reliance on the paradigm of "things". Before the advent of programming languages, people understood the world as being made up of specialized things that had specific uses. The power of software is that you can completely reconfigure one piece of hardware to be almost anything. Yet companies seem determined to continue selling us software "things". They want us to keep buying new 'plug-ins' (i.e., software packaged up as a specific thing

with a specific use), when we could instead be learning how to code our own plugins and inventing our own synthesis and processing algorithms and making our own instruments.

It's same old story of giving someone a fish instead of teaching them *how* to fish. To me the biggest challenge in the music technology space right now is to help people remember that they are creators, not just consumers.

ChS: What are you working on now?

CaS: Right now? It's a new version Kyma that's about to be released in the next two weeks.

ChS: Is there any particular innovation in music technology that you are really excited about right now?

CaS: Yes, the new version of Kyma! :)

Appendix E:
Laetitia Sonami:

Laetitia Sonami is a composer, sound artist, and educator based in Oakland, California. She is best known for her gestural interface 'The Lady's Glove'.

Laetitia Sonami, transcribed correspondence with author, March 14, 2015.

Laetitia Sonami: I mean it's such a big topic. So many ways to approach it.

Chloe Stamper: Narrowing it has been the hardest part.

LS: It could be completely focused on education access, and demographics, and there are not clear answers. That's the thing.

CS: And there's no real research on this particular part of it. On the actual engineering side of things. It's mostly focused on composition or performance.

LS: It's interesting. I work quite a lot with a woman engineer that I met at Princeton, Rebecca Fiebrink, who now is at Goldsmiths in London. I really like working with women engineers-- because I'm not an engineer. But she would design, I don't know this is maybe off topic for you, but you may want to send her some questions because she is a really high-end engineer. And she designed this system 'Neural Networks', I don't know if you know it much, but I use it. Actually, some women invited me at Princeton, I forget whom. It was quite a few years ago. And Rebecca was teaching there… no she was finishing her PhD there and eventually she taught in the engineering department. But she also designed some software that was used at … on the ChucK platform, and some people told me you should check with her because she has this 'Neural Nets'. And I had tried to do neural nets quite a few years ago and it didn't really work and I was like kind of dubious. But then it worked on the Glove but I was already set up with something else. But then when I tried to think of another instrument I started working with her, which was really great. So after Christmas, she's at Goldsmiths now teaching, and also doing research. She wanted to improve her neural nets so she came to Normandy where I was, and for a week and we worked, I mean she worked, because it's way high end for me, to do that programming. But it was really nice. And we talked a little about women, because she's the only woman in the department, and at Princeton I think she was (also) the only woman. So it was interesting. And she's not like openly feminist; you know, she learned like a lot of us to just move quietly.

CS: Blend in.

LS: Blend in. Yes exactly, and just kind of get what you need, get what you want.

CS: But in a quiet way.

LS: Yeah, yeah, and it was interesting. Because I was curious if she felt that had changed

much.

CS: Yeah, it's been interesting over the last few years.

LS: Things haven't changed that much.

CS: I have some texts back from the 80s and it's just like, nothing has really changed. The way that I am kind of approaching the whole thing is looking at it in the context of emerging maker culture that's happening, which is really moving resources away from academia. Which I think could be a good thing in a lot of ways, it could be a bad thing too.

LS: In what way?

CS: Just that it's not as structured, and there's not as great of a depth of knowledge. People sometimes run with it but a lot of time it's pretty superficial knowledge. But it would be a good thing because people of different classes would have access to all these tools that they didn't before, and it's also making information available, that was previously kind of guarded.

LS: It's really kind of an issue of popularizing… anything, I guess. It makes it sometimes less exclusive, and it's like you said it loses a certain depth. But then there are always people who are going to take it to another level. So in a way, like the question of are there less people? Because I agree with you. I mean, it happened with the laptop. Originally when people started having the laptop and Max MSP came out, I remember because it came out of IRCAM, and I think there was some reticence of having this kind of easily accessible software on this easily accessible platform.

CS: Mhm. And there are still people that are pretty against it. James Fei, at Mills too, I've seen him talk very disparagingly about software culture and how the products of it are never particularly innovative.

LS: Yeah. I think that in his case maybe cause he's so into analog, so I think it's not so much the popularizing of software, but more the idea of software. He doesn't really use software, so I think it doesn't have much to do with political or cultural, it's mostly just aesthetics.

CS: Yeah he's so into the weird one-off outcomes you can get out of pieces of technology by subverting them.

LS: So yeah, I think it's true. I use to teach DIY a bit and people get so excited to turn the light bulb on, and that's unfortunate. Because it doesn't go anywhere. I think it just spread, because the peak of people who are really good at it, they're still amazing and it's just like instead of going like this (gestures arms to creature narrow based pyramid), it's like this (gestures wider based pyramid).

CS: Yeah.

LS: So what are your questions? I could blah blah blah.

CS: Yeah it's easy to just talk on it. Okay so…
What is your background in music technology, how did you start? So, more focusing on education and how did you end up in this field?

LS: It was really by accident, you know? I wasn't really looking for it, I knew nothing about technology, I wasn't interested so much in technology, and I wasn't even interested in music. So that kind of took care of all of that. But I think that it was curiosity. I've always been attracted to things I don't understand. When I came to do fine arts in Boston, I was 17, I was just out of high school, and there was a synthesizer. So I thought, this is crazy, and it didn't sound good at all, but I was like oh this is amazing. It's 1975, 76, so there's definitely already quite a lot, but there's not that much going on-- so I go back to France, and I want to do it. At that point I was just interested in doing electronic music. I wasn't that interested in technology, even though I think that my main attraction was that there was this thing that was so magic. Technology for me is like magic. It's like spiritual or something, you know? I was probably attracted to that. So when I went to France and there was not that much access. It was tied to the radio stations, they were the ones that had the equipment, and I went there and I said, "I want to do electronic music" and they said, "You have to go to conservatory, then come back in three years." and I said I'm not interested in conservatory, I don't want to do music.

So, talking about mentorship, I was very lucky that someone said that they knew of this composer in France, in Paris, who had equipment-- an ARP 2500-- which was Eliane Radigue. So they introduced to Eliane. At the same time there was a weird pilot program at a University where they had a couple of classes on computer programming, but they didn't really had a studio. So mostly it was through Eliane, and I was very, how do you say? Admirative, and shy, because she was beautiful, and she had a studio in her room, she had the big ARP synthesizer, and she art everywhere. The place looked so high culture. Anyway, she said, why don't you come four times and I'll just show you how the synthesizer works, and we'll see. She wasn't really into having students. It was in her place, she lived there, so there was no way for her to isolate herself. Anyway, she ended up letting me the whole year, one day a week.

