A Corpus-assisted Discourse Analysis of

Music-related Practices Discussed within Chipmusic.org

by

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ABSTRACT

This study examined discussion forum posts within a website dedicated to a medium and genre of music (chiptunes) with potential for *music-centered making*, a phrase I use to describe maker culture practices that revolve around music-related purposes. Three research questions guided this study: (1) What chiptune-related practices did members of chipmusic.org discuss between December 30th, 2009 and November 13th, 2017? (2) What do chipmusic.org discussion forum posts reveal about the multidisciplinary aspects of chiptunes? (3) What import might music-centered making evident within chipmusic.org discussion forum posts hold for music education? To address these research questions, I engaged in corpus-assisted discourse analysis tools and techniques to reveal and analyze patterns of discourse within 245,098 discussion forum posts within chipmusic.org. The analysis cycle consisted of (a) using corpus analysis techniques to reveal patterns of discourse across and within data consisting of 10,892,645 words, and (b) using discourse analysis techniques for a close reading of revealed patterns.

Findings revealed seven interconnected themes of chiptune-related practices: (a) composition practices, (b) performance practices, (c) maker practices, (d) coding practices, (e) entrepreneurial practices, (f), visual art practices, and (g) community practices. Members of chipmusic.org primarily discussed composing and performing chiptunes on a variety of instruments, as well as through retro computer and video game hardware. Members also discussed modifying and creating hardware and software for a multitude of electronic devices. Some members engaged in entrepreneurial practices to promote, sell, buy, and trade with other members. Throughout each of the revealed themes, members engaged in visual art practices, as well as community practices such as collective learning, collaborating, constructive criticism, competitive events, and collective efficacy.

Findings suggest the revealed themes incorporated practices from a multitude of academic disciplines or fields of study for music-related purposes. However, I argue that many of the music-related practices people discussed within chipmusic.org are not apparent within music education discourse, curricula, or standards. I call for an expansion of music education discourse and practices to include additional ways of being musical through practices that might borrow from multiple academic disciplines or fields of study for music-related purposes.

Dedicated to the forum members of chipmusic.org.

ACKNOWLEDGMENTS

I debated for months whether I should include an acknowledgements section in this document. The reason is because I simply do not have the space to acknowledge everyone who (in)directly helped me along this path. The following list of acknowledgments is not all encompassing. Each paragraph is generally listed in chronological order.

First and foremost, I must thank my parents, Dee and Lee. Their unyielding support and love over the years has shaped my life in so many beautiful ways. You were, and are still, always there for me. I would never have had the opportunity to walk this path if it were not for your support and love.

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about music making. One summer Kyle asked me to help him teach a middle school percussion class, and it was through this experience that I realized I wanted to go into music education. It is with great irony and humility that I ended up becoming the elementary general music and band teacher for his daughters. It truly is a small world.

As I continued my journey into music making and learning, I have had some amazing friends, educators, and administrators who I have learned from, laughed and cried with, and am grateful for having met. These include the music students and staff members at Mountain Pointe and Mountain Ridge; all of my professors over the years at Arizona State University; staff members in Mesa, Avondale, and at BootUp; and the various people I met along the way while pursuing my love for drumming, music education, and computer science.

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CHAPTER 1

INTRODUCTION

In the late 1970s and early 1980s, advancements in computer technology led to a decrease in computer size and manufacturing costs, contributing to an increase in availability and affordability of home computer and video game systems. Some early adopters of home computing technologies modified or created software that pushed hardware and software boundaries of early computing devices (Simon, 2007; Swalwell, 2012). Within this practice of computer hacking or modifying, a subculture focusing on music making through computer and video game hardware and software emerged. The resulting medium and genre of music became known as chiptunes (Carlsson, 2010; K. Collins, 2013; Lysloff, 2003; Pasdzierny, 2013; Paul, 2014; Ratliff, 2007).

Chiptunes

Chiptunes are electronic music compositions or performances either emulating the sounds of or created through computer and video game sound chips typically from the 1970s and 1980s. Chiptunes "are derived from a variety of stylistic realms [and] are presented together in live performances, on CD compilations, or on websites devoted to chip music" (Tonelli, 2014, p. 406). Many of the early sound chips utilized a limited number of audio channels dedicated to sine, square (pulse), sawtooth (saw), or triangle waveforms, as well as white and pink noise to create a game's music and sound (K. Collins, 2008). Such hardware limitations "shaped the sound of early video game music by way of the affordances they offered and the constraints that they imposed" (McAlpine, 2017, "The aesthetics of constraint?," para. 3). An early example of a video game with iconic chiptune sounds and hardware limitations is Pong, which debuted in 1972. Due to

hardware constraints, Pong has no background music or overlapping sounds.[1] As computer and video game hardware advanced, so did music and sound capabilities. For example, the game Super Mario Bros. for the Nintendo Entertainment System (NES), introduced in 1985, has background music and sound effects occurring simultaneously.[2]

Initially, chiptune practices consisted of modifying hardware and software of 1970s and 1980s computer and video game sound chips to create music. Eventually, practices expanded to include engagement through software emulating the technological constraints of early sound chips (Paul, 2014; Polymeropoulou, 2014; Tomczak, 2009). Today, people engage with chiptunes through a wide variety of ways: music performance, computer and video game hardware modifications, software modifications and computer programming, traditional Western European classical composition practices, music production, electrical engineering, and art production[3] (Carlsson, 2010; K. Collins, 2013; Lysloff, 2003; Pasdzierny, 2013; Paul, 2014; Tonelli, 2014; Yabsley, 2007). Some people combine these practices to "cover" contemporary songs through chiptune aesthetics,[4] reimagine contemporary games with chiptune sound effects and music,[5] perform acoustic music with chiptunes,[6] perform live chiptunes with video game handhelds and

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[1] For example, listen to a gameplay recording of the arcade version of Pong: youtu.be/fiShX2pTz9A

[2] For example, listen to the sounds and music from a gameplay recording of level 1-1: youtu.be/PsC0zIhWNww

[3] Dan Behrens's TEDxBuffalo talk discusses and demonstrates some of these chiptune practices: youtu.be/_7k25pwNbj8

[4] For example, the song "Ridin' ft. Krayzie Bone" by Chamillionaire covered within the chiptune aesthetic: youtu.be/_Kd1Mzfp4_8?t=1m2s

[5] For example, reimagining the sounds and music for the game Battlefield 3: youtu.be/vtbsje5dHtM

[6] For example, in the group I Fight Dragons' cover of "Heart of life" by John Mayer, the group sang alongside precomposed and live chiptunes: youtu.be/hJjL7Hjwqfs

MIDI controllers,[7] or create entirely new instruments with sound chips from a computer or video game console.[8]

The prevalence of chiptune practices continues to grow both online and through in-person meetups or chiptune-focused events across the world (Lysloff, 2003; Polymeropoulou, 2014); however, few studies explore implications of such practices in education. Instead, most chiptune-related scholarship explores chiptune culture (Lysloff, 2003; Polymeropoulou, 2014; Tomczak, 2009; Yabsley, 2007), history (Carlsson, 2008, 2009, 2010; K. Collins, 2013; Paul, 2014; Ratliff, 2007), or music practices (Mitchell & Clarke, 2007; Pasdzierny, 2013; Rovito, 2014) without consideration of educational practices or contexts.

Making

The ways people engage with chiptunes can be understood as a form of inquiry-based learning with high priority on authorship, or what Gutwill, Hido, and Sindorf (2015) refer to as "making." *Makers*, according to Sheridan et al. (2014), are people who participate

> in a space with diverse tools, materials, and processes; [find] problems and
> projects to work on; [iterate] through designs; [become] a member of a
> community; [take] on leadership and teaching roles as needed; and [share]
> creations and skills with a wider world. (p. 530)

Makers often meet in physical spaces within libraries, schools, institutions, or organizations to make and collaborate (E. Halverson & Sheridan, 2014). These spaces are often referred to as *makerspaces*: "places where groups and individuals of diverse

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[7] For example, performing with a Game Boy and multiple MIDI controllers: youtu.be/-hisdP3sM9M

[8] For example, a "gAtari" (youtu.be/S8e7g8kJIlo) or Commodore 64 bass guitar (youtu.be/_kDhpFaf4EY).

ages, genders, and backgrounds come together to 'make': to mess around at the crossroads and fringes of disciplines such as science, technology, engineering, art, and math" (Brahms & Werner, 2013, p. 1). The prevalence of makerspaces in formal and informal learning spaces and the wider practices in maker culture continue to grow through events such as the White House's 2014 makerspace festival (Brahms & Crowley, 2016; E. Halverson & Sheridan, 2014), magazines such as MAKE[9] (Brahms & Crowley, 2016), and online communities or resource hubs such as DIY.org or instructables.com. Sheridan et al. (2014) found makerspaces shared three unifying characteristics: (a) learning is in and for the making; (b) learning arrangements within makerspaces are diverse; and (c) multidisciplinarity encourages engagement and innovation (pp. 527-528).

Multidisciplinary Practices

Brahms and Crowley (2016) describe multidisciplinary practices as practices that "are drawn from or resemble certain disciplinary practices, but no one discipline or singular set of established disciplinary practices captures the essence of participation in the making community" (p. 25). Sheridan et al. (2014) posit makerspaces and maker culture "support making in disciplines that are traditionally separate" (p. 526), as "disciplinary boundaries are inauthentic to makerspace practice" (p. 527). Sheridan et al. (2014) also suggest maker practices "break down disciplinary boundaries in ways that facilitate process- and product-oriented practices, leading to innovative work with a range of tools, materials, and processes" (p. 527).

Multidisciplinary practices within makerspaces and maker culture tend to occur within informal learning spaces without a formalized curriculum; however, curriculum scholars also describe practices that blur disciplinary boundaries within a formalized

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[9] makezine.com/

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education context. Instead of using the term "multidisciplinary" to describe such practices, curriculum scholars tend to use terms such as "interdisciplinary," "transdisciplinary," or "interdiscipline" (J. Barrett, 2016; Burton, 2001; Friman, 2010; Gardner & Boix-Mansilla, 1994). For example, Friman (2010) suggests interdisciplinary curricula challenge "the boundaries of disciplines; they are transgressive and, to be truly interdisciplinary, must also synthesize disciplinary knowledge in new ways rather than simply adding supplementary perspectives" (p. 6). Such a description of *interdisciplinary curricula* is congruent with discussions on *multidisciplinary engagement* in maker culture scholarship; however, curriculum scholars often refer to *multidisciplinary curricula* as using disciplines as a lens for a topic (Gardner & Boix-Mansilla, 1994) or juxtaposing disciplines without attempting to make explicit connections (Burton, 2001). This distinction is important to note, as the *multidisciplinary practices* I refer to throughout this document are not practices that juxtapose disciplines or use disciplines as a lens for chiptune engagement. Rather, curriculum scholars have described *transdisciplinary curricula* as curricula that moves beyond disciplines by solving problems through whatever knowledge or practices are needed, regardless of academic discipline or field of study (Burton, 2001). Such a definition of transdisciplinary curricula is relevant to chiptune practices, which solve the problem of being able to create music through computer and video game sound chips; however, chiptune practices do not adhere to a curriculum.

Because there are conflicting definitions for such practices that merge or blur disciplinary boundaries, I want to explicitly clarify my own definition of multidisciplinary practices. In this study I focused on an informal space of a chiptune discussion forum. Given this informal context rather than a formalized education environment or curriculum, I find it appropriate to refer to multidisciplinary practices as the practices and ways of knowing that blur disciplinary boundaries. Therefore, my use

of the term multidisciplinary practices aligns more closely with maker culture

scholarship than with curriculum scholarship. This distinction between maker culture

practices in informal settings and curriculum scholarship in relation to formal learning

settings is important because this study investigates an informal space to inform music

education that typically occurs within formal learning settings, and the word

"multidisciplinary" holds different meanings in different settings and scholarship. Before

I introduce the setting and central phenomenon under investigation, I clarify my use of

the term *music-centered* making to describe chiptune-related practices.

Music-centered Making

Throughout this document, I use the term *music-centered making* to describe

maker practices that merge or blur practices from a multitude of disciplines for music-

related purposes. For example, maker culture scholars might describe practices such as

designing, manufacturing, and building electronic devices as *making*; however, for the

purpose of this study, I describe such practices as *music-centered making* when people

engage in these practices for music-related purposes (e.g., designing, manufacturing, and

building an electronic musical instrument). Examples of such practices that might be

described as music-centered making include three to five year old children building

performing instruments (Strawhacker, Sullivan, & Portsmore, 2016); using a MaKey

MaKey to create a "banana piano," which "consists of a row of bananas lined up like

piano keys, with each banana triggering a piano note [when a circuit is completed]"

(Rosenbaum, 2016, p. 123); creating DIY[10] music technologies (Flood, 2016; Jo,

Parkinson, & Tanaka, 2013) and handmade electronic music instruments (N. Collins,

2009); creating sound-art through a combination of computer engineering and

computational principles with music and sound (Brunvand & McCurdy, 2017); as well as

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[10] DIY is an acronym for "Do-It-Yourself."

building guitars (Wilson & Gobeil, 2017) and other instruments (Culbertson et al., 2009; Richards, 2013). In each example, people use a combination of practices from disciplines such as computer science, electrical engineering, visual art and design, and more for music-related purposes. While many of the practices I discuss throughout this document are forms of *making*, I am forwarding a concept of *music-centered making* to suggest that making for music-related purposes is of relevance to music educators and the field of music education.

Chipmusic.org

Most makerspaces are physical locations. Makers, however, often share ideas and creations through online discussion forums, blogs, or magazines (Brahms & Crowley, 2016). Unlike physical makerspaces, online discussion forums, blogs, and magazines revolving around maker culture and practices can allow people the ability to bypass geographical and chronological barriers through asynchronous or internet-based communication. In addition, online and printed text have the potential to provide data on maker practices that can date back several years. Such affordances enable researchers to analyze data with the potential to span over several years and from places around the world.

Rather than investigating a physical space where people engage in chiptune-related practices, this study investigates discussions of music-related practices within chipmusic.org. Chipmusic.org is an online, informal website and discussion forum focused on chiptunes with over 11,000 registered members from around the world who contribute to chiptune-related discussions. The oldest publicly visible discussion forum post on chipmusic.org is December 30th, 2009.[11] People from around the world log into chipmusic.org to share and discuss chiptune practices, resulting in hundreds of

[11] chipmusic.org/forums/topic/7

thousands of discussion forum posts. This setting is ideal for the purpose of this study as it includes several years of discussion forum posts on chiptune-related practices from around the world.

Technically speaking, chipmusic.org is not a place "where groups and individuals of diverse ages, genders, and backgrounds come together to 'make'" (Brahms & Werner, 2013, p. 1), but rather, a space where people share and discuss practices that can be understood as music-centered making. The key difference between a makerspace and chipmusic.org is that makerspaces involve active making within a physical space, while chipmusic.org is an online space where people share and discuss chiptune projects and practices created outside of chipmusic.org. Studying this rich repository of chiptune forum posts provided me with insight into the multidisciplinary aspects of chiptune-related practices and music-centered making.

I do not classify chipmusic.org as a *makerspace*, but as a *chiptune affinity space* with discussion forum posts involving maker practices that constitute *music-centered making*. Music affinity spaces are physical, virtual, or a combination of locations that act as participatory hubs for music making and learning through social networking and sharing around an affinity (interest) (Gee, 2004, 2008; Gee & Hayes, 2010; O'Leary, in press). The multidisciplinary practices inherent within maker cultures and makerspaces serve as a framework for exploring chiptune-related practices evident within the discussion forum of chipmusic.org.

Central Phenomenon and Research Questions

Schools and communities across North America are adopting practices from maker culture. Though growing number of people create and share music through maker culture practices, little scholarship explores implications of music-centered making in music education, especially in relation to music making and learning that blurs a multitude of disciplinary practices. Understanding such music practices within maker

cultures may inform or raise questions about how music educators can assist with music making and learning within contexts that some might describe as "multidisciplinary," "interdisciplinary," or "transdisciplinary." Furthermore, understanding music making and learning that blurs a multitude of disciplinary practices might help music teacher educators prepare music educators to teach or facilitate these practices. I draw on the multidisciplinary characteristic of maker practices as a framework for exploring a space (chipmusic.org) with discourse on music-centered making in order to understand practices evident within the discussion forum and how those practices might incorporate knowledge and understandings from multiple disciplines. This may inform or raise questions about music education practices.

Some chiptune-related scholars mention the diversity of chiptune practices (Carlson, 2010; K. Collins, 2013; Pasdzierny, 2013; Paul, 2014; Ratliff, 2007; Yabsley, 2007); however, these publications do not investigate educational implications of chiptune practices that merge or blur disciplinary practices between music and other fields. The purpose of this study is, therefore, to investigate chipmusic.org discussion forum posts to understand and inform music-centered making through multidisciplinary practices. The central phenomenon under investigation for this study is music-centered making evident through discussion forum posts within chipmusic.org. An investigation of music-centered making may inform or raise questions about how music educators can assist with music making and learning within educational contexts that involve merging or blurring practices from multiple disciplines, as well as how music teacher educators can prepare music educators for teaching or facilitating these practices. The following questions guide an investigation of the central phenomenon:

1. What chiptune-related practices did members of chipmusic.org discuss between December 30th, 2009 and November 13th, 2017?

2. What do chipmusic.org discussion forum posts reveal about the multidisciplinary aspects of chiptunes?

3. What import might music-centered making evident within chipmusic.org discussion forum posts hold for music education?

Research Considerations

To investigate the research questions of this study, I needed a research method with tools and techniques that could assist with analyzing 245,098 discussion forum posts that consisted of 10,892,645 total words. While there are many approaches for analyzing text-based data, some approaches are better suited for analyzing a large quantity of text. I describe some of these approaches in Chapter Three. The following section clarifies my use of the word "discourses" to refer to individual discussion forum posts, as well as my use of the word "discourse" to refer to the larger language and practices evident within chipmusic.org. Following this clarification of terminology, I introduce the research methods used in this study.

Defining "Discourse" and "Discourses"

The word "discourse" holds a variety of meanings (Baker, 2006; Fairclough, 2012; Gee 2014a; Mantie, 2009), which I summarize in Chapter Three. For sake of clarity, I follow Fairclough's (2006) differentiation between discourse and discourses by using the singular (discourse) to describe meaning-making acts and processes, and the plural (discourses) to describe specific ways of representing a part or aspect of a world (Fairclough, 2006). I use "discourse" when referring to the "big picture" of language and practices within chipmusic.org, and "discourses" when discussing various discussion forum posts within chipmusic.org.

Corpus-assisted Discourse Analysis

In this study I use corpus-assisted discourse analysis techniques to investigate hundreds of thousands of forum posts within chipmusic.org. Corpus-assisted discourse

analysis combines a variety of tools from corpus linguistic and discourse analysis methodologies to reveal patterns of language in large data sets (corpora) to guide a close reading of data (Baker, 2006; Flowerdew, 2012). Corpus-assisted discourse analyses usually follow two interconnected and often cyclical phases: (a) revealing patterns of discourse using corpus analysis techniques, and (b) a close reading of revealed patterns using discourse analysis techniques. Patterns of discourse provide insights for further inquiry through a closer reading of the text, and a closer reading of the text provides questions for revealing patterns of discourse.

Through engaging in corpus analysis techniques, I identified the multidimensional nature of music-centered making evident through chiptune-related discourse. For example, software assisted in discovering associations or word cluster patterns not apparent (or practicable) through introspective inspection alone (Baker, 2006). Associations and patterns revealed through corpus analysis techniques guided discourse analysis techniques utilized to explore the research questions for this study. Discourse analysis techniques provided tools for exploring context (Gee, 2014a; 2014b) to better understand associations or patterns of music-centered making. For example, an exploration of patterns of verb associations or word clusters relating to designing and building chiptune instruments revealed engagement through chiptune performance practices and electrical engineering, while chiptune composition practices tended to incorporate computer programming practices.

Positionality

A variety of experiences and questions led to my interest in this study. Such experiences include questioning the potential intersections of digital and acoustic musicianship, using a laptop in place of conducting at elementary band concerts,[12]

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[12] youtu.be/J130Iz0oJWY

augmenting a community ensemble through digital percussion and sound effects,[13] and performing live digital and acoustic music and sounds to live video gameplay.[14] In addition, I engaged in projects that questioned the potential intersections of video and audio editing practices in music education contexts through stop-motion[15] and YouTube cover compilations,[16] as well as the potential intersections of computer programming (coding) and the arts.[17] These experiences were often guided by the questions "when is music" and "when are music practices," which originated out of class projects and discussions during my graduate studies at Arizona State University.

In addition to questioning music and music practices in relation to music education contexts, I have research interests in exploring the intersection of video games, music, and learning (O'Leary & Tobias, 2016; Tobias & O'Leary, 2016). My passion for video games and video game culture predates my interests in music, as I began playing video games in early childhood and did not actively pursue any form of music engagement until eighth grade (13 years old). Both passions evolved in parallel but separate tracks in my life, until the last few years when I began to explore their intersections through a mixture of experiences, presentations, and publications. It is through the combination of these experiences and questions that my interest in an investigation of chiptune-related practices emerged.

Although two of the identities I ascribe to myself include gamer and musician, I do not yet consider myself to be a chipmusician or a member of the chipscene. This

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[13] youtube.com/playlist?list=PL7dVsD-fLcAOHCK_0Q5azv0yzIqOm_kIo

[14] youtu.be/GZzCCmLsY48

[15] youtu.be/wyU6wcQv430

[16] youtu.be/qYze0GB-ppw

[17] jaredoleary.com/music-coding/

resonates with other scholarship on chipmusicians, which found most chipscene participants do not identify as gamers (Tonelli, 2014) and only mention video games when an interviewer mentioned them first (Yabsley, 2007). Although I feel nostalgia whenever I hear chiptunes, I have only explored one chiptune project for a course during my graduate studies in music education. One of the purposes of this project was to explore popular music practices to understand pedagogical and curricular implications in K-12 contexts. To complete the project, I researched chiptune practices, wrote a MIDI version of Schubert's "Der Doppelgänger," and used the MIDI data to create chiptune appropriations by experimenting with different waveforms associated with the chiptune aesthetic. Aside from this one formal exploration of a chiptune process, at the time of the writing of this document I have not yet actively participated in other forms of chiptune-related practices.

Chapters of this Document

The remaining chapters of this document expand upon the concepts and methods introduced within this chapter. Chapter Two provides an in-depth literature review of background literature informing this study. I divide Chapter Two into several subsections focusing on chiptunes, the mod scene, maker culture, and online music spaces. Chapter Three provides an in-depth explanation of the research design and method as they relate to the purpose of this study. Chapter Four introduces seven themes of interconnected, chiptune-related practices evident within chipmusic.org: (a) composition practices, (b) performance practices, (c) maker practices, (d) coding practices, (e) entrepreneurial practices, (f), visual art practices, and (g) community practices. Chapter Five discusses the potential for multidisciplinarity across the revealed practices by discussing multidisciplinarity evident within a single topic, post, and image. Chapter Six discusses implications for music educators and the field of music education.

CHAPTER 2

REVIEW OF LITERATURE

In this chapter I discuss four areas relevant to the study: chiptunes, the mod scene, maker culture, and online music spaces. The chapter begins with chiptunes, the medium and genre of music discussed within chipmusic.org. I describe research on chiptunes and why the music-centered making inherent with chiptune practices are ideal for the purpose of this study. In the second section I describe research on the mod scene, a video game culture with forms of making relevant to the purpose of this study. Although practices in the mod scene shed light on forms of music-centered making associated with chiptunes, they are not as broad in terms of multidisciplinary engagement. In the third section, I describe research on maker culture and makerspaces. In particular, I discuss the multidisciplinary characteristic of maker practices to better understand multidisciplinary music engagement. I conclude the chapter by discussing research related to online music spaces.

Chiptunes

Chiptunes are a medium and genre of music using, emulating, or sampling digital sound chips typically from the 1970s and 1980s (Carlsson, 2008; Pasdzierny, 2013). As a medium, chiptunes are the appropriation of old computer and video game technology as a musical instrument (Yabsley, 2007; Carlsson, 2008; Pasdzierny, 2013). As a genre, sine, square (pulse), sawtooth (saw) and triangle waveforms – as well as the use of white and pink noise – characterize the retro aesthetic of chiptunes (K. Collins, 2008), regardless of whether original hardware and software create the sounds (Pasdzierny, 2013).

Chiptunes are often referred to as 8-bit music, chipmusic, or micromusic with subgenres or alternative names such as bitpop, Gameboy music, nerdcore, chip-hop, bitcore, fakebit, or Konami-style (Carlsson, 2008; Paul, 2014; Polymeropoulou, 2014;

Rovito, 2014). Some chipmusicians distinguish between micromusic and fakebit as genre, and chiptunes, chipmusic, or 8-bit music as a medium; however, others note devotees contest these strict or loose definitions (Carlsson, 2008, 2010; Pasdzierny, 2013; Paul, 2014; Polymeropoulou, 2014). For the purpose of this study, *chiptunes* are considered electronic music compositions or performances either emulating the sounds of or created through computer and video game sound chips typically from the 1970s and 1980s. *Chipmusicians* are musicians who create chiptunes, and the *chipscene* is the larger social world encompassing chiptune culture and practices.

Chiptunes are a product of the demoscene (Carlsson, 2010; K. Collins, 2013; Lysloff, 2003; Pasdzierny, 2013; Paul, 2014; Ratliff, 2007), which emerged in conjunction with personal computers and video game consoles in the 1980s, and "revolved around the production, dissemination, and competition of realtime generated audiovisual works (demos), demonstrating how to maximize specific hardware through unorthodox programming" (Carlsson, 2009, p. 16). Within the demoscene, "crackers" are people who remove copy protection from games and add their own real-time generated audiovisual works in the form of graffiti-like signatures known as "demos" (Carlsson, 2008, 2010; Sihvonen, 2011). Demosceners initially distributed and discussed demos across the demoscene network through postal mail, copy parties, diskmags, and online Bulletin Board Services (BBSs) (Carlsson, 2009; Paul, 2014; Ratliff, 2007). The early demoscene consisted of a multitude of engagement with demos. For instance, programmers altered computer programming code, composers created music, visual artists (graphicians) created text art, swappers mailed distributed floppy disks, traders sent data over modems, and system operators (sysops) operated BBSs (Carlsson, 2009). Although there have been a range of engagements revolving around demos, computer programming played a central role in early chiptune practices due to an initial lack of

software programs dedicated to creating music without computer programming (Carlsson, 2009; K. Collins, 2005a, 2008; Pasdzierny, 2013).

To assist with creating music through computer and video game hardware, computer companies and demosceners created trackers (short for module trackers) – software for manipulating musical information through text. Tracker design maximizes limited hardware resources inherent with early chiptune production (Carlsson, 2010). Trackers make it easier for people to create and perform chiptunes without having to modify a game's code.

Tracker interfaces often display the audio effects options (e.g., panning, pitch bends, delays, etc.) in a column next to the notation column (see Figure 1), providing effects control over each note (Carlsson, 2010). Such interface displays only a small number of notes at any given moment, which has the potential to prevent a composer from seeing the bigger picture of a composition (Paul, 2014) or influence tracker creations (Yabsley, 2007).
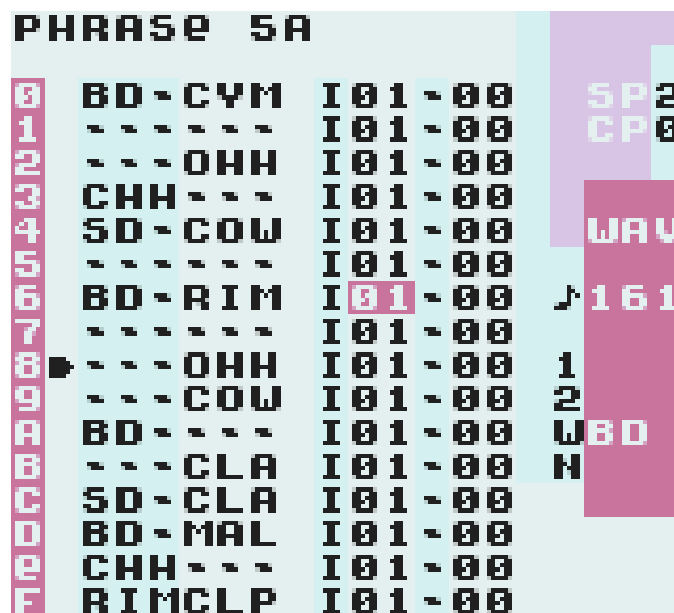
Figure 1. An image from the tracker Little Sound DJ, which displays the notes and effects columns. Source: littlesounddj.com/lsd/index.php

Although most early chipmusicians use trackers in the demoscene, the demoscene and chipscene are now two distinct subcultures, as some chipmusicians use forms of music practices not apparent in the demoscene (Carlsson, 2010). For instance, some chipmusicians now remove the original, electronic sound chips from a gaming platform and implant them into a new external system for easier access and control (Paul, 2014). Each computer chip differs in terms of programmable oscillators, number of channels, number of waveforms for each channel, polyphony/monophony per channel, envelope control (ADSR: Attack, Decay, Sustain, and Release), filters, modulators, tempi, memory, processing speeds, timbre, and tuning (Carlsson, 2010; K. Collins, 2005a, 2005b, 2006, 2008; Hopkins, 2015; Paul, 2014; Rovito, 2014; Tomczak, 2009). Not only does each sound chip differ from other chips, each chip has its own unique sound when compared with chips of the exact same model number due to manufacturing inconsistencies and the impact of wear due to usage (Tomczak, 2009). Some chipmusicians consider these imperfections desirable, while others prefer working with a consistent chiptune aesthetic (Carlsson, 2010).

Other chipmusicians engage in a process known as "circuit-bending" by intentionally short-circuiting electronic hardware to create new sounds (K. Collins, 2013). Ghazala (2004), the individual credited with discovering circuit-bending, describes the process of circuit-bending: (a) start with a low-voltage battery-powered sound circuit (e.g., a musical toy or gaming platform) and touch one end of a wire to a circuit with all other points on the circuit; (b) if there is a sound, mark it then move on; (c) once you find all of the sounds available through a starting point, move to a new starting point and repeat the previous processes; (d) when all of the sounds have been discovered, create permanent switches for making and breaking these found connections. This approach to finding unique sounds by experimenting with altering

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electrical circuitry demonstrates the experimental nature of some chiptune-related practices.

The retro hardware and software used to make chiptunes has technological constraints that shape chiptune production (K. Collins, 2005a, 2008, 2013; Carlsson, 2010; Ratliff, 2007; Tomczak, 2009; Yabsley, 2007). Carlsson (2010) summarizes these constraints as falling within four typical categories: polyphony, timbre, memory, and external constraints (e.g., processing speed and frame rate). Each category of technological constraint has creative solutions for expanding sonic possibilities within given hardware and software limitations (K. Collins, 2005a, 2008, 2013; Ratliff, 2007). Although many composers today cite these challenges as enjoyable or as a stimulant for creativity (Carlsson, 2010; K. Collins, 2013; Yabsley, 2007), some prefer to transcend the limitations of early hardware and software (Carlsson, 2010).

Present-day chipmusicians employ the same forms of music practice from the early days of the demoscene and chipscene, along with new forms through emulation of the sounds produced by older technology. Chiptune emulators often come in the form of stand-alone emulators or VSTs (Virtual Studio Technology) for a modern DAW (Digital Audio Workstation), which allow chipmusicians to use modern hardware and software to replicate the sound chips from old computer and video game hardware. In fact, some chipmusicians find chiptune making through emulation practices as more advantageous than older hardware and software, as emulators avoid the perceived limitations of the demoscene's hardware (Tomczak, 2009). Today's chipmusicians create chiptunes through a combination of newer hardware and software – often alongside acoustic instruments – without considering the early hardware limitations that characterized early chiptune practices (Pasdzierny, 2013; Polymeropoulou, 2014). In addition, live performance of chiptunes, a practice not possible in the early demoscene (Pasdzierny, 2013), have continued to grow in popularity (Paul, 2014; Yabsley, 2007). Yabsley (2007)

notes, however, that some of these "live performances" are in fact chipmusicians playing pre-composed sequences and pretending to trigger sounds and music.

Demosceners often learn how to make chiptunes by analyzing the code of a "cracked" game and then composing their own songs based off existing code (Carlsson, 2010). Unlike with MIDI or audio files, chipmusicians can analyze each sound within a distributed .MOD file (and later .XM file[18]) in detail, as the file formats are self-contained packages housing all information about how a tracker creates music and sounds (Carlsson, 2008, 2009; Pasdzierny, 2013; Ratliff, 2007). Polymeropoulou (2014) found that the internet is the main source for learning how to create chiptunes, as individuals copy how other chipmusicians create music before applying their understandings to their own musical ideas. K. Collins (2008) found that chipmusicians who engage in hardware manipulation tend to transfer their knowledge from previous experiences with chiptune hardware to similar hardware. Franklin (2009) noted that circuit-bending practitioners share and learn circuit-bending practices and discoveries through annotated pictures or diagrams. Each of these sharing and learning practices are evident within chipmusic.org and are discussed in the following chapters. In addition, these practices resemble an even larger participatory culture of a mod scene, of which the chipscene and demoscene are a subculture of (Postigo, 2010).

The Mod Scene

While a limited amount of scholarship about chiptunes explores chiptune-related practices, research on the mod scene sheds additional light on "making" and multidisciplinary music making that I refer to as "music-centered making." Although not all of the practices in the following section directly apply to the purpose of this study,

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[18] MOD and .XM files are two different file types used by trackers to create chiptunes.

multidisciplinary practices within the parallel culture of the mod scene provide insights

relevant to the purpose of this study.