So I really had a mentor, and I really had a woman mentor, which is very rare in electronic music. I was talking to Marina Rosenfeld who I teach with at Bard and she was saying you know I never had a woman mentor. I was extremely lucky, because I think that I was rebellious, and I was very against authority of any kind, and even though she was very strong I guess that I did not envision her as this kind of like, male culture that I had encountered at radio stations who had these ideas. I think she had a big influence, and she's the one who actually said you're not going to be able to do anything in France; you have to go to America. She introduced me to Robert Ashley and to David Berman, and that's how I ended up at Mills in 78, and at the time, when I went to Albany they had a huge Moog studio. There was I think another woman there… But it was not so much

about technology but it was about the electronic sound that I was very interested in. Eliane had very little interest in technology, she hated anything digital. But she knew that's where it was going to go, so she if you go to America you're going to have to learn computers, because I think the future -- it was not there yet-- but she said the future is going to be in the computer.

Yeah, so I think that was huge, to have a woman that I admired, even though I had so many mentors, and I would not be anything if I didn't have people who influenced me. I was lucky. I was actually talking to my daughter, because she didn't have mentors, she felt, and we were thinking about how do these social platforms change, maybe, the idea of mentorship. Which would be really an interesting study to do. I had Eliane, but I also had male mentors, like Robert Ashley was a huge influence on me, and David Berman even though I didn't really study with him that much. People just made me. I was just extremely lucky to encounter people who I really loved.

So it was not really about technology but when I arrived at Mills in 78, people were building stuff. And I came from the French tradition that if you want something you ask somebody to do it. Still I can see it now in Europe this division between engineers and artists is quite pronounced. Even the DIY culture, it would be interesting to see how it compares to America, but I think in general you have great engineers, specialists, people who know everything, and then the artists who tell the engineers what to do. So when I came here, people were, Maggi Payne and Frankie Mann, there were some women you know? Frankie Mann was an amazing engineer, she was just studying, but she knew about a lot of stuff. Now she does software. It would be interesting to talk to her.

So at Mills there were people doing stuff and building stuff. There was a big culture of building. At first there was John Bischoff, so many people I mean, Maggi would know all those people. But it was the first microcomputers and just, people were so smart. And then you could buy kits, so I started like, I need this but I don't know how to do it. But Frankie helped, and Maggi was also helping, and I think that we did it. There other people to help somehow, and there was this community. I've found that since, whenever I have students that say oh I want to do this can you show me, I say you do it first. Because there will always be someone to tell you how you did it wrong.

CS: Always. No matter how you do something there's always going to be someone who disagrees.

LS: And they're going to help you, and they're going to fix it. Because if they know something that you did wrong, the tendency is to want to fix it. If you don't do it, no one is going to help you. So I say do it. Do it wrong, do it whichever way you want, but do it, and then go and ask. They'll say, oh that's not the right way to wire it, this and that. As a woman I really learned that. If you want someone to help you, just do it, and then they'll go, oh that's really not the way to do it!

So I really just fell into it, and there was no access, you couldn't really get a lot of the stuff. There was this kind of fearlessness where you just do things. People seem so casual

about it that it was not a big deal. You know, here technology was cheap enough that you could blow it. While in France you couldn't really do that, you couldn't just blow things because they were expensive. I'm just tinkering, I'm not an engineer, I never understand, you know? I'm lazy, like oh I need to do something. But again, I've been lucky to have amazing people around.

CS: There seem to be little pockets that pop up. If you're lucky enough to stumble upon one it can be really great.

LS: I think so. It really helps to come through community. You can always think, I did everything myself. Part of me thinks I've done everything myself. But I have to more and more acknowledge that I pretty much did not do anything myself.

CS: I don't know if anyone really does anything themselves.

LS: No but you know you think sometimes that you invent, or people tell you, oh you invented this or you invented that and you just go, oh yeah.

CS: So did the twenty other people who advised this process.

LS: Yeah exactly.

CS: I'm not a fan of the lone genius model. I don't think it's effective and I don't think it's true. I think everything is a collaboration in some sense.

LS: Yeah. You know you're into the times you know, you're in that period where certain ways of thinking about something occur. Sometimes you're lucky to be just seeing it, or just smelling it just a little before, and then you realize, oh that's definitely a trend.

CS: It's been interesting watching cyberculture and all of these different trends emerging. I follow a lot of the maker culture thing that's happening, just to see where it's going. Especially with new technologies and what's going to catch and what people are going to be into. I'm interested to see what happens with the whole single board computer trend, like Raspberry Pi and Beagleboard, where people are able to embed software into systems without having to write pure firmware. Which is going to be interesting I think for music technology.

LS: Yeah there's always the question does that make people have more interesting ideas?

CS: We'll see.

LS: Yeah, we'll see.

CS: People are still so attached to their laptops right now. You don't see many things without a laptop sitting next to it.

LS: Well it's like, then you go into the whole wearables or something and that's a whole

question. I think I sent you the article I wrote, 'Now we Leave Wearables to Dictators'. I think that the corporate world has a lot of interest in a lot of ideas that were really fun. But now it's like, why would you want to do with Google. We should build huge machines; we should build things that are totally cumbersome.

CS: Unwieldy for anyone to co-opt.

LS: Exactly. Exactly. That will be totally inefficient. Because I don't know, I think, who knows? It's hard to know where it's going.

CS: Wearables are an interesting thing. I talked to a woman in Greece who makes her own wearable sensors. She's doing something with cosmic radiation, like music generated from data from cosmic radiation. I think there might be a resurgence with it, just because people are so attracted to something that's that tactile. Right now it's seeming a bit stagnant.

LS: Again it's what you do with it.

CS: Yeah. A lot of people are doing the same thing with it, unfortunately.

LS: Yeah. Yeah.

CS: Okay. Well you were saying that you had built kits. That was a thing… How did you get into kit building, it was just whatever you needed?

LS: Yeah whatever I needed, and there was this thing called the Curtis chips, I don't know if they still exist. But there was Praia, in the 70s there was a lot of kits. I'm not an engineer so I couldn't build circuits from scratch. So I wanted to make a synthesizer. So I bought all these kits-- which is happening now again-- and then I made a box and I would just take a variety of boxes and just build thing. And I performed with this synthesizer that I had made from chips. And you know, you'd have to be pretty dumb to screw this thing up. It's printed, you just put the things in, so you know, you do it wrong, like a capacitor maybe one or two times. So I like to ask students when I show them, because nobody knows how to do circuits and I teach a class where they have to build a mic or something, and I don't teach people how to build stuff but we have to do a couple of things, and they're like whoa! You know? We're so disconnected to like plus is plus, minus is minus, you know? Very simple things. Then I realize like how could you not get it, you know? I'll see them doing the weirdest things, like how did you even come up with doing something so screwed? But then I realize that's what I did too.