The "mod scene"[19] is the surrounding social world encompassing activities or

practices (*modding*) by people (*modders*) who create or modify video games (*mods*)

(Scacchi, 2010). Postigo (2007) situates modding within the larger fan culture of

tutorials, fan-based news coverage, servers, and other fan activity. Sihvonen (2011)

describes the practice of modding as a semi-collectively mediated ritual facilitating the

(re)construction of identities and imagined communities. Many of the practices within

the mod scene consist of practices within maker culture and the chipscene.

Mods are the "customizations, tailorings, remixes, or reconfigurations of game

embodiments, whether in the form of game content, software, or hardware" (Scacchi,

2011, p. 36). Two larger mod categories exist: hardware mods (hard mods) and software

mods (soft mods) (Schäfer, 2011). Hard mods include both functional modifications

(e.g., overclocking a CPU to increase computing performance) and aesthetic

modifications (e.g., customizing a computer case with paint and neon lights) (O'Donnell,

2013; Scacchi, 2010; Schäfer, 2011; Simon, 2007). Software mods include graphical or

"skin" mods, sound mods, defined scenario mods, map mods, achievement/trophy mods,

user interface mods, or code modifications (Laukkanen, 2005; Moshirnia, 2006, 2007;

Nardi, 2010; Nieborg, 2004; Scacchi, 2010; Sotamaa, 2010a, 2010b; Taylor, 2006).

When an individual or team combine modding types with the intention of completely

overhauling every aspect of a game, these mods are known as "total conversion" mods

(Laukkanen, 2005; Nieborg & van der Graaf, 2008; Scacchi, 2010, 2011). The range of

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[19] Scholarship about the mod scene often use "mod culture" and "mod scene"
interchangeably, and are not related to a late 1950s and mid 1960s music and fashion
culture known as "mod culture"; see Hebdige (1979) to learn more about this subculture.
To alleviate confusion between these two distinct cultures, I describe video game
modding culture as the "mod scene."

mods use a number of practices for altering computer hardware and software that are similar to practices discussed within chipmusic.org.

Modding practices incorporate multidisciplinary making and learning through a variety of engagements. El-Nasr and Smith (2006) found modders might learn the following concepts through modding practices: software development and design (e.g., teamwork, critique and reflection, scheduling, management, iterations and refinement, and prototyping), programming concepts (e.g., threading and event-based programming, component-based development, and software patterns), artistic concepts (e.g., lighting, architecture design, and character design), and game concepts (e.g., game design, game mechanics, and balance). El-Nasr and Smith (2006) also noted that designing mods involves peer and expert feedback during construction, that problems usually have multiple solutions, and that modding processes use synthesis, evaluation, analysis, and revision.

Modders learn how to mod in formal and informal contexts (Sotamaa, 2007). Gaming press and fan websites often advertise formalized learning through school- and industry-sponsored events such as workshops, competitions, or classes (Sotamaa, 2007). El-Nasr and Smith (2006) noted that within formalized settings, modding helped to motivate computer programming students more than computer programming from scratch.

Sotamaa (2007) and El-Nasar and Smith (2006) discuss learning to mod within formalized learning contexts; however, informal learning also occurs in a several ways across the mod scene. Modders often collaboratively share code and content freely among mod communities (Kow & Nardi, 2010a; Laukkanen, 2005). This practice is similar to the practice of sharing .MOD and .XM files in the demoscene, and the

remixing practices that Lysloff (2003) describes within the chipscene.[20] Although Lysloff's (2003) research examined the chipscene, it did not address the question of the multidisciplinary nature of chiptune-related practices or their implications within educational contexts.

Modders often share progress on websites and monitor other mods to learn from others (Hong & Chen, 2014). Modders praise and celebrate the works of others, in addition to offering ideas or suggesting new features (Sotamaa, 2010b). In the music industry, some artists live-stream their creation processes (e.g., Deadmau5) while others post in-progress excerpts on social media platforms.

Modding has no fixed end, as there are always opportunities for continuous updates and improvements of released mods (Kow & Nardi, 2010a); i.e., once released, subsequent mod updates fix errors, alter, or add content. Hong and Chen (2014) report the majority of modders interviewed in their study spend between 30 and 50 hours a week on modding. When modders abandon a project that is taking too much time or that is no longer of interest, other modders often take over their work to continue updates and improvements on popular mods (Kow & Nardi, 2010a, 2010b).

Modding is a social activity where modders share appropriations within collaborative environments across space and time (Scacchi, 2011; Sihvonen, 2011; Steinkuehler & Johnson, 2009). Modding websites often serve as hubs for creating, sharing, and remixing these artifacts (Jansz & Theodorsen, 2009). Sometimes remixing involves modding other mods (Nieborg, 2005), especially total conversion mods (Laukkanen, 2005). A related practice in music would be if someone remixed another person's remix.

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[20] Lysloff (2003) uses "mod scene" to refer to what I am describing as the "chipscene." For clarity, I replace his terminology with "chipscene" as I refer to the mod scene as an entirely different participatory practice than chipmusicians who use .MOD files.

Some modders join mod teams with an array of expertise gathered together to work on complex projects (Jansz & Theodorsen, 2009; Sotamaa, 2010b). Mod teams tend to consist of a core membership between one and five members; however, peripheral contributors may number in the hundreds (Jeppesen, 2004). One team in a study by Postigo (2007) had 27 members specializing in at least one of the following roles: leader, co-leader, modeler, coder, mapper, graphics artist, skinner, scripter, texture artist, mapper, music artist, sound artist, concept artist, tools programmer, fan fiction writer, beta tester, webmaster, server provider, test server, and file server. In what I would consider a parallel within the mod scene, Lysloff (2003) found "crews" formed within the chipscene, which included composers, visual artists, and programmers working together on collaborative projects.

Although the mod scene provides scholarship about variegated practices with shared historical origins with the chipscene, the mod scene centers around modification of preexisting computer artifacts and hardware, not the creation of new artifacts or hardware potentially unrelated to video games. While chiptune practices may resemble some of the multidisciplinary practices evident within the mod scene, practices within the mod scene were not broad enough to frame all of the music-centered practices discussed within chipmusic.org. To assist with the analysis, I drew upon the multidisciplinary characteristic of maker practices to guide an exploration of music engagement as a form of "making."

Maker Culture

As discussed in Chapter One, one can view the ways people engage with chiptunes as a form of music-centered making. Definitions for "making" include a form of inquiry-based learning with high priority on authorship (Gutwill, Hido, & Sindorf, 2015); "a multidisciplinary, interest-driven, distributed, and evolving form of informal learning" (Brahms & Crowley, 2016, p. 27); a blend of art, craft, math and science, and

engineering (Marshall & Harron, 2018); or as "activities that can be designed with a variety of learning goals in mind" (E. Halverson & Sheridan, 2014, p. 501). In a critique of the unquestioned adoption of "making," Vossoughi, Hooper, and Escudé, (2016) write "In its most narrow, branded version, making is depicted as a uniquely American activity focused on technological forms of innovation that advance hands-on learning and contribute to the growth of the economy" (p. 207). Such hands-on practices are said to consist of the following elements: (a) ownership and empowerment through personally meaningful, playful or enjoyable, and individualized or original creations; (b) maker habits that treat failure as positive, are growth oriented, and value self-reliance; (c) production of an artifact, usually through physical manifestations; (d) collaboration through community connections, as well as through shared tools and products; and (e) both digital and physical tools (Marshall & Harron, 2018).

People who participate in maker culture are often referred to as *makers*. Sheffield, Koul, Blackley, and Maynard (2017) describe makers as

> people who enter designated spaces to collaborate, tinkering with materials with an endpoint in mind. Makers may have a variety of skills within the collective and can support each other on individual projects or work on more collaborative ideas. (p. 149)

Makers tend to meet in physical spaces — often referred to as *makerspaces* — within libraries, schools, institutions, or nonprofit and for-profit organizations to make and collaborate (E. Halverson & Sheridan, 2014). Makerspaces are described as the "places where groups and individuals of diverse ages, genders, and backgrounds come together to 'make': to mess around at the crossroads and fringes of disciplines such as science, technology, engineering, art, and math" (Brahms & Werner, 2013, p. 1) or as "informal sites for creative production in art, science, and engineering where people of all ages blend digital and physical technologies to explore ideas, learn technical skills, and create

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new products" (Sheridan et al., 2014, p. 505). In general, such spaces "have developed from two primary areas: educational reform movements, and do-it-yourself hobbyists" (Sweeny, 2017, p. 3). Sheridan et al. (2014) found makerspaces shared three unifying characteristics: (a) learning is in and for the making; (b) learning arrangements within makerspaces are diverse; and (c) multidisciplinarity encourages engagement and innovation (pp. 527-528).

Sheridan et al. (2014) describe makerspaces as being in and for the making. Makers within these spaces often "mess around with materials with no project in mind or to have a series of started projects that do not come to fruition" (Sheridan et al., 2014, p. 528). When makers create a product, it is often "meant to be shown, used, sold, or shared" (Sheridan et al., 2014, p. 529). However, as Hira and Hynes (2018) assert, "Makerspaces have also become to be known as places where people can pursue their creativity by Making things that are personally meaningful to them no matter their utility to the broader public" (p. 2). Unlike this characteristic of a makerspace, many schools tend to grade completed projects rather than understandings learned through processes and final products turned-in to the teacher only.

Sheridan et al. (2014) posit learning arrangements within makerspaces is diverse. Makerspaces include "many of the ways of seeing, valuing, thinking, and doing found in participatory cultures yet incorporates pedagogical structures found in more formal studio-based settings, such as demonstration, facilitated workshops, and critique" (Sheridan et al., 2014, p. 527). Unlike what typically occurs in schools, engagement with processes and practices are voluntary, as "people choose which learning arrangements suit their needs, what to work on, when to work on it, and whether and how they want to continue" (Sheridan et al., 2014, p. 527).

Sheridan et al. (2014) posit the disciplinary boundaries found within most schools result from curricula, standards, and assessments: "makerspaces seem to break

down disciplinary boundaries in ways that facilitate process- and product-oriented practices, leading to innovative work with a range of tools, materials, and processes" (p. 527). Brahms and Crowley (2016) found making practices evident in most articles published in MAKE — a magazine dedicated to maker practices — were multidisciplinary and "yet rarely does each discipline occur independently of others" (p. 18):

> Our analysis suggests that the practices that characterize participation in making cannot be simply described as practices that come from or point to any one educational disciplinary pathway such as engineering, science, or math. It can be argued that aspects of maker practice are drawn from or resemble certain disciplinary practices, but no one discipline or singular set of established disciplinary practices captures the essence of participation in the making community. Makers have developed a set of sophisticated community practices and modes of participation that, as a whole, are organic and, possibly, unique to making. (Brahms & Crowley, 2016, p. 25)

Within these multidisciplinary practices, Sheridan et al. (2014) suggest "there are multiple entry points to participation [which lead] to innovative combinations, juxtapositions, and uses of disciplinary knowledge and skill" (pp. 526-527). An investigation of music-centered making with the potential for multidisciplinary practices may inform or raise questions about how music educators can design and facilitate multidisciplinary music practices, as well as how music teacher educators can prepare music educators for these practices.

Critical Perspectives on Maker Culture

Although much of the scholarship on makerspaces present maker culture and practices in a positive light, some scholars critique maker culture and practices. One such critique is that "the broader purpose of making . . . is to cultivate and harness individual capabilities that will ultimately contribute to corporate agendas and

strengthen existing economic structures" (Vossoughi, Hooper, & Escudé, 2016, p. 208). Such a critique is similar to arguments against neoliberal practices of corporations positioning themselves as "industry experts" in the development of education curricula and standards (Benedict & O'Leary, 2018). Vossoughi, Hooper, and Escudé (2016) also suggest many of the maker practices engaged with by adult, white males in their leisure time have historical roots in 20th century vocational education and further suggest maker culture discourse positions working-class communities of color "as targets of intervention rather than sources of deep knowledge and skill, and dominant communities are reinscribed as being ahead, with something to teach or offer rather than something to learn" (Vossoughi, Hooper, & Escudé, 2016, p. 212). Furthermore, Abrams (2018) suggests maker events and discourse may inadvertently make discovery-based learning and integration of the arts across other disciplines "seem like the exception and not the rule" (p. 104).

Online Music Spaces

Several scholars have investigated online spaces or communities that revolve around interests. For example, investigations of online spaces include a focus on Dance Dance Revolution (Holden, 2012), The Sims fan fiction (Lammers, 2012), Neopets writing (Magnifico, 2012), celebrities (Ellcessor & Duncan, 2012), video games (DeVane, 2012; Duncan, 2010, 2012a, 2012b; E. King, 2012; Steinkuehler & Duncan, 2008), video game modding (Durga, 2012; Hayes & Lee, 2012; Moshirnia, 2006), and the chipscene (Lysloff, 2003). Although many of these studies include findings of potential interest to music educators, these studies do not investigate multidisciplinary practices relevant to music-centered making.

Scholars investigating online spaces dedicated to music engagement, teaching, or learning provide examples of investigations of online discourse. For example, researchers have investigated discourse within a German-speaking hip-hop website and

discussion forum (Androutsopoulos, 2007), music educator groups on Facebook (Bernard, Weiss, & Abeles, 2018; Palmquist & Barnes, 2015; Rickels & Brewer, 2014), an online Finish music community (Partti & Karlsen, 2010; Salavuo, 2006), an online music community focusing on collaboratively composing an opera (Partti & Westerlund, 2013), and online spaces dedicated to particular instruments or styles of music (Waldron, 2009, 2011, 2012, 2013). While each study has its own merits for the field of music education, they do not relate to the purpose of this study as they do not investigate multidisciplinary practices or music engagement as a form of music-centered making.

Commentary

Scholars who write about the chipscene, the mod scene, and maker culture describe similar hardware and software practices engaged with by people who participate in each subculture. For example, chipmusicians engage in software modification practices (e.g., coding a tracker) that are common among the mod scene, as well as hardware creation and modification practices (e.g., circuit-bending) common within maker cultures. A distinguishing factor between each subculture is the purpose for such practices, rather than the practices themselves. Chipmusicians engage in practices that relate to or enable creating chiptunes, whereas modders tend to engage in software modification practices to create or modify video games, and makers tend to engage in hardware practices that might not relate to music making. However, my review of literature on these subcultures and online music spaces assisted with my own understanding of the music-related practices discussed within chipmusic.org and informed my decision to use the term *music-centered making* to describe maker practices that merge or blur practices from a multitude of disciplines for music-related purposes. Throughout Chapters Four, Five, and Six I describe how the findings from this study relate to and differ from scholarship discussed within this chapter.

CHAPTER 3

METHOD AND DESIGN

The purpose of this chapter is to provide a detailed explanation of the method and design of this study as it relates to the central phenomenon under investigation. I begin with a brief overview of perspectives on "discourse" and several approaches for analyzing discourse. I divide the remainder of the chapter into subsections detailing the setting, data selection and collection, data analysis, research relationships, and ethics as they relate to the purpose of this study.

What is Discourse?

The word "discourse" holds a variety of meanings in different contexts (Baker, 2006). For instance, Fairclough (2012) proposes discourse as "(a) meaning-making as an element of the social process; (b) the language associated with a particular social field or practice (e.g. 'political discourse'); (c) a way of construing aspects of the world associated with a particular social perspective (e.g. a 'neo-liberal discourse of globalization')" (p. 11). Discourse has also been described as language in use (Gee, 2014a), "general discursive and non-discursive disciplinary practices" (Mantie, 2009, p. 36), or institutionally produced knowledge (Kress, 2012). In order to distinguish concretized instances of language from the larger truths they embody, Gee (2000, 2013, 2014a, 2014b, 2014c, 2015) employs the words "discourse" and "Discourse," whereas Fairclough (2006) uses the words "discourses" and "discourse."

For sake of clarity, I follow Fairclough's (2006) differentiation between discourse and discourses by using the singular (discourse) to describe larger meaning-making acts and processes, and the plural (discourses) to describe specific ways of representing a part or aspect of a world. I use "discourse" when referring to the "big picture" of language and practices within chipmusic.org, and "discourses" when discussing various discussion

forum posts within chipmusic.org. The following section summarizes some of the techniques or approaches for analyzing discourse and discourses.

Approaches to Discourse Analysis

Like discourse, discourse analysis holds a variety of meanings, and scholars who employ discourse analysis use a multitude of "techniques for making connections between texts and their meanings" (Lemke, 2012, p. 79). These techniques group together to form analytical approaches for different data and purposes. Some examples include conversation analysis (Clayman & Gill, 2012), corpus-based discourse analysis (Baker, 2006; Biber, 2012; Flowerdew, 2012), critical discourse analysis (Fairclough, 2012; Flowerdew, 2012), discourse-centered online ethnography (Androutsopoulos, 2008), discursive psychology (Potter, 2012), interactional sociolinguistics (Jaspers, 2012), linguistic anthropology (Richland, 2012), mediated discourse analysis (Scollon & de Saint-Georges, 2012), multimedia analysis (Lemke, 2012), multimodal discourse analysis (Kress, 2012), narrative analysis (Thornborrow, 2012), and systemic functional linguistics (Schleppegrell, 2012). Gee (2014a) posits that not one approach to discourse analysis is the only approach worth undertaking, as different approaches assist with different data and questions.

Music education scholars have used discourse analysis techniques to explore classroom or lesson discourse (M. Barrett, 1996; Dobbs, 2005; Nerland, 2007; Talbot, 2010b), professional discourse (Dobbs, 2012; Farmer, 2015; Kopkas, 2011; Mantie, 2009, 2012, 2013; Schmidt, 1999; Thompson, 2002), media discourse (Talbot & Millman, 2010), and online discourse (Androutsopoulos, 2007). Talbot (2013) claims that discourse analysis techniques assist with discovering "successful ways to switch between languages, musics, and legacies of participation" (p. 58). Other researchers suggest discourse analysis techniques assist with understanding how discourse influences teaching and learning (Dobbs, 2010; E. Stevens, 2016).

If the corpora under investigation for this study were spoken language or face-to-face interaction involving music-centered making, discourse analysts might draw upon approaches such as interactional sociolinguistics (Jaspers, 2012), narrative analysis (Thornborrow, 2012), or conversation analysis (Clayman & Gill, 2012). If exploring music-centered making outside of talk or text, researchers might engage in discursive psychology (Potter, 2012), mediated discourse analysis (Scollon & de Saint-Georges, 2012), multimedia analysis (Lemke, 2012), or multimodal discourse analysis (Kress, 2012). If combining techniques with other methodologies, scholars might use discourse-centered online ethnography (Androutsopoulos, 2008) to reveal cultural themes evident within a discussion forum or use critical discourse analysis to gain a "better understanding of the nature and sources of social wrongs, the obstacles to addressing them, and possible ways of overcoming those obstacles" (Fairclough, 2012, p. 13). Each approach provides tools for analyzing various modes of discourse, but none are ideal for analyzing a large number of discussion forum posts as undertaken in this study.

Researchers might use text-based approaches, such as corpus-based analysis (Flowerdew, 2012), systemic functional linguistics (Schleppegrell, 2012), or linguistic anthropology (Richland, 2012) to analyze discussion forum posts. Each approach, however, focuses on either macroscopic linguistic patterns of discourse from large corpora (e.g., patterns of pronoun usage within several years of discussion forum posts) or microscopic linguistic details of discourse from relatively small data sets (e.g., grammatical structure within a single discussion forum post). The research questions guiding this study benefited from a combination of techniques for macroscopic analysis (i.e., patterns of music-centered making evident through discourse from large corpora) and microscopic analysis (i.e., close readings of select patterns of music-centered making). The following section describes corpus-based analysis, a branch of discourse

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analysis that combines tools from corpus linguistics with other forms of discourse analysis.

Corpus-based Analysis

Corpus linguistics is a disciplinary area that focuses on language and the construction of discourse within a text (known as a "corpus"). Corpus-based analyses combine computational analysis with quantitative and qualitative analytical techniques to reveal linguistic patterns within large texts (Biber, 2012). Corpus-based analysts investigate corpora (collections of written text) by exploring patterns of word use through quantitative techniques to determine linguistic frequencies, relationships, or patterns. Corpus-based analysts also use qualitative procedures to analyze linguistic patterns established through quantitative techniques. Corpus-based analysts seek to reveal linguistic patterns to understand construction of discourse or reality (Baker, 2006). An epistemological assumption for corpus-based analysis is that patterns in discourse demonstrate widely-shared meanings within a given discourse. For example, Farmer (2015) found professional discourse in music education publications associated the word "urban" with low socioeconomic status and students of color.

Although a valuable approach for determining and analyzing linguistic patterns within a large body of text, some critics voice concerns over utilizing this approach in studies that seek a close reading of a large body of texts or a contextualized investigation of linguistic patterns which may contribute to enacted discourse (Baker, 2006; Flowerdew, 2012). Analysts interested in interpreting linguistic patterns within a large body of text might prefer approaches with more qualitative procedures rather than focusing on approaches that count linguistic features (Biber, 2012). Although corpus-based discourse analysis techniques might assist with an investigation of linguistic patterns evident within forum posts within chipmusic.org, another approach, corpus-assisted discourse analysis, attempts to address some of these concerns.

Corpus-assisted Discourse Analysis

Corpus-*assisted* discourse analyses differ from corpus-*based* analyses in that corpus-assisted discourse analyses use corpus analysis techniques and tools to support or guide a closer reading through discourse analysis techniques. Mantie (2009) and Farmer (2015) used corpus-assisted discourse analysis techniques to reveal patterns of language in use within various music education journals. Rather than only reporting word frequencies and other corpus-based findings, Mantie and Farmer use corpus analysis techniques to guide a close reading of contexts surrounding their corpus analysis results.

Corpus-assisted discourse analyses usually engage in two interconnected, and often cyclical phases: (a) revealing patterns of discourse using corpus analysis techniques, and (b) a close reading of revealed patterns using discourse analysis techniques. Patterns of discourse provide insights for further inquiry through a closer reading of the text, and a closer reading of the text provides questions for exploring more patterns of discourse. This approach allows for a closer reading of a large body of text than a corpus analysis on its own.

Because I investigated music-centered making evident through discussion forum posts within chipmusic.org, I engaged in corpus analysis to establish patterns of music-centered making within a corpus (a large body of text) consisting of hundreds of thousands of forum posts. These patterns of language in use then assisted with a closer reading of the forum posts. To explore the research questions of this study, I drew heavily on two scholars for guidance through the two approaches forming a corpus-assisted discourse analysis.

I followed Flowerdew's (2012) suggestion for using Baker's (2006) book as a guide for using corpus analysis techniques to assist with discourse analyses. Baker's thorough walkthrough of corpus analysis techniques assisted with revealing patterns of

music-centered making evident through discussion forum posts within chipmusic.org. To analyze patterns of music-centered making, I used some of Gee's (2014a, 2014b) suggested approaches for discourse analysis. Gee's approach to discourse analysis encourages a contextually situated, multiperspectival analysis of discourse through several building tasks of language. Gee's emphasis on exploring discourses (i.e., discussion forum posts) in relation to surrounding discourse (i.e., the "big picture" of language and practices within chipmusic.org) provided a useful framework for questioning the revealed patterns of discourse in relation to surrounding context such as the discussion topic, subforum, and the discussion forum as a whole. In addition, Gee's emphasis on a multiperspectival analysis of discourse provided several useful lenses for questioning and analyzing music-centered making within chipmusic.org.

Given the quantity and type of data under investigation, corpus-assisted discourse analysis provided techniques for exploring the research questions for this study through a combination of microscopic and macroscopic analysis techniques. The corpus-assisted discourse analysis techniques used in this study revealed patterns of music-centered making within a large collection of data and guided a closer reading of revealed patterns of music-centered making. The following section outlines the research design for this study as it relates to the purpose of this study.

Research Design

Overview

Chipmusic.org is an online, informal website and discussion forum focused on chiptunes with over 11,000 registered members from around the world who contribute to discussions spanning several years. I used extraction techniques that I describe later to collect all forum posts from chipmusic.org. Once collected, I used corpus-assisted discourse analysis tools to engage in two interconnected and cyclical analysis phases guided by the research questions for this study.

The first phase of the analysis cycle consisted of discerning patterns of music-centered making evident through discussion forum posts by using tools I describe in one of the following subsections on data analysis. The second phase of the analysis cycle consisted of a close reading of the patterns of music-centered making revealed in phase one of the analysis cycle through discourse analysis techniques also described in one of the following subsections on data analysis. The analysis in phase two led to more questions best explored through techniques in phase one, continuing the analysis cycle (see Figure 2). The analysis cycle ended when both phases exhausted an exploration of the research questions for this study, a point where further inquiries consistently reaffirmed prior findings or failed to generate questions relevant to the purpose of this study. The following subsections describe the research design for this study in further detail. I divide the following subsections into discussions on setting, data selection and collection, data analysis, research relationships, and ethics.
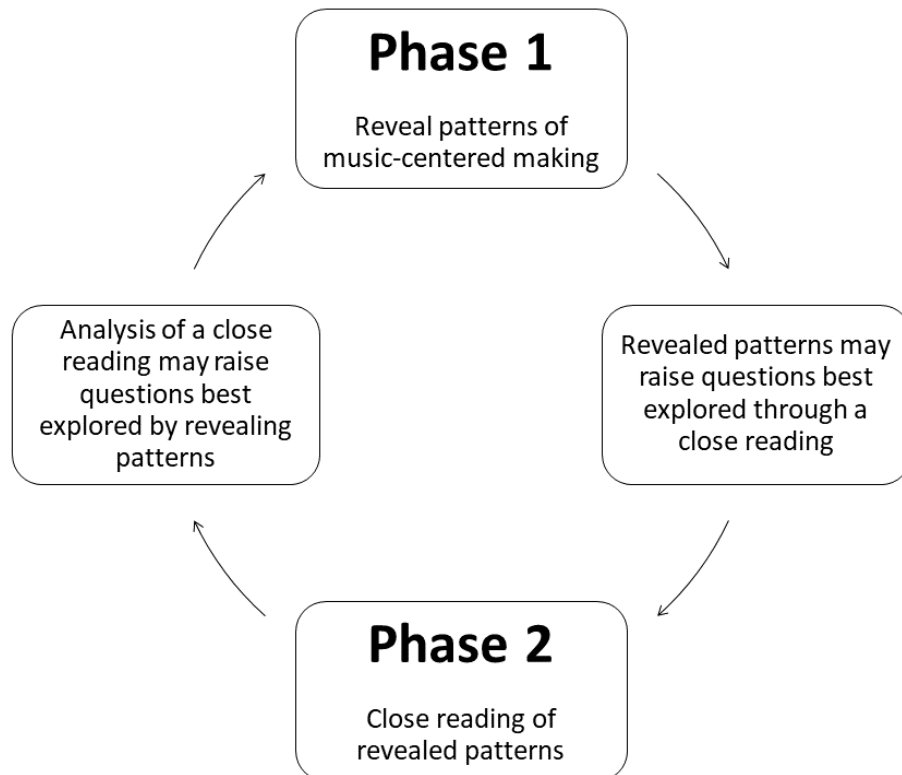
Figure 2. A visualization of the two-phase analysis cycle.

Setting

Although other video game music discussion forums with larger numbers of members discuss chiptunes,[21] chipmusic.org is a large, English-speaking, online space dedicated entirely to chiptunes, rather than the broader category of video game music. At the time of data extraction, chipmusic.org had over 11,000 registered members contributing to hundreds of thousands of discussion forum posts since the oldest publicly visible discussion forum post on chipmusic.org, which dates to December 30th, 2009.[22] Chipmusic.org provided an ideal setting for exploring music-centered making evident through discourse within an informal, online discussion forum. Although I identify chipmusic.org as the setting for this study, not all discourse within chipmusic.org were studied as data.

Data Selection, Collection, and Cleaning

Data selection. I limited data to discourse within chipmusic.org. This study did not analyze hyperlinked discourse referenced within chipmusic.org (e.g., hyperlinked YouTube videos, articles, tutorials, code, etc.) or from other chiptune discussion forums. Much of the hyperlinked resources within chipmusic.org did not relate to discourse on chiptunes or music-centered making. The purpose behind drawing this boundary was to focus on music-centered making evident through discussion forum posts within chipmusic.org. However, I provide hyperlinked resources throughout this document to assist with clarifying context surrounding discussion forum discourses.

Data collection. Manually copying and pasting discussion forum posts could generate a source of data; however, this process is unnecessarily slow. Automated

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[21] For example, ocremix.org has over 34,000 members contributing to 822,000 posts within 46,000 topics as of March 3rd, 2018.

[22] chipmusic.org/forums/topic/7

website data extraction software[23] offers an efficient and effective approach to compiling forum posts. With either approach, there are possibilities for collection error due to humans or algorithms (Baker, 2006). Because the discussion forum posts date as far back as December 30th, 2009, and because the forum contains hundreds of thousands of posts, I chose to use automated extraction tools to cut down on manual extraction errors and save time.

In this study, I used an automated website extraction tool called Web Scraper[24] to customize which data were collected from chipmusic.org forum posts. The extraction code (see Appendix A) extracted the subforum title, topic title, post text, and URL for each post's location within chipmusic.org as a separate spreadsheet file (see Figure 3) for each of the 24 subforums.[25] I used four separate laptops to simultaneously extract all posts within the discussion forum over a 16-hour period beginning at 5:00 pm Mountain Standard Time (MST) on November 13th, 2017. This resulted in data ranging from December 30th, 2009, through the period of data extraction.

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[23] Also known as "scraping" or "harvesting" software.

[24] webscraper.io/

[25] The subforums titles are (a) "Constructive criticism," (b) "General discussion," (c) "Past events," (d) "Releases," (e) "Trading post," (f) "Upcoming events," (g) "Atari," (h) "Audio production," (i) "Circuit bending," (j) "Commodore computers," (k) "Littlegptracker," (l) "Nintendo consoles," (m) "Nintendo handhelds," (n) "Other hardware," (o) "Other vintage computers & consoles," (p) "Product reviews," (q) "Sega," (r) "Software & plug-ins," (s) "Tutorials, mods, & how tos," (t) "Bugs and requests," (u) "Rules and announcements," (v) "Graphics, artwork & design," and (w) "Motion graphics."

	post_title	post_title-href	subforum	subforum_page-l	post_text		post_pag	post_pagination-hre
1								
2189	Layering Ending of Track into Beginn	https://chipmusic.org	Previous	https://chipmusi	Serious response: I think what he was talking about with Attack Attack was actually Negative Tra		2	https://chipmusic.or
2190	Any synthesis gurus can assist with I	https://chipmusic.org		2	https://chipmusi	Hey guys, thanks for all the help! Yea, a poly square wave with distortion and a touch of LFO is the ticket!!Yea, I really like the		2	https://chipmusic.or
2191	vocal smoothing	https://chipmusic.org	Previous	https://chipmusi	BitPop wrote:Mic control is mainly just for live work. In the studio the vocalist should stay as sta		2	https://chipmusic.or
2192	Volume Levels?	https://chipmusic.org	Previous	https://chipmusi	"super low" is just as bad.you have a limited bit depth, make the most of it		2	https://chipmusic.or
2193	Checking your mix/master	https://chipmusic.org		3	https://chipmusi	Hey guys, I'd be interested in what your usual routine for checking whether your mix and master are good is. I usually let the n			
2194	BIT SHIFTER - AVAILABLE /Booking ar	https://chipmusic.org		2	https://chipmusi	Is the misspelling of the word "Available" some sort of non-conformist statement?			
2195	Elements For Chipbreak	https://chipmusic.org		4	https://chipmusi	I drop amen breaks in a lot of my nanoloop tracks (i use wav samples and nanoloop iPhone). Chipbreak is my favorite variant o			
2196	What kinds of mixers are you all usir	https://chipmusic.org		4	https://chipmusi	Like Herr says, the vlz series is great.. built like a tank, clear sound, virtually noiseless		3	https://chipmusic.or
2197	What tricks/tips do you you when pr	https://chipmusic.org	Previous	https://chipmusi	Shonen_ wrote:Record it RAW. And then EQ it a bit to BOOST DA BASS.this.		3	https://chipmusic.or
2198	MacBook Pro/laptop recommendati	https://chipmusic.org		2	https://chipmusi	As for giging I live in Midwestern Kansas so shows are small venues and it's not very hard for me		2	https://chipmusic.or
2199	wav to mp3 woes	https://chipmusic.org	Previous	https://chipmusi	You might want to try to roll off the bass frequencies around 40-60hz (?) I've not heard the wav yet so i don't know (waiting "in			
2200	Bass Sound On Stevie Wonder Track	https://chipmusic.org		6	https://chipmusi	Could well be right. The Wikipage lists a moog and and arp but isn't specific about which models.http://en.wikipedia.org/wiki/			
2201	how can i reproduce this sound	https://chipmusic.org		4	https://chipmusi	patawic wrote:The trouble is, i cant seem to get the arpeggio fast enough, its going faster then 128ths to the point where the v			
2202	Music theory question.	https://chipmusic.org		3	https://chipmusi	Sol La Ti Do is "easier" to sing than Sol Le Ti Do. It was typically avoided but in contemporary music this rule has weakened. But			
2203	Gameboy/Launchpad/Ableton Live :	https://chipmusic.org		4	https://chipmusi	an arduino boy.			
2204	two related questions about music I	https://chipmusic.org/forums/topic/16566/two-re			I don't see what the problem is as long as it's not clipping			
2205	Looking for someone to mix/master	https://chipmusic.org	Previous	https://chipmusi	I'll give it a shot...What kind of files would you be sending? IS the whole thing done in LSDJ or what? If it's just one file that'd b			
2206	Gameboy/Launchpad/Ableton Live :	https://chipmusic.org		4	https://chipmusi	But you really dont need rca outputs.		2	https://chipmusic.or
2207	Scratches, noises, and general feel c	https://chipmusic.org		3	https://chipmusi	found ithttp://chipmusic.org/forums/topic/2643/ ... bloopcart/that thread has some of the bant		2	https://chipmusic.or
2208	Live Recording	https://chipmusic.org		4	https://chipmusi	@Kinetic Yeah I usually use a mic for introduction/hype@Krubbz Like I said before (regarding mics) i dont have much in the wa			
2209	Anyone ever record chip on cassette	https://chipmusic.org/forums/topic/6798/anyone			I am a very happy owner of this:http://truechiptilldeath.com/blog/2009/ ... xygenstar/			
2210	Checking your mix/master	https://chipmusic.org		3	https://chipmusi	Scopes are great for the high end and low end especially.		2	https://chipmusic.or
2211	Seperating pieces of audio	https://chipmusic.org		4	https://chipmusi	well there is a whole big feature about doing exactly that in this month's computer music magazinei have nothing against shari			
2212	What studio monitor speakers do yc	https://chipmusic.org	Previous	https://chipmusi	Event TR6 Biamped Tuned Reference Studio MonitorsIncredible monitors.http://www.zzounds.		2	https://chipmusic.or
2213	Live Recording	https://chipmusic.org		4	https://chipmusi	That should work fine			
2214	Anyone ever record chip on cassette	https://chipmusic.org/forums/topic/6798/anyone			The little 4 track cassette recorders tend to (ham-handedly) do some of your EQ work for you w		4	https://chipmusic.or
2215								

Figure 3. An example spreadsheet generated from data extracted from the "Audio production" subforum.