I didn't have to design anything. Then there was like Popular Electronics.

CS: There was like Heathkit and RadioShack.

LS: RadioShack had the books. That came later. I have the whole collection of, what's his name? He's a great guy. He had a whole collection of circuits. There was like a whole

collection of circuits that you could do so if I needed a power amp or something I would just build it. So it was really again, fairly simple. Then asking some people. Then there were some circuits; I had certain ideas of certain things I wanted. Like I was really at the time not into sequencing, but into dividers. So I just ask people, how would I do that? There was always someone who knew. Then they give you these schematics that were half-baked.

CS: You get it and you put it together and it doesn't quite work.

LS: Yeah, doesn't work. And they go well of course because you did that wrong. So I always tease, I have a friend who's really good but I always tease that he's always giving me half information, so I always fail. But I think I was unabashed at asking people.

CS: That's important.

LS: I think it is. I think that getting that confidence, you know, especially for a woman, that you just don't give a shit if people think you're stupid, you just need information. I don't care what you think, I just need information and I'm going to get it. So that's what I did at the time. I knew enough. I tried to take an electronic class but I was just, you know.
…
CS: We talked a little bit about programming. You work with Max (MSP) quite a bit?

LS: I did yeah, because I think originally I had these synthesizers and these kits and there was no software for live performance, and I was only doing live. So there was a friend of mine who was at IRCAM who said there's this piece of software that they're working on in the basement, you might be interested in it. So he sent me Max, it must have been before Max was released. So that's the only software that I've learned. So it was Max and it was Max MSP, and I just kind of grew with it. There was nothing for real-time. There was SuperCollider; I don't think it was out there. I was just starting to use computers in performance and that was the only thing that I could use so I just did it. I had learned basic programming, something like FORTRAN, some kind of machine language I had done some class, I think after Mills. But none of them were real-time. I kind of liked it but it's not something I really got into. So then when I got into Max, Max was so easy, and at the time it was so simple. Just connect the dots. So I just went for that, and then I just continued with it. Now I keep thinking this has been what like, I don't know how many years? It has been quite awhile. Now I am like I wish I would learn another thing. I really like what people do with SuperCollider. But sometimes you know I can't just keep on learning things, it takes so long to master. I'm alright at Max, I can do just do what I need to do. I used to be good enough that I could teach it. Nobody knew it, I think there were three of us in the bay area who used it. Now there are lots of people who know really well how to do it.

CS: People are doing wild things in it.

LS: Yeah. Some of the students I get, like Josh was working on his Max Patch. They come to study with me and I say you figure it out, I don't know how to do that. I'll tell

you how good it is but I'm not going to tell you how to do it because they are so much smarter at it. There was just no other way if I wanted to work with computer, and I was already into interconnecting platforms, so Max was just a good way to do it. Some people were like, John Bischoff, and some of those guys were like, early on before Max, they were doing their own programming, Frankie Mann too I think. You know, they were sitting and programming at the concerts.

CS: Live coding.

LS: Yeah.

CS: The most bizarre performance.

LS: Yeah, exactly! They were the really early live coders. You know, I loved what they did but I was like, I'm not going to sit there and do that. I was too embarrassed.

CS: Yeah, the silly thing is when they throw the code up behind them, and you see it and you're like, oh that's what they're typing, I still don't understand!

LS: Yeah it's like tapestry. So yeah I've gotten far enough and I don't think I'm going to really learn anything.

CS: It's not really necessary.

LS: I'm tired of Max too; I've done it for so long. But it's like, I'm not going to learn anything else. So sometimes I go oh maybe I should get better at it.

CS: Well if it does what you need it to do.

LS: But the big question with technology, and I think with anything, if it does what you need to do. But what you don't realize is what you need it do is limited by your understanding of what it does. So it's a very chicken and egg thing. So you go, okay, the only thing I kind of know is this, so then you start shaping your ideas around this because that's what you know. How could you do something that you don't know? It's a little tricky. So in the case of Max, it's interesting because it's been so long that actually the way I think about it is really based on what I know of the software. What if I didn't use the software? How would I do it? Or how different would my ideas be? That's why I stopped with the Lady's Glove, because what would I do if I didn't have it? Because I think I can do what I want but actually I'm doing just what it's offering.

CS: Whatever is within that framework.

LS: Exactly. So that's always an issue. But at the same time you have to have limitations. Obviously.

CS: Everything is just everywhere all the time, nothing gets done.

LS: Yeah.

CS: It's a tricky relationship to navigate, especially with all this new stuff coming out all the time. It's like, do I want to learn that? It's cool, but, do I need this, is it actually going to be useful?

LS: I think limitations are actually more and more interesting. You know, what do you do with it? That kind of thing.

CS: There are not a lot of constraints, unfortunately.

LS: There is but you don't acknowledge them.

CS: But you'll see people just go off with sound and just make these incredibly dense things that aren't very intentional at all.

LS: Yeah, exactly.

CS: There are no boundaries so they just expand beyond anything rational.

LS: Yeah it's just this kind of Super Market of sounds. It is tricky. That's why I think that live performance is interesting, in the sense that, what you can do live is very limited. That's why performance is interesting, or installation, or object or something. There's like the limitations of space, setting up all those limitations is very interesting, as opposed to being always editing.

CS: It's very easy to never finish anything. Or to leave everything just so open ended that it becomes incomprehensible.

LS: You have to learn that the hard way.

CS: I impose limitations on myself on purpose now because otherwise I'll never get anything done. Because everything is exciting. I could spend hours and hours and days and days learning new things and never applying them in an interesting way.

LS: And at the end, what is it that you want to say? What is it that you want to share or do, right?

CS: It's a vulnerable thing. To actually choose to do something.

LS: Vulnerable. It is, you expose yourself. It's true.

CS: It's necessary. But you can avoid it for a long time. I see a lot of people avoiding it.

LS: In a way, for me, what makes art successful is this exposure or vulnerability. I think that that porousness is what actually allows people to come in the work. I think more and more, because technology gives this idea of some kind of security, which is total lore, but

it's still built around this idea that the computer is going to do exactly what you want. But actually when you expose that porousness of the system I think people can empathize. So I think that it's important. Yeah you can avoid it, but eventually, nobody is interesting in what you do. I think that maybe 15 years ago, 20 years ago, you could really wow people with these amazing systems. But now it's like, people are not that interested, and then there are people who do amazing systems much better than you anyway.