Data cleaning. Although data extractions from 14 subforums resulted in a match between the number of extracted topics and subforum post metrics[26] available at the time of data extraction, 10 of the subforums had an excess of up to 814 more posts in the extracted data than indicated by subforum metrics. Repeated extractions across several laptops resulted in the same discrepancies in each subforum extraction, indicating a consistent collection error or discrepancy. I conducted a manual inspection of each subforum and found the discrepancy was due to moved or closed forums being extracted by Web Scraper, but not counting toward subforum metrics. For example, the topic titled "Piggy Tracker Thread"[27] accounted for 814 of the extracted posts in the "Software & plug-ins" subforum; however, the topic was moved to the "Littlegptracker" subforum, resulting in duplicate data. Although the topic appeared in both subforums, these posts did not count toward the site metrics for the "Software & plug-ins" subforum. I manually inspected each discrepancy, removed duplicate data from subforums with moved topics, and kept data for closed topics (e.g., a topic in the "Trading post" subforum might close when the items were traded or sold). In addition, I chose to leave quoted replies within the data because members often used quoted replies to restate another member's original post or to respond to excerpts from a larger quote.[28] The following table indicates the total number of topics and posts extracted from each subforum:

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[26] Subforum metrics such as number of topics, number of posts, and last post date are located on the right side of each subforum's title: chipmusic.org/forums

[27] chipmusic.org/forums/topic/118/piggy-tracker-thread/

[28] See the following page for examples of restating and quoting excerpts within the same topic: chipmusic.org/forums/topic/6488/chip-music-app-solved/page/2/

Table 1

Number of topics and posts extracted from each subforum of chipmusic.org

Subforum title	Topics	Posts
Community		
Collaborations	379	8,812
Constructive criticism	668	4,693
General discussion	2,898	68,979
Past events	1,640	18,776
Releases	4,054	31,050
Trading post	2,107	20,874
Upcoming events	4	30
Hardware & software		
Atari	132	1,555
Audio production	161	2,213
Circuit bending	87	674
Commodore computers	407	4,423
Littlegptracker	166	3,444
Nintendo consoles	449	7,893
Nintendo handhelds	2,703	38,515
Other hardware	483	6,124
Other vintage computers & consoles	204	2,958
Product reviews	13	127
Sega	159	3,812
Software & plug-ins	385	6,311
Tutorials, mods, & how tos	230	2,399
Site operations		
Bugs and requests	293	3,197
Rules and announcements	19	515
Visual arts		
Graphics, artwork & design	281	5,646
Motion graphics	235	2,078
Total	18,157	245,098

Note. Each topic contained one or more posts; however, each post is a response to a single topic.

Although relatively easy to extract data, this type of research poses interesting ethical questions I discuss at the end of this chapter. After collecting a range of discussion forum posts from chipmusic.org, the remainder of the study involved an analysis of collected data. The following section details the analysis process for this study.

Data Analysis

I used corpus-assisted discourse analysis techniques to address the research questions posed in this study. Although corpus-assisted discourse analyses use two distinct sets of analytical techniques, I do not intend for the following detailed outline of each set of techniques to imply corpus analysis techniques stopped once discourse analysis techniques began. When a closer reading of the text raised questions best explored through corpus analysis techniques, I used additional corpus analysis techniques. These techniques were iterative and cyclical in nature. In other words, data analysis began with corpus analysis techniques revealing patterns of music-centered making. I then analyzed revealed patterns through discourse analysis techniques. However, a close reading of revealed patterns of music-centered making often led to more questions best explored through additional corpus analysis techniques.

Corpus analysis techniques used within this study. Software programs designed for corpus analysis typically provide a suite of corpus analysis tools designed to reveal patterns of discourse within corpora (a large collection of texts). Corpus analysis software generates metrics such as word lists, frequency analysis, dispersion, concordances, collocation, or keyness. Each metric provides insights into patterns of discourse within corpora that are too large to analyze through discourse analysis

techniques alone. I used WordSmith Tools,[29] a piece of corpus analysis software designed for analyzing large, text-based data sets through corpus analysis.

Corpus analysis techniques assisted with answering the research questions within this study by revealing patterns of language in use across and within a large number of discussion forum posts within chipmusic.org. These techniques did not require any particular order or sequence, as they were different tools of inquiry that overlapped or cycled in various ways. For instance, when keyness revealed differences in discourse between two subforums within chipmusic.org, I explored these differences through combinations of concordance, collocation, or dispersion techniques, which I describe in the following sections. If a technique illuminated a pattern of discourse not yet explored in detail, I investigated this new pattern through techniques previously used on other patterns. These techniques were essential for narrowing down the focus of the discourse analysis, as the corpus analysis results guided the discourse analysis techniques described in the following section. I now summarize the corpus analysis techniques used within this study.

Word lists. Corpus analysts use computer-generated word lists to quickly analyze corpora to determine frequency of word use. Word lists are computer-generated lists of words within a corpus displaying frequencies and percentage of contribution in relation to a corpus (Baker, 2006); see Figure 4. This approach resembles word clouds in that it allows someone to quickly identify the most frequently used words across a body of text. Knowing which words occur the most or least within chipmusic.org led to a better understanding of what forms of music-centered making were most or least prevalent within chipmusic.org. For instance, members of chipmusic.org discussed composition

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[29] lexically.net/wordsmith/

practices more than performance practices, which indicated composition practices were more prevalent than performance practices within chipmusic.org.

N	Word	Freq.	%	Texts	% Dispersion	Lemmas	Set
1	THE	5,215	3.81	1	100.00			
2	#	3,937	2.88	1	100.00	0.00		
3	A	3,692	2.70	1	100.00			
4	TO	3,538	2.58	1	100.00	0.00		
5	I	3,302	2.41	1	100.00			
6	AND	2,804	2.05	1	100.00			
7	OF	2,153	1.57	1	100.00	0.00		
8	YOU	2,141	1.56	1	100.00			
9	IT	2,061	1.51	1	100.00			
10	IS	1,666	1.22	1	100.00	0.00		
11	IN	1,510	1.10	1	100.00	0.00		
12	FOR	1,430	1.04	1	100.00	0.00		
13	THAT	1,380	1.01	1	100.00			
14	ON	1,136	0.83	1	100.00			
15	WITH	1,097	0.80	1	100.00			
16	BUT	960	0.70	1	100.00			
17	HAVE	924	0.68	1	100.00			
18	THIS	913	0.67	1	100.00	0.00		
19	Ÿ	901	0.66	1	100.00			
20	IF	898	0.66	1	100.00			

Figure 4. A word list of the "Audio production" subforum.

A type/token ratio (TTR) is the percentage of unique words within a text. A TTR is determined by dividing the total number of unique words (type) by the total number of words (token) to determine what percentage of words within a text are unique. Corpus analysts might use word lists with a TTR to identify whether a corpus discusses a narrow (low TTR) or wide range of subjects (high TTR) (Baker, 2006). If a discussion forum within chipmusic.org had a low TTR, this indicated a low percentage of unique words within corpora and might indicate a space with relatively uniform discourse on music-centered making. If, however, there was a high TTR, this indicated a high percentage of unique words within corpora and may indicate greater variance in discourse on music-centered making; see Figure 5 for an example of TTR in WordSmith Tools.

43

text file	
file size	744,718
tokens (running words) in text	136,876
tokens used for word list	132,939
sum of entries	
types (distinct words)	8,493
type/token ratio (TTR)	6.39
standardised TTR	39.74
STTR std.dev.	58.73
STTR basis	1,000
mean word length (in characters)	4.24
word length std.dev.	2.31
sentences	5,537
mean (in words)	24.01
std.dev.	29.09
paragraphs	1
mean (in words)	132,939.00

Figure 5. An example image of the type/token ratio (TTR) for the "Audio production" subforum.

Knowing whether a corpus includes a narrow or broad range of subjects helps a corpus analyst determine if a corpus utilizes specialist languages and understandings. Specialist languages and understandings are styles of language used by experts when they are speaking or acting as specialists of a particular discourse (Gee, 2014a). For instance, chipmusicians use specialist language related to electrical engineering and computer programming.

While understanding which words corpora use the most may assist with gaining a general understanding of discourse, word lists do not filter for words salient to the purpose of a study, but instead display all words within corpora. Knowing members of the discussion forum within chipmusic.org use the word "the" more than the word "an" would not provide a better understanding of the research questions of this study; however, knowing the word "compose" appears more than the word "perform" did. To better understand what people talk about within a given corpus, corpus analysts might use a technique known as lexical frequency analysis.

Lexical frequency analysis. Lexical frequency analysis is an analytical technique for revealing the focus of a text or revealing when people speak in unexpected ways. For example, I did not expect to find discourse on audio editing software within subforums on visual arts. However, when this occurred, a closer reading of unexpected discourse assisted with understanding the context surrounding text. Similar to word lists, this metric displays a word count; however, lexical frequency analysis filters out words unrelated to determining what a corpus is about (e.g., articles such as "the," "an," or "a"). See Figure 6 for example lexical frequency analysis of keywords in the "Audio production" subforum. Although lexical frequency analyses might help determine what a corpus is about, the analysis should not stand on its own, but also relate to context (Baker, 2006).

N	Key word	Freq.	%	Texts	RC. Freq.	%	BIC	Log_L	Log_R
1	KSCR	307	0.22	1	307		1,856.93	1,873.18	6.37
2	MASTERING	300	0.22	1	761		1,393.37	1,409.63	5.02
3	EQ	270	0.20	1	803		1,182.01	1,198.26	4.79
4	MIX	337	0.25	1	2,492	0.02	960.09	976.35	3.48
5	MIXING	193	0.14	1	957		674.29	690.54	4.06
6	RECORDING	261	0.19	1	2,315	0.02	659.67	675.92	3.22
7	COMPRESSION	117	0.09	1	339		508.03	524.29	4.83
8	STEREO	200	0.15	1	1,831	0.02	491.06	507.31	3.17
9	SOUND	550	0.40	1	15…8	0.14	410.68	426.93	1.50
10	RECORD	222	0.16	1	3,000	0.03	404.66	420.91	2.61
11	COMPRESSOR	81	0.06	1	180		381.62	397.88	5.21
12	REVERB	100	0.07	1	565		319.30	335.55	3.87
13	MASTER	161	0.12	1	2,057	0.02	303.55	319.80	2.69
14	NOISE	232	0.17	1	4,572	0.04	288.36	304.61	2.07
15	SPEAKERS	97	0.07	1	638		284.10	300.35	3.65
16	TAPE	126	0.09	1	1,305	0.01	277.41	293.66	2.99
17	MONITORS	72	0.05	1	279		271.46	287.71	4.41
18	BASS	207	0.15	1	4,004	0.04	261.25	277.50	2.09
19	AUDIO	223	0.16	1	4,941	0.04	238.66	254.91	1.90
20	EFFECTS	141	0.10	1	2,053	0.02	234.32	250.57	2.50
21	TRACK	307	0.22	1	8,773	0.08	228.97	245.22	1.53
22	FREQUENCIES	70	0.05	1	374		225.30	241.55	3.95
23	LIMITER	47	0.03	1	100		217.87	234.12	5.28
24	MIXER	131	0.10	1	1,963	0.02	210.60	226.85	2.46
25	DAW	92	0.07	1	916		204.20	220.45	3.05
26	CASSETTE	70	0.05	1	472		197.53	213.78	3.61
27	MONO	105	0.08	1	1,322	0.01	194.81	211.06	2.71

Figure 6. An example image of lexical frequency analysis results of the "Audio production" subforum.

Lexical frequency analyses might provide a better understanding of the lexicon used within a given corpus; however, corpus analysts need to account for people using language in different ways. For example, chipmusicians used variants of "compose," "composed," and "composing" to discuss composing music; however, a word count treats these words as separate and places them lower on a frequency list than if combined. To account for such uses of language, lexical frequency analyses can use lemmas. Lemmas are words belonging to the same major word class or stem, with differences in spelling or inflection (Baker, 2006). An example set of lemmas within chipmusic.org is for the word "chipmusic," which includes the lemmas "chiptune," "chiptunes," "micromusic," "fakebit," "nerdcore," "bitpop," "bitcore," "nintendocore," "chip-hop," and "konami-style." In addition, lemmas can account for general spelling mistakes. For example, the software "Ableton" was misspelled 32 times as "Abelton." I manually inspected each keyword list to reveal a list of 950 lemmas; see Figure 7 for an example lexical frequency analysis with lemmas.

Key word	Freq.	%	Texts	RC. Freq.	%	BIC	Log_L	Log_R	P	Lemmas
KSCR	307	0.22	1	307		1,856.93	1,873.18	6.37	0.0000000000	
EQ	312	0.20	1	803		1,182.01	1,198.26	4.79	0.0000000000	eq[270] eq'ing[7] eqing[22] eqs[13]
MIX	717	0.25	1	2,492	0.02	960.09	976.35	3.48	0.0000000000	mix[337] mixed[28] mixer[131] mixers[28] mixing[193]
STEREO	200	0.15	1	1,831	0.02	491.06	507.31	3.17	0.0000000000	
SOUND	550	0.40	1	15...8	0.14	410.68	426.93	1.50	0.0000000000	
RECORD	583	0.16	1	3,000	0.03	404.66	420.91	2.61	0.0000000000	record[222] recorded[55] recording[261] recordings[45]
REVERB	100	0.07	1	565		319.30	335.55	3.87	0.0000000000	
MASTER	461	0.12	1	2,057	0.02	303.55	319.80	2.69	0.0000000000	master[161] mastering[300]
NOISE	232	0.17	1	4,572	0.04	288.36	304.61	2.07	0.0000000000	
TAPE	155	0.09	1	1,305	0.01	277.41	293.66	2.99	0.0000000000	tape[126] tapes[29]
BASS	207	0.15	1	4,004	0.04	261.25	277.50	2.09	0.0000000000	
AUDIO	223	0.16	1	4,941	0.04	238.66	254.91	1.90	0.0000000000	
TRACK	307	0.22	1	8,773	0.08	228.97	245.22	1.53	0.0000000000	
DAW	106	0.07	1	916		204.20	220.45	3.05	0.0000000000	daw[92] daws[14]
CASSETTE	93	0.05	1	472		197.53	213.78	3.61	0.0000000000	cassette[70] cassettes[23]
MONO	105	0.08	1	1,322	0.01	194.81	211.06	2.71	0.0000000000	
CHANNEL	353	0.17	1	6,138	0.05	181.32	197.57	1.61	0.0000000000	channel[227] channels[126]
MACKIE	48	0.04	1	178		179.11	195.36	4.48	0.0000000000	
ABLETON	100	0.07	1	1,323	0.01	176.75	193.01	2.64	0.0000000000	
STUDIO	95	0.07	1	1,241	0.01	169.05	185.30	2.66	0.0000000000	
VOLUME	283	0.10	1	2,999	0.03	135.01	151.26	1.88	0.0000000000	volume[134] dynamics[35] loud[56] loudness[36] quiet[22]
AUDACITY	54	0.04	1	551		110.94	127.19	3.02	0.0000000000	
WAV	103	0.08	1	2,194	0.02	107.30	123.55	1.95	0.0000000000	
GUITAR	140	0.09	1	2,772	0.02	106.47	122.72	1.80	0.0000000000	guitar[117] guitars[23]
BEHRINGER	44	0.03	1	353		105.14	121.40	3.36	0.0000000000	
PEAKS	22	0.02	1	42		97.09	113.35	5.43	0.0000000000	
BOOST	37	0.03	1	261		93.91	110.16	3.55	0.0000000000	

Figure 7. An example image of the lexical frequency analysis with lemmas for the "Audio production" subforum on the right side of the screen.

Although isolated lexical frequencies provided some insight into discourse within the discussion forum in chipmusic.org, I also analyzed clusters (word combinations) around a lemma or verb. This technique allows a corpus analyst the opportunity to compare frequent word combinations around specific words. For instance, a cluster around the use of the word "play" within the discussion forum in chipmusic.org revealed different uses of the word, such as "play a show," play an instrument," and "show I played." See Figure 8 for an example cluster within the "Audio production" subforum.

KW Cluster	Freq.
NOISE CHANNEL	26
FL STUDIO	24
WAV CHANNEL	23
NOISE REMOVAL	22
FINAL MIX	21
GUITAR AMP	18
RECORD [.] CHANNEL	17
MIXING [.] MASTERING	17
INFINITY CURVE	15
STUDIO MONITORS	14
MIC INPUT	13
CHANNEL SEPARATELY	13
NOISE REDUCTION	12
STEREO MIX	12
EQ [.] MASTER	11
RECORD [..] SEPARATELY	11
BASS AMP	11
RECORD [.] TRACK	11
MASTER BUS	10
MASTERING PROCESS	10
STEREO EFFECTS	10
STEREO IMAGING	10
MASTERING ENGINEER	9
EQ [..] SUB	9
MINOR [.] TRILL	9
MIX [.] MASTER	9
BASS GUITAR	9

Figure 8. An example image of word clusters found within the "Audio production" subforum.

Sometimes it was helpful to compare lexical frequencies of two different corpora. For example, comparing a subforum on circuit-bending with a subforum on audio production to better understand how discourse differed between the two subforums. In this instance, corpus analysts can run lexical frequency analyses for each subcorpus to compare lexical frequencies between two subforums (Baker, 2006). Knowing subforums use different lexicon indicated some forms of music-centered making are more prevalent in certain subsections of chipmusic.org than in others.

Dispersion. Corpus analysis techniques can reveal patterns of discourse within corpora. Although word frequencies may assist with understanding corpora lexicon, word frequencies lack contextual information. One technique for contextualizing word use is dispersion. Dispersion refers to the level of distribution a word appears across text, which provides an approach for better understanding context surrounding a word's use (Baker, 2006). Dispersion plots can indicate if a word is evenly distributed across a text, indicating common usage, or used within a limited number of instances, indicating less common usage. For example, the word "circuit" is more evenly distributed across the text in the subforums at the top of Figure 9 than the subforums at the bottom.

	File	Words	Hits	per 1,000	Dispersion	Plot
1	circuit (Overall)	10,417,226	1,619	0.16	0.929	
2	circuit sub_generalDiscussion_postsAndTopics	3,058,089	180	0.06	0.926	
3	circuit sub_otherHardware_postsAndTopics	328,197	129	0.39	0.877	
4	circuit sub_nintendoHandhelds_postsAndTopics	2,069,214	456	0.22	0.874	
5	circuit sub_pastEvents_postsAndTopics	628,893	128	0.2	0.852	
6	circuit sub_tradingPost_postsAndTopics	739,603	177	0.24	0.824	
7	circuit sub_nintendoConsoles_postsAndTopics	435,490	81	0.19	0.809	
8	circuit sub_circuitBending_postsAndTopics	31,838	139	4.37	0.798	
9	circuit sub_releases_postsAndTopics	962,691	64	0.07	0.797	
10	circuit sub_tutorialsModsAndHowTos_postsAndTopics	153,502	55	0.36	0.778	
11	circuit sub_commodoreComputers_postsAndTopics	242,549	53	0.22	0.715	
12	circuit sub_sega_postsAndTopics	220,994	44	0.2	0.71	
13	circuit sub_otherVintageComputersAndConsoles_postsAnd	186,372	32	0.17	0.694	
14	circuit sub_motionGraphics_postsAndTopics	62,120	14	0.23	0.663	
15	circuit sub_atari_postsAndTopics	94,492	8	0.08	0.577	
16	circuit sub_collaborations_postsAndTopics	314,924	11	0.03	0.545	
17	circuit sub_bugsAndRequests_postsAndTopics	121,402	18	0.15	0.438	
18	circuit sub_productReviews_postsAndTopics	10,765	5	0.46	0.4	
19	circuit sub_littlegptracker_postsAndTopics	142,467	5	0.04	0.4	
20	circuit sub_audioProduction_postsAndTopics	130,736	2	0.02	0.345	
21	circuit sub_softwareAndPlugins_postsAndTopics	318,657	13	0.04	0.343	
22	circuit sub_graphicsArtworkAndDesign_postsAndTopics	164,231	5	0.03	0.328	

Figure 9. An example image of a dispersion plot of the word "circuit" across each subforum. The bands on the right indicate frequency of the word dispersed across each subforum.

Although I searched for many of the words and acronyms members of

chipmusic.org used in their discussion forum posts to better understand some of the

discussed practices, I used dispersion plots to find false positive keywords in corpora.

For example, the acronym "KSCR" is the most unique keyword in the "Audio production"

subforum, as indicated by the BIC score; however, a dispersion plot of the acronym (see

Figure 10) indicates a 0.000 dispersion rating, meaning the word is not evenly

distributed across the subforum. Although the acronym is used 307 times within the

subforum, this is due to one person typing the word repeatedly, and another person

quoting the word in a reply (see Figure 11).

Key word	Dispersion	BIC score	Link tokens	Hits	Plot
Overall				11…8	
KSCR	0.000	1,856.93	0	307	
MASTERING	0.717	1,393.37	271	300	
EQ	0.777	1,182.01	403	270	
MIX	0.779	960.09	405	337	
MIXING	0.832	674.29	197	193	
RECORDING	0.917	659.67	300	261	
COMPRESSION	0.785	508.03	176	117	
STEREO	0.751	491.06	258	200	
SOUND	0.914	410.68	435	550	
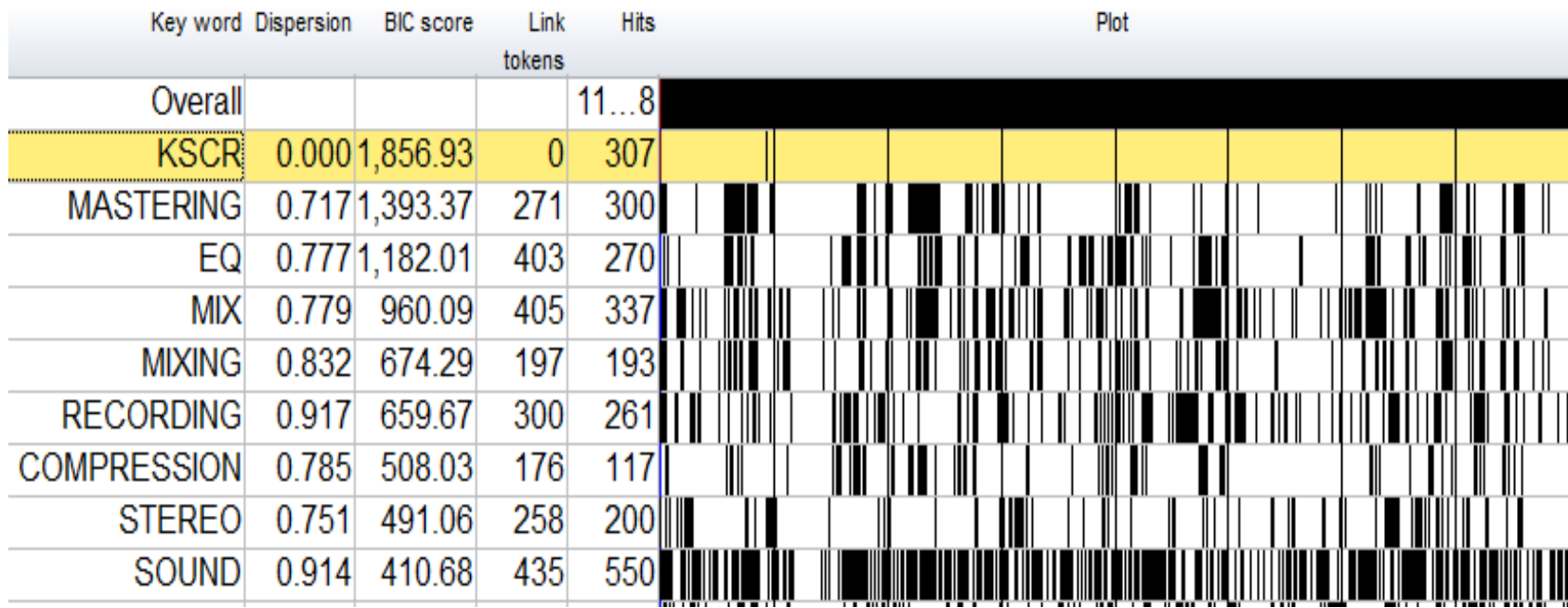
Figure 10. A dispersion plot of the false positive acronym "KSCR" within the "Audio production" subforum. Notice the dispersion rating is 0.000 with only one dark line on the right (indicating infrequent use), while other words within the dispersion plot are distributed across a larger spread of the subforum (indicating frequent use).
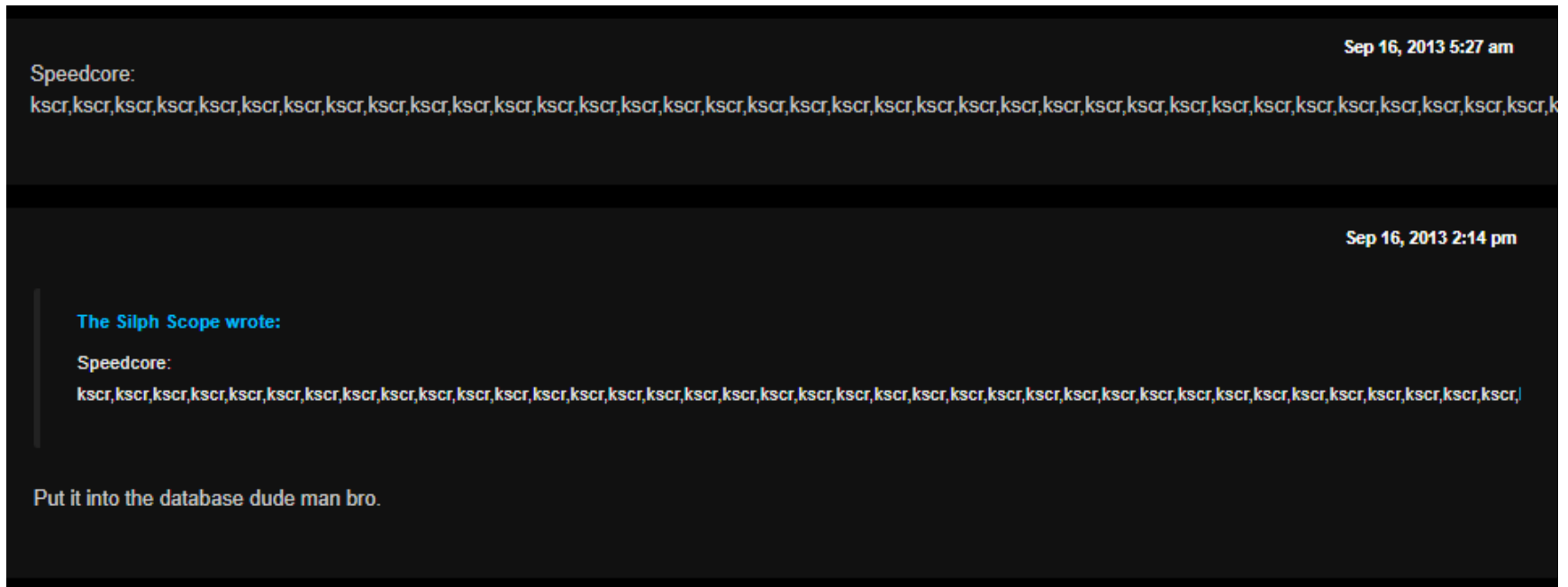
Figure 11. An example post and reply that demonstrates how false positive keywords may appear within a lexical frequency analysis.

Source: chipmusic.org/forums/topic/12212/rhythms-database/

Concordances. In addition to using dispersion to contextualize word usage patterns within a text, and using clusters to show frequent word combinations, corpus analysts might compare immediately surrounding contexts of a word across corpora. For instance, knowing the word "practice" frequently occurs within a corpus provides little information on the word's usage or semantic patterns. To investigate contextual patterns of a word, corpus analysts can use concordances to reveal patterns of language in use based on repetitions of semantic preference (Baker, 2006). Concordances list "all of the occurrences of a particular search term in a corpus, presented within the context that they occur; usually a few words to the left and right of the search term" (Baker, 2006, p. 71). This technique assists with better understanding a word's contextual patterns. See Figure 12 for an example of revealed concordance patterns for the word "circuit" and Figure 13 for the word "circuit" with surrounding context.

L5	L4	L3	L2	L1	Centre	R1	R2	R3	R4	R5
THE	THE	THE	THE	THE	CIRCUIT	BENT	THE	THE	THE	THE
TO	TO	TO	OF	SHORT		BENDING	AND	AND	TO	AND
AND	OF	OF	TO	AND		BOARD	IS	TO	AND	IS
OF	IT	AND	ON	THIS		IS	IT	IT	IT	TO
FOR	AND	WITH	IN	TO		BEND	TO	FOR	FOR	IT
IS	YOU	ON	WITH	OF		AND	YOU	THAT	IS	YOU
THAT	IS	IS	FOR	IN		THAT	STUFF	IN	THAT	OF
IT	ON	IT	AND	YOUR		TO	IN	IS	CIRCUIT	WITH
ON	CIRCUIT	FOR	AN	PRINTED		BOARDS	BE	WITH	YOU	IN
YOU	THAT	IN	FROM	THAT		FOR	THIS	ON	OR	FOR
WITH	FOR	YOU	MIDICHA…NG			BUT	CASIO	OF	BE	YOUR
THIS	AN	BE	THAT	SOME		IN	NES	CAN	WWW	BE
IN	BE	UP	USING	PR…ON		WITH	THAT	YOU	THIS	ON
HAVE	WITH	SOME	OR	MY		SO	HAVE	THIS	AS	BUT
BE	HAVE	AN	YOUR	WITH		WHICH	FOR	SO	OF	WOULD
SHOULD	MY	OR	UP	AMP		THE	WITH	BE	AN	THIS
ARE	IN	PART	CHI…NE	FOR		WILL	OR	OR	MY	NOT
IF	IF	THIS	IS	MIDI		COULD	BUT	BUT	HAVE	THAT
AN	COULD	FROM	IT	CHARGE		LIKE	TOYS	NOT	WHEN	IT'S
CAN	THIS	HAVE	THIS	SIMPLE		FROM	ON	HTTP	BUT	ONE
DMG	SOME	CAN	BUILD	AM…R		AS	THERE	JUST	FROM	CAN
NEED	JUST	LIKE	NOISE	NEW		DESIGN	TOY	SK	WITH	DON'T

Figure 12. Concordance patterns of the word "circuit."

N	Concordance
1	locations mapped out along with who from the scene is available for support at each stop.ÿ Ideally we could map out a ""circuit"" like this for East and West coast at least. The possible show locations wouldn't necessarily be chip events.ÿ
2	to go beyond the underground circuit and its own community, start
3	each stop.ÿ Ideally we could map out a ""circuit"" like this for East and West
4	of having an East and West coast tour circuit for chip artists to a few people at
5	was a pretty decent east coast touring circuit: mtl, rochester, bos, Salem, nyc,
6	in order to ""promote"" the chiptune and circuit bent scene in Greece, where
7	tedious trial and error)..." "I think that like circuit/data/soft bending, generative
8	(unfinished buisness) Chip Touring Circuit(s) - How to organize? Calling all
9	guy who wants to promote chiptune and circuit bent in Greece.....If you had any
10	to get a drone set put together for Short Circuit so i know i'll get something. just
11	in order to ""promote"" the chiptune and circuit bent scene in Greece, where
12	, man!ÿ That does help.ÿ I've researched circuit bending but haven't really tried it
13	on the DJ page ... enjoy! for all your circuit bent and gameboy modification
14	cheapest starting place I can think of is circuit-bending.There are tons of tutorials
15	of tutorials online about circuit-bending.Circuit-bending is mostly lots of its trial
16	.There are tons of tutorials online about circuit-bending.Circuit-bending is mostly
17	4:18 Apple Tooth ... enjoy! for all your circuit bent and gameboy modification
18	I'll report back on how it went. Break a circuit, er LEG! (and kiss your chipcherry

Figure 13. An example concordance analysis of the word "circuit" with surrounding context. WordSmith Tools provides researchers with the ability to show more or less surrounding context for each instance of a word, as indicated by the larger amount of text in the first cell.