CS: I think that technology has gotten to a point where it's such a saturated thing, our lives are so saturated with technology that people aren't impressed by the technology itself anymore. Even if you are doing something that's technically very interesting, innovative, if it's not aesthetically interesting people aren't going to care. Because they are so used to seeing all of these things happening, like whatever, you're using a computer. That's fine. Why should I be interested? You've got to have another hook.

LS: You have to have something to say. Even if it's not big, you still have to say something.

CS: Well, it seems like the instruments that you design are a necessity for your practice, but they also shape your practice as a performer and composer. How do you feel that the instruments you design affect your practice as an artist?

LS: Well they cannot be disassociated. They dictate the practice. They come out of a certain necessity, which is again this idea of like and certain performative aspects. But they completely shape it, in the sense that even though I think I want this to do this, I want this to do that. But once the system is built it's a whole system that I hadn't really understood the implications of. So then I learn the implications. For instance, the Lady's Glove, it took 20 years to understand or to learn with it, you know? It's like, oh let's do this, but then suddenly it's like, an instrument talks back to you, things talk back, and then trying to understand what it is saying. I don't build things to "do" things in a certain way. I thought I did. But it turns out, I build things to reveal, hopefully, something about music or performance. More and more I would like to do things that allow me to find some kind of discovery. I think that that article that I sent to you kind of tries to imply these things, that we, as artists, we're not there to do efficient systems, we're not there to control the world, we'll let dictators do that. We're there to actually not control it, and then discover new terrains. See what happens, and out of that see, there's something there. I wish, there's only so much time, but I wish I could invent like, crazy things. But you know, it's just a very small drop in the bucket. Like saying oh that's interesting, like the neural nets and chaotic systems, I say, oh that's interesting, for me. It's not revolutionary but it's just kind of trying to create a platform where things can happen. So the instruments are essential. They become like platforms for discovery. While before it started out with, what do I need to control.

CS: You start out with this idea of this thing that's going to do this very specific task, and then it ends up doing all these other things, and not doing certain things.

LS: Then you pretend that you wanted it to do the other tasks, like that's exactly what I

wanted it to do. I want it to be unreliable. I'm really interested in unreliability. I was never interested in reliability, but then with the glove I found unreliability was very interesting. IT's just making something and then looking at where it's pointing. So they are completely tied to the practice, completely tied to how I view the world. For the performances anyway. For the installations, I'm not really thinking about letting people manipulate, but more allowing people to discover sound, but not so much manipulate. I'm not that interested in that. Because of the learning curve. That's a big thing. Games, if you create a situation that's very simple to learn for the public, that's more like a game, which is great, I'd love to do games, but I don't know how to do that. But if you want them to learn. You must have experienced that in your installation, it's like, what you are demanding, how much time are you demanding for people to get something. If it's no time at all, how is it engaging, how can you maintain the surprise? So it's a lot of really fascinating questions that I haven't really be able to answer. I think at least you need to know, this is what it's going to do, and this is what the relationship is going to be.

CS: The relationship between the audience and the piece itself. You can guide it to a certain extent, but you can't tell people how to feel about something, they're going to find what they find in it.

LS: Again, you're offering a platform, but in a different way, because obviously you don't know, people have to encounter it and figure it out really quickly.

CS: Especially people who aren't familiar with technology, to walk into those situations and interact with these things, and if you explain it it's more confusing.

LS: It is just a wow thing, like wow, when I push the button the light comes on.

CS: That's less interesting. I like the mystery; people have to play with it a little bit to decipher it.

LS: Exactly, connect the dots.

CS: If there's some uncertainty inherent in it, people seem attracted to that.

We talked a little bit about mentors, and we talked a little bit about having a woman as a mentor and that kind of being a different experience, and a rare experience. What do you feel like is notably better or worse about that relationship?

LS: Talking to other people who didn't have, and also having been myself involved a lot with some kind of teaching--I wouldn't say mentoring women--but trying to make some kind of the idea of technology accessible in classes. In my experience working with men and women, it's very hard to generalize, but usually I've noticed that men are more interested in convincing you on the right way to do things. Women tend to have less of a mission, so there's more of an openness. So I think that, I've that through tech stuff, where again, if you use a piece of software or a piece of technology in a certain way, the engineer, if it's a guy, usually they'll say well you're not using it the right way because

this is how it has to be done because this is how it works, while I've found that women usually be interested and more like oh I hadn't thought of the system working that way, let me see if I can implement that. There's more a curiosity; the system is less closed. So I think that, as far as for mentorship, I think it was important that, it's the same with like race and gender, you need to have people that are part of your group of people to make it feel like it is possible. It's like if you have only white people teaching, which is the case is many art schools, then people complain that there's no African Americans, you go well yeah, because there's nobody at the heads. There's no mentors, even if they're not mentors, they're still role models. So I think that having a woman, even though I wasn't thinking it at the time it was special, I wasn't looking for one, I think that there was a certain generosity in allowing me to be what I needed to be, and I think that from what I hear and what I experienced later that it would be a little different with guys. Robert Ashley was totally like that. Ashley was not interesting in having you do something. I think that a lot of people were like that here, were not interested in having you perform in a particular way. I've learned that it was really important, and now that I have had a few more workshops with women, I have a few that have continued in sound art. I'm trying to create more a confidence. I'm interested in a way to have women do it, because first it's needed, and also because I'm a woman and I've experienced it and I feel maybe more committed to encouraging women.

CS: Every individual that comes to it is going to have a different perspective to offer.

LS: That's my experience. Hopefully I can share it.

CS: I think it's important to do. Especially for people who've been in the field, to show what's possible.

LS: Yeah, keep that confidence.

CS: And whatever path you've taken, it's useful for people to see, oh you can do this and this and this.

LS: And it's okay, you don't have to be scared. With technology, there's more of a fear.

CS: Well it's a socialized thing. We're socialized in a lot of ways to believe that that is something that's not accessible to us. That our minds aren't meant to do that. Which is not true at all, obviously. But there's so much fear around it. Brenda and I were talking about it, the emotional intelligence and empathy that you find working with people who are similar to you, who've maybe had similar experiences. You obviously don't always want to work with people who have the same background as you because then you'll never be challenged, but this understanding that your practice is not the only part of your life, and recognizing that there's other things that everyone is going through on a day to day basis and being able to relate and be supportive. And it isn't something that happens for a lot of people. The human experience is kind of excluded in a lot of ways from institutions.

LS: From knowledge.

CS: Which is something that should change. The humanitarian side of academia.

LS: Maybe you will change it.

CS: Slowly but surely. I've been reading up a lot of about it. I think that the work that Tara Rodgers is doing, highlight these accomplishments that have not necessarily been acknowledged, and highlighting these works and practices that you don't see otherwise, it's really valuable for people.

I think we touched on it a little bit, the differences between access in France and America, and the question, if you've encountered and particular challenges as a woman in music technology spaces.

LS: In like the making or the performance?

CS: The making.

LS: Well like I said, there's less women doing it, it's mostly men. It's changing, but I think I had like Frankie Mann, and Maggi, so these are two women, there may have been more, that involved themselves with technology. SO I think again, that's this kind of creating this community of people that are kind of like you or have somehow experienced the same limitations. Access has been more difficult. There's more to catch up, because girls often are not taught to build, usually you aren't really taught to take things apart. Whether you are not taught or your inclinations are not really geared towards, that's a whole topic. I think that there are limitations. Then designing and performing with something I have made was interesting, because there was much more an assumption that it was not working, or that it was failing, when it was not. I think that the audience, or the people would question much more what I was doing as being half-baked. I don't that it was taken that seriously, and I that the only reason that it got to be taken a little more seriously is that I did it for so long. It seems to me that women have to persevere more than men to be taken seriously. If you do the same thing for a long time people will say, oh I guess it's not dead yet, she's still doing that. So I think there's a lot of small things, a lot of these limitations, at first in how we have access to technology, then how we are taught how to use technology, how you're being helped, and then once you actually use it, how much you are believed or taken seriously. So it's all along the way, there are issues.

CS: You feel like you're having to prove yourself constantly.

LS: You have to prove. You have to be confident. You have to do it for longer. All along the way, and I think it happens with minorities too. They're not taken as seriously, and I think that you have to do it for long enough and then maybe die, and then people go oh wow, here's a black who did this for forty years and it's good. I think that, it's not general, but that it takes us more perseverance, and I think that's where it becomes tricky.

Because as you said, there's already a problem of sticking with things, then on top of it, you have to do it much longer, so that's not really helping.

CS: Well there's the interview with Bjork, and she said something like, a woman has to say something five times that a man is assumed to have said, like you have to say, I did this, five times before anyone is like, oh wow.

LS: But that's how it is, and you just keep on doing it and eventually it changes a bit.

CS: Well there's also this way, particularly in American culture but I am sure also in other countries, of the way that girls are taught. You're supposed to just be inherently gifted at something and if you don't understand it and have to try at it, the more effort you put towards it, the less you know it. It's totally reflected in how teachers interact with students, effort versus ability. You see it in Science and Math, and you also see it in Art and Music. So coming into a field like music technology, it's this double-edged sword of effort versus ability at this intersection of Technology and Art.

LS: So you said the more effort you put forth…

CS: The less ability you are perceived to have.

LS: How is effort judged? Positively or not?

CS: Negatively. Which is logically very strange, and it's not true across all fields, like there are certain fields like Writing is a field where if you put a lot of effort into it, it's perceived as a really positive thing, like oh you've worked so hard. But with music it's like, you have a gift, and if you don't have a "gift" and you really have to try at it you're perceived as lesser.

LS: And is it different with men?

CS: Yes, because a lot of men are assumed to have ability even if they are putting in effort. Their effort isn't perceived as strenuous. I've read a lot about music education and STEM and what stereotypes really push people out of these fields. There's this implicit bias that educators oftentimes have, where if they see someone trying really hard they think they are less gifted.

LS: Interesting.

CS: It's tricky. How are you supposed to do anything if you don't have the space to learn it?

Do you feel that online spaces are useful for discussing music technology?

LS: I don't use them. So I can't say. I just go and give lectures, and workshops, and don't much online.

CS: Why do you think that is?

LS: I think that it's just something that I don't do, I don't have Facebook, I don't have twitter, I don't really do it. I don't have much time. I really like physicality. I like life, I like contact. I like showing people stuff and sharing stuff. It's a different interact, and I just don't have that much time. I'd rather just be with a group of people and talk with them. I create physical objects to perform, and I think that a lot of my communication is through presence. Maybe it's generational too? I think that I did not learn that way.

CS: It's definitely a very different way of interacting. I think that it's usually a pretty true interaction most of the time but there's this barrier that's insurmountable a lot of the time.

LS: But it's great too, I think. These people in Iran were asking me to give a class in sound technology and sound art, because they don't have access. I want to do it--I hope--if I don't reply too late. I totally feel like there are plenty of places that need to be reached that way.

CS: It's an issue of access. It's kind of a stand in for a human interaction.

LS: It's really about access. There's no other choice.

CS: It's something I've been considering.

LS: Why do you ask?

CS: I've been dealing with a lot of forums and things, like music technology forums, and some of the cultural and gender issues around them. There are two main ones, and they're named 'Muff Wiggler' and 'Gear Slutz', so those are the two options, and they're not particularly inviting for many people. Mostly they attract men. So I was trying to engage in these communities for awhile, just to see if there was value there for me and see if it could be something that would be a positive, and see if I could learn or connect with people. In some ways I did, and in a lot of ways I was very put off.

LS: What was the information? More about performance, or for builders?

CS: There was a lot of people sharing their work and critiquing and offering feedback, which was interesting. But there was just this underlying culture of machismo that locker room humor that was so off putting. I just couldn't stick with it. I didn't feel comfortable in those spaces.

LS: And you were doing that while also being at school? Did you do that because at school you were not getting it?

CS: No. I just wanted to know. Because a lot of people are using those spaces, and I wanted to know who those people were and what they were really doing. I'm building a

site now that is trying to get away from that culture, trying to bring it back to more discussing conceptual ideas and the creative process of using music technology and not just fetishizing gear and making crass jokes. So I've been working with a friend of mine, we've been building it to see what will come of it. I don't know, I can't decide still if it's going to be useful or if I should just continue to teach workshops and reaching out to people and collaborating with people, which is something I am obviously going to keep doing regardless. But it's just like, is this going to be useful for people. It's an issue of access, again.

LS: You've got to do it and see. It's hard to know. There's no yes or no, it just depends how you do it.

CS: Right. It's been somewhat successful in that there are people in different parts of the country and the world that have reached out and been like hey this sounds like a really great thing and I feel pretty isolated in my practice and I think it would be really nice to connect with people with similar interests. In that way I see it being a good thing. But it's hard to navigate.

LS: I remember a concert I did in China a while ago, and the guy who was the curator, he had a radio show he would do in Beijing every month or something. So he did the festival, it was mostly noise, and he invited some of us from here, but what was amazing is that some of the people can from the most isolated areas, but he knew about them because they sent some music that he played on the radio. But they came from very far away remote villages and they were doing noise stuff, totally isolated in their community, but they found each other through the radio. So it was very interesting, that necessity to share and come together.

CS: I mean, you can go and isolate yourself and work and work and make all of these things and enjoy it for the process of it, but at a certain point I feel like a lot of people want to share that and discuss and see what sticks for people and what works. And there's value in being able to have access to other people who do it.