Baker (2006) suggests ten steps for conducting a concordance analysis, which I followed when analyzing data: (a) access a corpus; (b) decide on a term; (c) obtain concordance of the term(s); (d) clean the concordance by removing irrelevant lines; (e) sort using different words to the left or right; (f) look for patterns; (g) investigate instances of the term more closely; (h) when there are no more patterns, do a close analysis of remaining concordance lines; (i) take note of rare or non-existing cases and check if they occur in other, more general, corpora; (j) hypothesize why there are patterns and relate them to contexts or discourse.

Collocation. When analyzing a large amount of data, researchers often make choices about which data to investigate in detail. For instance, ethnographers might have several months or years of data in the form of interviews, video, researcher journals, field notes, demographic information, archival data, or artifacts. Rather than exploring all emergent themes, ethnographers often explore a narrow subset of emergent themes (Boellstorff, Nardi, Pearce, & Taylor, 2012). When analyzing corpora with a high percentage of unique words (i.e., a high TTR), it may become difficult to determine which words and contexts are most related to the purpose of a study. Collocation provides one way of focusing a corpus analysis by finding "the most salient and obvious lexical patterns surrounding a subject" (Baker, 2006, p. 114).

Like concordances, collocation analysis creates a window of words to the left or right of a search term, however, collocation analysis differs from concordances by counting the number of occurrences another word appears within the window to illuminate associations and meanings of words; see Figure 14 for an example collocation of the word "circuit." However, these patterns require exploration within context as some words have different meaning within different contexts of use (Baker, 2006); for instance, the utterance "8-bit" might refer to a genre of music, a specific type of sound, a style of visual art, or computer processing abilities. Concordances assist with understanding contextual patterns, while collocation provides a "signal" of what an activity or style engages in by revealing associations within contextual patterns (Baker, 2006). For instance, certain combinations of hardware and music software might signal music-centered making related to the purpose of this study; however, on their own, they may not signal music-centered making.

Word	Set	Texts	Total	Total Left	Total Right	L10	L9	L8	L7	L6	L5	L4	L3	L2	L1	Centre	R1	R2	R3	R4	R5	R6	R7
CIRCUIT		21	1,686	48	52	8	4	4	5	5	3	14	1	4		1,586		3	1	16	5	8	3
THE		21	1,360	910	450	60	46	58	61	45	65	71	67	151	286		5	68	56	59	44	50	35
#		20	1,253	689	531	66	68	70	84	74	65	56	64	68	74	33	16	52	64	85	50	56	63
A		20	749	481	268	32	29	20	28	26	41	49	57	97	102		10	33	33	35	31	32	23
TO		20	651	358	293	22	35	29	38	25	32	46	62	40	29		33	26	32	34	25	26	41
AND		19	596	260	336	27	36	20	21	27	29	17	26	19	38		41	53	49	36	32	37	23
BEND		17	593	30	563		3	6	1	2	5	4	7		2		524	2	3	2	8	7	4
I		18	382	212	170	28	13	10	31	29	40	33	19	7	2		22	18	19	21	12	22	23
OF		19	371	263	108	15	16	25	22	16	24	25	25	67	28		4	5	16	7	10	16	13
IS		18	355	152	203	7	14	25	22	15	21	15	20	9	4		64	30	17	10	24	13	18
IT		17	293	130	163	15	9	16	20	18	17	12	17	4	2		3	27	20	18	21	18	16
THAT		15	270	141	129	14	19	16	15	8	18	16	4	14	17		35	14	17	14	6	9	1
FOR		16	257	141	116	11	13	8	19	13	18	13	16	19	11		26	13	18	12	13	10	7
IN		14	237	125	112	8	10	7	5	13	9	10	12	31	20		14	17	21	5	10	5	9
WITH		17	236	133	103	9	9	11	11	10	13	13	21	23	13		15	12	14	8	12	9	5
HTTP		12	228	89	139	6	11	12	12	12	10	8	7	3	8		4	12	14	17	8	23	15
ON		17	217	128	89	5	6	7	8	13	14	14	18	35	8		7	11	15	7	11	7	13
YOU		17	207	115	92	15	9	12	17	9	14	18	14	3	4		3	16	10	9	10	4	12
BOARD		16	189	12	177	1			6			4		1			164		1			2	
THIS		16	178	111	67	8	10	9	11	7	13	9	5	7	32		1	14	9	5	7	6	7
BE		17	144	64	80	5	6	3	7	5	11	13	11	3			2	16	8	8	8	16	4
OR		15	130	61	69	5	3	7	4	6	1	7	10	9	9		9	12	10	6	2	4	6
AS		17	127	66	61	9	11	10	4	9	4	3	7	6	3		8	5	4	9	5	8	4
BUT		14	126	50	76	6	5	12	4	4	4	7	6	2			19	12	8	6	9	5	3
HAVE		15	126	81	45	7	13	8	6	8	11	12	8	7	1			13	2	6	5	4	3
FROM		15	118	55	63	4	3	3	4	4	7	2	9	17	2		10	8	5	6	7	7	3
IF		17	118	65	53	6	3	8	14	10	9	11		4			2	5	4	4	6	7	6

Figure 14. An example collocation analysis of the word "circuit."

Baker (2006) suggests ten steps for collocation, which I followed when analyzing data: (a) access a corpus; (b) decide on a term; (c) obtain collocates list; (d) determine how many will be analyzed; (e) determine if collocates can be grouped together semantically, thematically, or grammatically; (f) obtain concordances of collocates and look for patterns; (g) think through potential contesting discourses; (h) analyze which concordance lines do not contain collocates and think through whether they contradict findings; (i) find relationships between collocates in first or second-order collocational networks; and (j) try to explain discourse patterns.

Keyness. When analyzing corpora, corpus analysts might compare two corpora or sub-corpora (sub-groups of text within corpora). For instance, I compared discourse within the "Circuit bending" subforum with the "Audio production" subforum to investigate similarities and differences in music-centered making. To do this, I used a corpus analysis technique known as keyness. Keyness is a corpus analysis technique for comparing word frequencies between two sub-corpora while accounting for differences in word counts (Baker, 2006). Keyness techniques used within this study included keyword lists and key clusters.

Generation of keyword lists requires determining which words in one subcorpora appear statistically more often than in another sub-corpora (Baker, 2006). Keyword lists might allow corpus analysts to compare frequency of word use between two sub-corpora. In addition, negative words – words occurring in small amounts or missing entirely – can illuminate analysis of keyness of a corpus (Baker, 2006); for instance, illuminating when certain forms of music-centered making are absent from discourse in some subforums and pervasive in others. To obtain keyword lists for each subforum, I compared each subforum with all of the extracted data from chipmusic.org. To obtain a keyword list for the entire corpus, I compared all extracted data with the

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Open American National Corpus,[30] an openly shared, English language corpus consisting of over three million spoken words and eleven million written words from a several sources. This allowed me to create a keyword list for the entire corpus in addition to a list for each subforum and subforum category.

Key clusters compare keyword clusters between two corpora to measure the dispersion of keywords across a given corpus. Key clusters can help determine if a particular speaker or use case attributes to keyness or to the corpora as a whole to better understand if patterns are pervasive or isolated (Baker, 2006). Key clusters assisted with determining whether discourse around certain forms of music-centered making was common or uncommon when comparing two subforums within chipmusic.org.

Discourse analysis techniques used within this study. Gee (2014a) describes seven building tasks of language for exploring language-in-use through discourse analysis: significance, practices (activities), politics (the distribution of social goods), identities, relationships, connections, and sign systems and knowledge. Talbot (2010a) suggests Gee's seven building tasks of language help with reflexive music education practices through an analysis of language and music in context. In particular, Talbot (2010a) believes Gee's seven building tasks of language can "ask questions about notations of music, enactments of music, and interactions surrounding music performance learning" (p. 86). The following subsections explain the building tasks of language that assisted with making sense of revealed patterns of music-centered making to answer the research questions posed within this study.

Significance. When analyzing patterns of music-centered making evident through discourse, I explored the significance of particular forms of music-centered making in relation to other forms of music-centered making. Significance refers to

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[30] anc.org/data/oanc/

discourse indicating views of significance of something (Gee, 2014a, 2014b). Discourse analysts can inquire of data "how is this piece of language being used to make certain things significant or not and in what ways" (Gee, 2014a, p. 32)? Placing parts of an utterance within the foreground or background has implications for levels of significance (Gee, 2014b). Within this study, significance assisted with questioning when members made certain practices significant or not. Significance assisted with investigating both research question one and three; (1) "what chiptune-related practices did members of chipmusic.org discuss between December 30th, 2009 and November 13th, 2017?" and (3) "what import might music-centered making evident within chipmusic.org discussion forum posts hold for music education?"

Practices. Music-centered making evident through discourse revealed patterns of musical practice. Practices (activities) are what we say, do, and are when using language within a practice (Gee, 2014a, 2014b). Gee (2014b) refers to actions as the things we do, and activities as the social, institutional, or cultural norms followed during an action. When analyzing a practice (activity), one could explore the structure, patterning, or rigidity of a routine within a practice (Gee, 2014b). Discourse analysts can inquire of data "what practice (activity) or practices (activities) is this piece of language being used to enact (i.e., get others to recognize as going on)" (Gee, 2014a, p. 33)? Within chipmusic.org, actions such as discussing creation processes of a song, sharing promotional media for an event, or debating the rules in the discussion forum are all practices I explored in this study. Gee's (2014a, 2014b) notion of practices assisted with investigating research question one and two; (1) "what chiptune-related practices did members of chipmusic.org discuss between December 30th, 2009 and November 13th, 2017?" and (2) "what do chipmusic.org discussion forum posts reveal about the multidisciplinary aspects of chiptunes?"

Politics. Techniques in phase one revealed some patterns of power or politics influencing music-centered making within chipmusic.org. Politics are the distribution of, and claims about, social goods (Gee, 2014a, 2014b). Social goods give people power and status in society as they assist with "a person being taken as acceptable, normal, important, respected, an 'insider' or an 'outsider,' or as being connected to acceptable, normal, or important things (in the right circumstances)" (Gee, 2014b, p. 96). Social goods may indicate whether a social group encourages or discourages deviation from the norm (Gee, 2014b), which affected chiptune engagement or practices. For instance, moderators of chipmusic.org enforced forum rules and community norms by praising or reprimanding members' behavior within the discussion forum.

> Van Dijk (2008) notes within discourse analysis,
>
> We must ask who has access to the fundamental power resource of public discourse, who has access to political discourse, to media discourse, educational discourse and scholarly discourse. . . . Because once you control part of the production of public discourse, you also control part of its contents, and hence, indirectly, the public mind - maybe not exactly what people will think, but at least what they will think *about*. (p. vii, original emphasis)

Discourse analysts can inquire of the data "what perspective on social goods is this piece of language communicating (i.e., what is being communicated as to what is taken to be 'normal,' 'right,' 'good,' 'correct,' 'proper,' 'appropriate,' 'valuable,' 'the ways things are,' 'the way things ought to be,' 'high status or low status,' 'like me or not like me,' and so forth)" (Gee, 2014a, pp. 34-35)? For instance, one of the characteristics of chipmusic.org is everyone can contribute to the space; however, when distribution of social goods impairs opportunities for particular forms of music-centered making, some forum members will move to alternative spaces (Duncan, 2012a). Politics assisted with investigating research question three by exploring the politics behind revealed practices;

(3) "what import might music-centered making evident within chipmusic.org discussion forum posts hold for music education?"

   Connections. Depending on phrasing, language can connect/disconnect, or bring/diminish relevance between two subjects (Gee, 2014a, 2014b). Sometimes connections are implicit because of assumptions the reader will make, or to manipulate a conversation (Gee, 2014b). Discourse analysts can inquire of data "how does this piece of language connect or disconnect things; how does it make one thing relevant or irrelevant to another" (Gee, 2014a, p. 35)? Of interest for this study are the ways patterns of music-centered making connected or disconnected practices from multiple disciplines. For instance, discourse on modifying chiptune-related software connected with discourse on computer programming. Connections assisted with investigating research questions two and three; (2) "what do chipmusic.org discussion forum posts reveal about the multidisciplinary aspects of chiptunes?" and (3) "what import might music-centered making evident within chipmusic.org discussion forum posts hold for music education?"

   Organizing findings into themes. Throughout each iteration of the two-phase data analysis cycle, I documented findings and questions from each subforum, category, and the discussion forum as a whole into a research notebook on my computer. Upon completion of the two-phase analysis cycle, I copied each of the practices revealed through my analysis process into a single document and spent several days organizing each practice into different themes and subthemes. This process resulted in seven interconnected themes and subthemes I discuss in Chapter Four.

   Data analysis summary. The prior sections on data analysis discussed two interconnected and cyclical phases of corpus-assisted discourse analyses: (a) revealing patterns of discourse using corpus analysis techniques, and (b) a close reading of revealed patterns using discourse analysis techniques. Corpus analysis techniques such as word lists, lexical frequency analysis, dispersion, concordances, collocation, and

keyness assisted with the first phase of the corpus-assisted discourse analysis by revealing patterns of discourse relevant to the research questions posed in this study. Some of Gee's (2014a) building tasks of language (i.e., significance, practices, politics, and connections) assisted with the second phase of the corpus-assisted discourse analysis by contextualizing and seeking to understand how the patterns of discourse revealed in phase one relate to the questions posed within this study. The findings in phase two raised more questions about patterns of discourse best explored through techniques utilized in phase one, creating a data analysis cycle (see Figure 15). After completing an analysis cycle of an entire subforum, I manually inspected each topic's title to check whether the findings appeared to match general discourse and to look for practices that were not revealed by corpus analysis techniques. When a title appeared to discuss practices or topics not revealed in either phase of the analysis cycle, I read through the posts within the topic and began a new analysis cycle to further investigate whether such practices were isolated to a single topic or spread throughout the discussion forum. Each phase – with their own respected techniques – worked together to form the approach for data analysis within this study. Data analysis concluded when I finished organizing findings from several analysis cycles into themes.
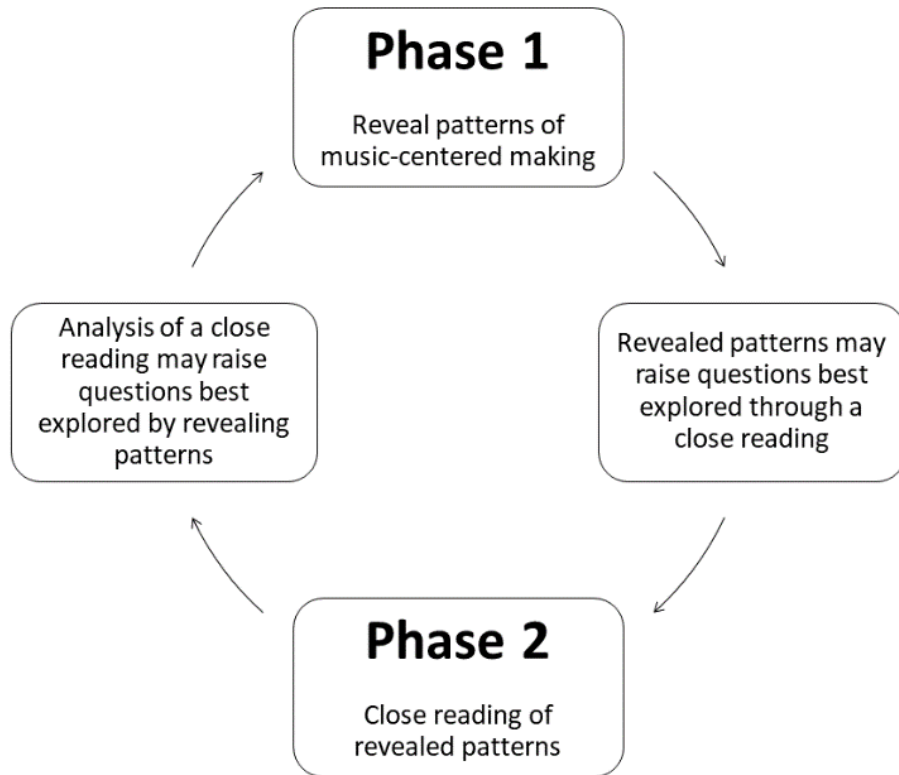
Figure 15. A visualization of the two-phase analysis cycle.