LS: Very much so, in anything. People don't want to be alone.

CS: Then there's also the idea of expose to people who are curious but don't know how to engage with the technology, and to be able to see other people doing it and get a little bit of the behind the scenes, of how these things are happening and how they are conceptualized and how they come to fruition is useful for people who are unsure how to start, who don't otherwise have access to a community of people who are doing it.

LS: Yeah.

CS: The only question left is, what are you working on now? I've seen the new instrument and I've seen you play a couple of times with it.

LS: I've built this new thing. I'm just trying to have more fun I think. Doing more

ridiculous and fun things, trying to have a good time. Trying to do things that I have not done. Really have more fun, it's hard to have fun working with music and technology sometimes, it's so easy to get mired down in the process. So I want to improvise, and I'm doing a piece with Eliane Radigue, who was my teacher forty years ago, and she never really taught me anything but she allowed me to do it and now she actually made a piece for me where it has to be her way. So I'm just closing the loop a bit, which is amazing. And just making more accessible tools that are more fun. I think I'm taking myself a little less seriously. I mean, you're not going to make money with it and you just do it because you like it and then suddenly you find that you don't like it, which is something necessary. But now it's like, okay, now I'm just going to have a little fun. It's necessary to stay engaged.

Appendix D:
Kaori Suzuki:

Kaori Suzuki is a composer and instrument designer primarily based in Seattle, WA. She runs the company Magic Echo Music, through which she designs and manufactures modular synthesizer systems. Her designs include a light triggered Theremin, named 'GEM', which utilizes light refracted through a prism to trigger sound; two iterations of PALette, a modular analog synthesizer system, and CICCs, a custom interface for computer controlled Serge.

Kaori Suzuki, email correspondence with the author, March 4, 2015.

Chloe Stamper: What is your background in music technology? How did you start?

Kaori Suzuki: When I was a teenager I got into synth and industrial music-- which didn't introduce me to music technology but to some weird sounds at the time. I played piano and violin when I was a kid and a guitar as a teen, but I got my first Alesis polyphonic keyboard when I was 16 or 17- it had some cheesy features but it was a workhorse to me at the time! I liked the string and percussive sounds. I never used the MIDI port because I didn't have anything else to hook into. By the end of high school in 2001, I was into all kinds of music and I was playing in a couple of bands that were inspired by riot grrrl stuff-- I had fun but I never felt like I was contributing the right kind of sounds. So I just did stuff alone! In 2003, I got a digital multitrack recorder, a little mic and a portable Sony Minidisc recorder/player--that short lived technology before MP3 players. I'd visit family in Japan and those were popular there. Only some of them had the record feature, so I made sure that I got that version. I recorded outdoors, plane and train sounds. I also went to anti-war protests throughout high school and college and recorded masses of people there. Maybe that was the start. This is all before I knew anything about synthesis! It was at Evergreen in 2003 that I became quite obsessed with different synthesizer music-- Jean-Michel Jarre, White Noise, Moroder, Cluster, Stereolab and Laurie Anderson, and started researching on my own. Besides the multitrack and recorder, I wasn't using electronic machines but I was listening to different technologies from an experimental music tradition-- tape machines, vintage synths, analog machines mostly. I had access to music labs at Evergreen around 2005-2006 by way of peers and that's how I discovered the machines I was looking for-- synthesizers, recording decks, sequencers-- everything in one room! I was so envious but I wasn't a music major so I didn't dive deep into it, but something definitely started clicking back then and I'd trace any of my current obsessions to that time.

CS: Have you ever built an electronics kit?

KS: I was inspired to build my first kit when a friend introduced me to the Japanese magazine "Science for Adults", which offered simple kits with the physical issue and they had made a mini Theremin kit available. I learned about antenna Theremins in college (Evergreen State College had a Moog Etherwave) so this was really exciting, but I couldn't get a hold of the magazine. With that seed planted, I built an optical Theremin

instead but the design wasn't actually offered as a "kit". So I ordered all of the parts from Mouser and as you may know, ordering parts from Mouser your first time is really daunting! Luckily I had some help and I actually enjoyed cataloging/searching through a seemingly infinite parts database. Now I've made many iterations of optical Theremins including kits for workshops and I've realized how much work goes into making kits no matter how simple the project is. You have to document everything, digitize the documents, find readily available parts and make yourself available for support. Since then I've built some kits for Eurorack modules. The Klee sequencer and Buchla 258J clone have been the most involved Eurorack builds since they required calibration, and they work perfectly! I love that moment of powering up a fresh new build from a kit. They are becoming really popular again and now with crowdfunding, many people are developing them. I've met a number of kids at work who have built snap-circuits and Korg Little Bits, which are both popular kits that I wish I grew up with. I would love to someday build the ARP 2600 clone kit by TTSH--it would be the most involved kit I've ever made and I definitely wouldn't leave my house during the winter.

CS: Have you worked with any programming languages?

KS: Not very many so far. I've only worked with Max/MSP a couple of times in the past year and I really liked it. I prefer a visual program since it's easier to understand without any prior text based programming knowledge. Years ago before I was designing anything, I was introduced to a program called Isadora which was geared towards multimedia and VJs. It was the first program that I used which had a modular interface that I found enjoyable to work with and I knew that I would someday go back to learning something similar. Using Max/MSP as part of of a hybrid digital/analog system can really change the way I interact with my current setup and open up exciting experiments. I just need a more powerful processor at this point, as I haven't kept that current. I've recently used Arduino (C/C++) in various projects, including a MEM synth interface that I built for a Serge modular system. So far, it's been used as various Boolean logic, gate sequencer, clock generator, sample and hold, and more mostly CV generation-- I've interfaced it with a Eurorack modular as well and it worked great. Arduinos don't have great audio processing abilities but you can still make some interesting real time changes by making internal modules in code, then cycling through them with the switches assigned to the Digital I/O. Or, assign various CV values and clock or toggle through them.

CS: When did you first become interested in designing instruments?

KS: I think I was interested in it before I knew anything real about synthesizers but was really into interactive, sound based art. Prior to knowing what gear was available to me, I thought about what it is I wanted in order to work with sounds-- and that's just what I did and I envisioned making them on my own. I was into the Fluxus art movement, I was into sound recordings existing in tandem with objects and I researched everything I could-- how to use solenoids, solder, electronics. Arduinos didn't exist and I knew nothing about microcontrollers. I lived in Olympia during that time and I heard that an artist named Trimpin had made an installation at the Frye Museum using triggered wooden clogs. So I

went to check that out and was introduced to his mechanical sound interface and I thought that the rhythm created in that room was really cool--I liked the feel of it being fragile and mechanical at the same time. I knew that I wanted to work within sound design and electronics then, but only in a vague sense. A year later, I did a linguistics research project that included speech synthesis and I got obsessed with analog vocoders--filter banks, carriers and modulators, oscillators and the big control boxes that they came in. Something lit up then and I felt like I was getting closer to something or somewhere personally. I read Ronald Pellegrino's book "Electronic Art of Sound and Light" and Allen Strange's manual to the Buchla Music Easel, and started self-educating myself on synthesis and design purely because I wanted these technologies for myself! I never made myself a vocoder though, since building those duplicate circuits seemed daunting and kits were unavailable. I did successfully make a ring modulator instead.

CS: Tell me about your instruments?

KS: There are a few that I've made under my company name Magic Echo Music-- a couple iterations of the GEM Theremin, the PALette analog synth V1 and V2, the CICCS Interface, and the CEM8 which will be a one-off. They are all analog circuits made from readily available parts and use modified circuits from manufacturer datasheets. A lot of hand silk-screening and assembly went into those, as I didn't use very modern facilities or SMT parts. The PALette synths have a vintage quality sound to them and I'm really glad that they have made their way into the studios of musicians that I like and respect. Everything in the PALette V2s were modified for board mounted parts, a simpler power supply, and is a sturdier build that can take on the road-- It's a dual oscillator analog synth with linear modulations. The filter has a definite sweet spot and is a self-oscillating little beast of a filter. I've heard them played in noise sets and I've heard them provide the textures that fly around in ambient, atmospheric sets. I've also played them in a number of recordings. Every time I see other people playing out with one I enjoy hearing what they do-- there is a lot of myself in them, and that's why I keep making small revisions and refining the design process. There are some design modifications that I would still make to that design, but I'm moving on from it. The same goes for the GEM Theremins. The GEMs have been used around the world and is also used an art object bordering on educational instrument. Those PCBs were all designed and hand cut, then casted in resin in a mold. I initially made those in Oakland for a Renegade Arts Fair (2010) and they were a success from that and kept morphing into a better design. I owe it to my friend who put up with our apartment smelling like resin for days and another friend who made the hand stitched cloth covers. This is all an expensive hobby business currently and I have a lot of other stuff going on, but it's a platform that I've built up to share my passion for sound design, collaboration, and building.

CS: How do the instruments you design affect your practice (as a performer/composer/artist)?

KS: It's played a large role, and sometimes the musical practice effects instrument design even more. Some of the focus of my musical practice has evolved into a systems-based approach where an idea is heavily influenced by the specific tool at hand. For example, a

few weeks ago I had the opportunity to play an improvised live set using the CICCS, with Timm Mason, who designed the interface with me. The interconnected aspect of our set was a guessing game using an incoming CV and XOR /AND logic coded into the CICCS, creating a gate sequencer generator for the each of us. We rehearsed the idea once and of course nothing sounded like the rehearsal, as they never do with analog modulars... but the idea worked and we both found some interesting new ways to use our respective set up for the show. A similar process can happen for solo performances as well. For me, tuning in to heavy analytical stuff and the fundamental elements of sound, some of that definitely comes from analyzing and understanding instrument designs. Sounds have so much physicality to them and it's another tool to connect me to a moment, an idea, or to other people--electronics and design is the best way for me to hone in more on that. Also, designing instruments constantly makes me want to hear and make something new. Even if I think that I understand an instrument well, I can put an idea for a patch together without hearing anything and then power it up to hear that it's ended up something totally unexpected. Sure it could be frustrating but other times it actually brings new design ideas to fruition or find a more efficient way to build that thing I wanted to do originally.

CS: How do you realize an instrument design? What is your process?

KS: It's a wildly different process for each design, but the constant so far is that they all interface with or produce sounds that are analog and are made in small runs. The production stage is another process to think about and I usually don't base an idea around whether it’s easily reproduced or not. It can be tweaked for that at any point. I usually have stacks of paperwork and a notebook associated with each design as I draw most of the schematics out, then make an electronic schematic capture on the computer, and then make a breadboard prototype and start tweaking parameters. It's all really hands on and it’s nothing like making a robot or a computer program since all the parts are there and you can see everything. I like to incorporate a new challenge for every instrument and come to understanding something new with each design. Realizing CICCS was a new experience for me since I was working with Timm Mason who was essentially the beta tester and customer for CICCS. He's a programmer who can get creative with writing code and not much experience about hardware--and I was the other way around. So we worked together on this custom interface for Serge modular users and I plan to make some more iterations of it. We are both active within this small music community in Seattle and a conversation about what we'd like to see in hardware/software integration came about one day and that's how that happened. I can see how my instruments can evolve by incorporating digitally set parameters in the future--so I'm exploring that direction.

CS: Has your practice been influenced by mentors or role models? If so, how?

KS: As far as design goes it's been inspired by other DIY instrument makers and the works of contemporary and pioneering designers. I think that the story and process behind the Buchla Music Easel is pretty fascinating and my interest in building custom boxes came from a similar desire -- Morton Subotnick and others from the early SF Tape Music Center started discussing a hypothetical instrument system, then Don Buchla sort

of took it up as a project and it slowly got funded from there! There are people like Madrona Labs in Seattle doing interesting software work and just getting to know a small grid of people with similar visions always inspires me. Engineers, pretengineers and developers who create work with integrity and keeps the music and people at heart, that pretty much keeps me inspired. I haven't worked with mentor figures though, no. Most of my learning has come from engineering books, art books, reading schematics from the Internet, and experimentation.

CS: Have you encountered any particular challenges in music technology spaces?

KS: All of the time! Currently my "music technology space" is either a venue, my studio, or my workplace and they are all really different cultural spaces. Some of the struggles are common, or self- imposed, like setting everything up in the most optimal way and having to quickly adapt to new technology and running with it. Electronic media is not an easy world to navigate. As a woman of color it's impossible to separate my identity in music tech spaces from the everyday, but this is the thing: It's difficult to produce work in a technology space that lacks criticality but if the environment is encouraging of my work, that's enough to get me focused on the vision at hand. There are no perfect spaces, and I don't feel like there is anybody stopping me from what I do or what I interact with, so I don't want to let myself stop me because of these challenges. People in music tech spaces still treat "women in electronic music" as a genre in and of itself and that is an external alliance that is made for you by an outside expectation-- this approach of curation doesn't particularly pose an interest or challenge to my work, but talking about experiences or creating a space of awareness and support, like you are, is something I really appreciate.

CS: What are you working on now?

KS: I'm working on a few designs; one of them is a modified analog signal processor with eight channels from an array of Curtis chips. I'll be working on a small synth/interface for a guitarist who wants to use the synth with a percussionist. And lastly I'm working on making the CICCS compact and available for more Serge users. I'm looking forward to a facilitating a youth program as a teaching artist at the Wing Luke Museum (Seattle) early this summer-- doing audio and recording works with teens and going on field trips. As for music, I'd like to get some solo recordings up to speed so that I can make a physical format available before the fall. There are recordings from bizarre machines at work that I'd like to go through and make sure are usable before I leave Seattle.

CS: Is there any particular innovation in music technology that you are really excited about right now?

KS: That's a good question, and I don't think that there is any one piece of new technology that I'm raving about--there's so much! With the current use of digital technology there are so many new ways in which old ideas are expressed, and what used to be lesser available analog technology is now more widely used. This definitely affects

a lot of things like, how "experimental" is experimental music right now? With all of this new technology and equipment, what are we hearing that is new? Sometimes I hear more buzz about the technology used than about the musical ideas, especially when you're working with engineers, and I hate to say this but sometimes it all just needs to slow down. Is that so wrong? We're not running out of tools to use. It's exciting that the lines between engineer/designer/composer are being blurred in contemporary practices and I've very much enjoyed some new works that incorporate graphical elements, even text. I'm generally excited about any music technology that uses a hybrid digital/analog system.

Appendix G:
Cynthia Webster:

Cynthia Webster is a modular synthesizer designer, manufacturer, and owner of the company Cyndustries, based in Glendale, CA. She received her BA at the Boston School of Electronic Music, as well as conducting further studies in electronic music at San Francisco State University and Mills College.

Cynthia Webster, email correspondence with the author, January 30, 2015.

Chloe Stamper: What is your background in music technology? How did you start?
Cynthia Webster: Listening to Emerson Lake & Palmer's song "Lucky Man" on the radio in the 70's got me totally interested. "What's could be making that wonderful sound??" In high School it was recommended to me that I buy an ARP 2600 semi-modular analog synthesizer but "it was totally cool" and it was a great deal. So I did, and then I set about learning all about it. Synthesizers were very new back then and anyone who heard that I had one immediately asked me to join their band, (trouble is that I never learned piano and had no idea). I fumbled around with some bands in High School (mainly learning how much I didn't know about playing keyboards). But I soon could use the machine to make dramatic unusual sounds. This led to my interest in attending the Boston School of Electronic Music, which was taught by Jim Michmerhuizen the author of the ARP 2600 manual and I felt like I'd gone to heaven. In their library they had a collection of mimeographed typewritten newsletters about music circuit electronics called ElectroNotes. I was fascinated by the schematics and quickly started learning more and eventually building my own circuits.

CS: Have you ever built an electronics kit?
CW: Yes, it's a great way to learn and you can substitute other values of resistors and capacitors to see what changes and what different parts of the circuit are doing. (It also means that you don't have to learn how to source all of the parts, which is very important later when doing your own designs, but not at first). Messing with different parts of the guts if a device is a bit like circuit bending, a great way to start exploring and learning. I think my first kit was an Aries synthesizer module.

CS: Can you talk about your experience working with Max MSP? Have you worked with any other programming languages?
CW: I've never used Max MSP but learned basic early in the days of personal computers. It too was a good way to learn what was going on inside, but I dropped programming pretty quickly as it was not really for me. I guess that I prefer hands-on as opposed to theoretical technology?

CS: When did you first become interested in designing instruments?

CW: In my late teens...Looking at schematics in electronics books and magazines would inspire me to apply them to musical purpose when they were often not designed for that. After a while one starts to think, "how can I add a knob to make the pitch go up and

down?" "That really sounds awful when I connect these two wires together, "I can probably add a switch to make or break that connection, "it'll be totally cool!" As one's confidence builds you start getting bolder in your deviations from the original circuit, or possibly combining parts of several circuits into one. After years of this, you learn more of what's important musically, and what isn't, and after a while someone will ask you what in heavens name are you doing? And they make suggestions that you never thought of, and it all grows from there.

CS: Tell me about your instruments?
CW: I design modular synthesizer modules, and stand alone electronic instruments. It's important to me to offer something not available elsewhere, or to do a new take on a familiar design, (or else why put your name on just another 'me too' product?) Front panel design is like a religion to me. I started by playing live electronic music and feel that I have a solid sense of what makes a good instrument. Eventually I learned that it's not always about putting every possible control or every circuit imaginable into your creation. A Minimoog keyboard synthesizer is a classic not just for everything that it's got, but also because of the choice of what was left out. A famous quote (by someone, perhaps Nietzsche) was that "without limitation, there is no art". I think it's a great saying. Imagine a violin, the 'limitation' of its body cavity size and shape, and the length of its strings define it. Violins are incredibly expressive instruments in the right hands and no one complains "why can't it also sound like a tuba?'

CS: How do the instruments you design affect your practice (as a performer/composer/artist)?
CW: As a design evolved I play it with and discover if the range of any parameter is too wide of too narrow. Usually it's a process of imposing controlled limitation to bring each control into a useful range. Oddly I find that there's more serious exploration into what an instrument can do by defining it, rather leaving everything completely open ended.

CS: How do you realize an instrument design? What is your process?
CW: It seems that most engineers design a circuit from the inside out. I was approaching from the other way around imagining the front panel and what controls would be useful, (often not knowing how to do what I drew, but figuring that I'd figure it out somehow. The aesthetic or presentation of the instrument and its controls have always been very important to me.

CS: Has your practice been influenced by mentors or role models? If so, how?
CW: I was greatly inspired by the designs of Don Buchla and the late Robert Moog. Composer Morton Subotnick opened my eyes and ears to the parametric approach to electronic music, basically breaking down all the possible variables in a sound, such as pitch, volume, tone or timbre, tempo, timing, phase, delay, echo, looping, panning, spatial location, and more. I developed a taste for some pretty exotic music and listened carefully to learn how to dissect it. (Try listening to some Harry Partch for example, not only are his 43 tone-to-the-octave scores unique, but the instruments he created to realize them are fascinating and beautiful, and many have been on display at the Museum of Modern Art in NY).

CS: Have you encountered any particular challenges in music technology spaces?
CW: Playing perfectly on a good acoustic piano can be quite challenging still.

CS: What are you working on now?
CW: I've got about thirty unique designs in the works that have never been offered, and really need to get on with them. The modular synthesizer world has changed rapidly in the past three years or so, and I'm holding off to see where it's going. I'd really love to step back from the manufacturing aspect and simply offer designs to other companies. I prefer the design process and enjoy it immensely. I feel it's what I do best.

CS: Is there any particular innovation in music technology that you are really excited about right now?
CW: Yes, the return to hardware! Another great quote comes to mind here, "If I had more time... I'd write you a shorter letter". Creating a great instrument is similar, the more time that you take with it, the more defined and better it will be!

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