Research Relationships

It is because I consider myself to be of the discourse of gaming, music, and technology – though not of chiptune discourse – that I feel I had enough perspective to understand music-centered making evident through discourse within chipmusic.org, while also having enough distance to "make it strange"; a process Gee (2014b) describes as acting as an "outsider" to intentionally find strange practices within a discourse while drawing on perspectives as an insider to provide context assisting with deeper judgments about meanings and purposes. In other words, my experiences with discourse related to chiptunes served as a research benefit while also limiting trustworthiness threats by having enough distance from the data analyzed. For instance, having experiences with various forms of music practices through Western European classical music, audio production, sound synthesis, technology, computer programming, modding, and video games helped me to understand various chiptune-related practices within chipmusic.org.

Ethics

Although ethical considerations should be embedded within the design of an online study (Boellstorff et al., 2012), ethics in online research largely revolves around questions with no clear answers. For instance, what offline research ethics for data collection are applicable in online spaces? When is online communication public and when is it private? In analyzing online spaces with thousands of members contributing to a collective discourse, when should a researcher obtain consent?

Sharf (1999) provides some ethical considerations for examining online discourse: researchers need to consider how research may harm or benefit a group; researchers should clearly introduce her/himself to the group in relation to identity, role, purpose, and intention; researchers should seek consent when quoting someone; researchers should seek feedback from participants in the study; and researchers should be sensitive to the members within the virtual community. Although helpful, some of these considerations may prove difficult to execute when analyzing online discourse. For instance, how can a researcher identify her/him/themself or seek approval of consent when analyzing an archive several years old? How is analyzing archived data different from historical research (which does not require consent)? If members of an online space are no longer participating within a space, it may prove to be difficult to obtain consent or introduce oneself as a researcher within the space. Additionally, Mann and Stewart (2000) note if a space is public, such as a chat room, it may be impractical to ask for consent from each person entering a space as it would interrupt the naturally occurring discourse.

Sveningsson, Buchanan, and Stern (2009) and Boellstorff et al. (2012) note that consent should be considered as an ongoing process providing comprehensive and correct information. Informed consent forms for online qualitative research should cover

issues of participant anonymity and confidentiality, parental permission if

children or young people are involved, participant risk, withdrawal (and a lack of

prejudice associated with such a decision), remuneration or compensation, as

well as issues of secure storage of data, the destruction of data and ownership of

data. (Mann & Stewart, 2000, p. 48)

Mann and Stewart (2000) note that if collected data leads to new purposes of a study,

researchers should redistribute fresh letters of consent to participants. Although many

agree on a need for informed consent for online correspondence between researchers

and participants, there is not a consensus for requiring informed consent when using

online data mining (i.e., data collection) or lurking (i.e., observation) as it may influence

the discourse within the space (Mann & Stewart, 2000).

Some researchers believe online public spaces do not require informed consent

because offline public spaces do not require informed consent (Boellstorff et al., 2012;

Sveningsson, Buchanan, & Stern, 2009); however, the line between public and private

space can blur in online spaces. Online Terms of Service (ToS), End User License

Agreements (EULAs), and Frequently Asked Questions (FAQs) may need to be taken

into consideration when determining whether a space views certain kinds of

communication as public or private (Boellstorff et al., 2012; Mann & Stewart, 2000).

Sveningsson et al. (2009) provide a suggested framework for viewing privacy along a

continuum between private and public in cases where the public-private distinction is

not explicit: (a) online public spaces do not require consent as they are similar to

physical public spaces open to everyone without requirement for membership or

registration to view content; (b) a semi-public online space may or may not require

consent as they are similar to libraries, hospitals, and schools accessible to anyone who

acquires membership or registers; (c) a semi-private online space may or may not

require consent as they are similar to companies or clubs requiring membership and

registration with formal commitments (e.g., financial commitments) to access the space; and (d) a private online space requires consent as it is similar to a private residence hidden or unavailable unless a creator grants access.

Although Sveningsson et al.'s (2009) framework provides suggestions for viewing online spaces, "what may seem private/sensitive to an observer is not necessarily apprehended so by the individual who exposed the content" (p. 82). Even when publicly visible online communication is open for anyone to view, not all who post online do so with the thought others outside of the space would view the post. This argument is worth considering; however, I cannot help but wonder why this argument does not apply to other forms of public communication used as data for analysis. For instance, this thought process could be applied to archived forms of public communication such as journal articles, newspapers, speeches, etc. to argue the original author/speaker did not anticipate analysis or discussion outside of their intended recipients.

Because chipmusic.org does not require membership to access all of the publicly available content within the website, for the purpose of this study, I considered this space a semi-public space where membership is a means for contributing within the space, and not for accessing contributions. Further, I aligned with Mann and Stewart's (2000) assertion that posting in an online space such as chipmusic.org includes "an implied licence to read, or even archive, the information it contains" (p. 46). In fact, the forum rules a member must agree to when registering states "07. Chipmusic.org's policy is to preserve the availability of all content posted, with exceptions made at the discretion of the site's administrator & moderation team (such as instances of spam, harassment, offensive material, etc.)."[31] In addition, chipmusic.org had the option for private conversation through private messages, emails, and an internet relay chat (IRC)

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[31] chipmusic.org/forums/topic/21/forum-rules/

channel not stored in a public repository; I did not collect these private forms of communication. Because members agreed to the forum rules indicating all posts are publicly preserved before being able to post within the forum, I viewed these data as archival data rather than human subject data because of the publicly visible, archived discourse. Members of Arizona State University's Institutional Review Board also considered the discussion forum posts are archived data and granted exemption (see [Appendix B](#)).

Another ethical issue arises in relation to maintaining anonymity when quoting a participant. Although pseudonyms for participants, servers, groups, guilds, or ISPs may help with maintaining anonymity (Boellstorff et al., 2012; Mann & Stewart, 2000), simple internet searches of direct quotes may reveal original sources despite precautionary measures taken. As such, researchers should take special care to avoid negative outcomes related to breaking anonymity (Boellstorff et al., 2012); for instance, using paraphrasing in conjunction with pseudonyms when discussing private data potentially resulting in negative outcomes. However, Boellstorff et al. (2012) note anonymity might not be necessary when quoting historical or public figures within an online space (e.g., website founders) or when a person wants a creative work attributed to them. Members of chipmusic.org choose whether to use a pseudonym when registering to publicly post on chipmusic.org, so they are able to determine their own level of anonymity within the website. Many members of chipmusic.org include their real name and affiliations in their member bios. In addition, I do not perceive negative outcomes for any of the quotes or example posts cited within this study.

Mann and Stewart (2000) note researchers should share identification information on databases used within a study. This is beneficial for trustworthiness, providing access to resources, and providing the opportunity for others to access data. For the purpose of this study, I identified chipmusic.org as the discussion forum studied

with the hope other music educators might explore a publicly available space revolving around music-centered making through chiptunes.

CHAPTER 4

REVEALED PRACTICES

In this chapter I highlight key findings from my examination of discussion forum posts within chipmusic.org. I begin with an overview of the discussion forum of chipmusic.org. The remainder of the chapter is divided into seven broad themes that answer research question one: "What chiptune-related practices did members of chipmusic.org discuss between December 30th, 2009 and November 13th, 2017?" Throughout this chapter, I use "discourse" when referring to the "big picture" of language and practices within chipmusic.org, and "discourses" when discussing various discussion forum posts within chipmusic.org.

An Overview of the Discussion Forum within Chipmusic.org

Although all topics and posts were visible to the public, chipmusic.org required site contributors to register for free membership[32] to create or reply to topics within the discussion forum. Discussion forum contributors referred to other contributors as "members," which is a word I borrow from emic discourse to describe people who contribute to the discussion forum. Site "moderators" (or "mods" for short) were long-standing community members with administrative rights to clarify and enforce the forum rules.[33] At the time of data extraction, there were over 11,000 registered members[34] and 18 moderators[35] contributing to the discussion forum.

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[32] chipmusic.org/forums/register

[33] chipmusic.org/forums/topic/21/forum-rules/

[34] chipmusic.org/forums/members/

[35] chipmusic.org/forums/users/?mods

Metrics

At the time of data extraction, members of chipmusic.org created 18,157 discussion forum topics with 245,098 posts spread across 24 subforums within one of four emic categories created by the discussion forum administrators (i.e., the people who developed the discussion forum): "community," "hardware & software," "site operations," and "visual arts." Each category contained between 2 and 13 subforums with emic titles based on a particular theme, topic, hardware, software, or practice. Extracted data revealed that subforums contained between 4 and 2,898 topics (see Table 2), which included a title describing the topic and an original post. Subsequent posts on a topic (if any) were known as "replies," which are included in the "Posts" column.

Table 2

Number of topics and posts extracted from each subforum of chipmusic.org

Subforum title	Topics	Posts
Community		
Collaborations	379	8,812
Constructive criticism	668	4,693
General discussion	2,898	68,979
Past events	1,640	18,776
Releases	4,054	31,050
Trading post	2,107	20,874
Upcoming events	4	30
Hardware & software		
Atari	132	1,555
Audio production	161	2,213
Circuit bending	87	674
Commodore computers	407	4,423
Littlegptracker	166	3,444
Nintendo consoles	449	7,893
Nintendo handhelds	2,703	38,515
Other hardware	483	6,124
Other vintage computers & consoles	204	2,958
Product reviews	13	127
Sega	159	3,812
Software & plug-ins	385	6,311
Tutorials, mods, & how tos	230	2,399
Site operations		
Bugs and requests	293	3,197
Rules and announcements	19	515
Visual arts		
Graphics, artwork & design	281	5,646
Motion graphics	235	2,078
Total	18,157	245,098

Note. Each topic contained one or more posts; however, each post was a response to a single topic.

Each subforum had between 1,204 and 3,122,407 word tokens (total number of words), and between 445 and 70,009 word types (total number of unique words). This amounts to 10,892,645 word tokens and 150,247 word types (see Table 3), indicating a large number of unique words within the extracted data. A standardized type/token ratio (STTR) is the average percentage of types (unique words) for every 1,000 tokens (total number of words) computed. The STTR for the entire discussion forum in chipmusic.org is 40.88%, with the lowest subforum STTR at 38.77% and the highest STTR at 42.93% (see Table 3). To contextualize these percentages, the STTR for the Open American National Corpus (see Chapter Three) is 39.48%, with the lowest STTR at 22.8% and the highest STTR at 64.9%. This comparison demonstrates the discussion forums within chipmusic.org have greater consistency in percentage of unique words than the reference corpus. Although this indicates a relatively consistent ratio between types and tokens, the STTR cannot account for thematic differences in content between each subforum.

Table 3

Tokens, types, and standardized type/token ratio of extracted data

Subforum title	Tokens	Types	STTR
Community			
Collaborations	319,411	16,253	40.23
Constructive criticism	279,500	13,457	39.52
General discussion	3,122,407	70,009	41.17
Past events	645,099	35,212	44.86
Releases	968,787	44,040	44.65
Trading post	749,689	23,278	40.73
Upcoming events	1,204	445	39.50
Hardware & software			
Atari	96,387	7,031	39.40
Audio production	132,939	8,493	38.74
Circuit bending	32,472	4,011	41.14
Commodore computers	243,760	12,326	39.91
Littlegptracker	145,470	8,595	39.69
Nintendo consoles	440,680	16,749	39.96
Nintendo handhelds	2,099,377	36,127	38.93
Other hardware	336,332	14,745	39.66
Other vintage computers & consoles	185,153	10,783	40.38
Product reviews	11,061	2,152	42.93
Sega	222,029	10,496	40.70
Software & plug-ins	327,055	14,749	40.23
Tutorials, mods, & how tos	155,720	9,355	38.77
Site operations			
Bugs and requests	123,626	7,805	38.72
Rules and announcements	22,998	2,970	40.07
Visual arts			
Graphics, artwork & design	167,863	12,661	40.46
Motion graphics	63,626	7,122	41.80
Total	10,892,645	150,247[a]	40.88[b]

Note. STTR = Standardized type/token ratio, which is the average percentage of unique words for every 1,000 words computed.

[a] The total number of types across the entire discussion forum accounts for duplicate types within each subforum.

[b] This is the average STTR across the entire discussion forum.

Themes and Subthemes

The discussion forum administrators (i.e., the people who developed the discussion forum) grouped the subforums into one of four emic categories. The "Community" category included subforums with a wide range of topics: (a) discussing chiptune events; (b) buying, selling, and trading chiptune-related hardware, software, and media; (c) providing constructive criticism on in-progress chiptunes; (d) sharing and discussing completed chiptune albums and tracks; (e) requesting chiptune-related collaborations or commissions from other members; and (f) general discussion on a wide range of topics. The "Hardware & software" category included subforums dedicated to (a) discussing chiptune-related practices relevant to products released by a particular company, (b) discussing specific chiptune software, (c) general hardware and software practices, (d) audio production practices, (e) a practice known as "circuit-bending," (f) product reviews, and (g) tutorials on a range of topics. The "Site operations" category provided a space for members to discuss the (a) discussion forum rules, (b) announcements, (c) bugs (errors), and (d) requested features. The "Visual arts" category included discussions on (a) chiptune-related artwork and design, in addition to (b) sharing and discussing video recordings of chiptune performances and music videos.

Although each category and subforum were dedicated to a particular theme, topic, hardware, software, or practice, many of the members discussed similar practices throughout multiple subforums and subforum categories. For example, members discussed visual art practices outside of the "Visual arts" category. Rather than organizing findings by the discussion forum's emic category or subforum titles, I discuss seven etic themes of chiptune-related practices evident across the entire discussion forum of chipmusic.org. These themes include: (a) composition practices, (b) performance practices, (c) maker practices, (d) coding practices, (e) entrepreneurial practices, (f), visual art practices, and (g) community practices. The themes and

subthemes presented within this chapter (and summarized in Table 4) were obtained

through an analysis of each subforum, category, and the discussion forum. I manually

organized each practice revealed through the analysis process into different etic themes

and subthemes in order to present findings across the entire discussion forum.

Table 4

An outline of the seven themes with corresponding subthemes

Theme	Subthemes

Composition practices	Chiptune appropriations
	    Sample-based producing, covering and arranging, remixing, mash-ups, and commenting and discussing
	Sound synthesis
	    Reverse engineering
	Composition concepts and tools
	    Western staff notation and music theory
	Fakebit

Performance practices	Using a Game Boy as a performing instrument Live performing Recording performances for streaming Performing with acoustic and electronic instruments Discourse on performance practices

Maker practices	Hard mods
	    Aesthetic mods
	    Functionality mods
	        Electrical engineering practices
	            Circuit-bending and soldering
	    Perspectives on modding
	    Learning how to mod
	Manufacturing or building new devices

Coding practices	Soft mods Source code Software development Learning how to code
Entrepreneurial practices	Promoting Selling, buying, and trading
Visual art practices	Pixel art Video mixing Databending
Community practices	Collective learning Constructive criticism Collaborating Competitive events Collective efficacy

Each of the following themes and subthemes includes summarized findings from phase one and phase two of this study. I present corpus analysis techniques such as word frequency and dispersion to indicate prevalence of a theme or topic across the entire discussion forum. Each corpus analysis finding guided discourse analysis techniques, which I present through excerpts and examples of discourses on a particular practice or topic. Rather than providing an exhaustive list of all instances of discourses related to each practice or topic, each theme includes selected examples of discourses representative of general findings. In addition, many of the practices within each theme are interconnected with practices in other themes, which I further discuss in Chapter Five.

Contextualizing Composition Discourse

Before discussing composition practices revealed through this study, I will clarify some terms and introduce two types of software used in most of the composition practices discussed within chipmusic.org. Members of chipmusic.org used various terms to refer to their chiptune productions (e.g., "compositions," "tracks," "songs," or "releases") and the processes used to create chiptunes (e.g., "compose," "write," or "create"), typically with some form of digital representation of music notation (e.g., text-based notation, MIDI notation, Western staff notation, etc.). For consistency and clarity, I use the emic term "compositions" to refer to chiptune productions and "compose" to refer to the process of creating a composition. The word "compose" and its lemmas (e.g., composing, composition, compositions, composer, etc.) accounted for 2,981 word tokens with an overall dispersion rate of 0.837 across the entire discussion forum, indicating discussions about composing occurred throughout much of the discussion forum rather than one isolated subforum or subforum category. Within chipmusic.org, composition practices appear to be the most discussed chiptune-related practices.

Members shared their compositions as individual tracks or entire albums through digital or "physical" releases (i.e., tangible products such as vinyl records, cassette tapes, or video game cartridges), discussed composition practices and tips for software, or engaged in appropriation practices. At the time of data extraction, the "Releases" subforum contained 4,054 topics and 31,050 posts primarily focusing on discussing released compositions. Despite accounting for just one of the twenty-four subforums (n = 4.17%), the "Releases" subforum accounted for the highest percentage of topics (n = 22.33%) and the third largest percentage of posts (n = 12.67%) within the discussion forum. In addition to sharing completed compositions in the "Releases" subforum, members shared in-progress compositions in the "Constructive criticism" subforum (668 topics and 4,693 posts), as well as 8,392 completed or in-progress compositions in the "Music" section of chipmusic.org.[36] Although the majority of the discussions within these subforums were on sharing and discussing created albums or tracks, most of the other subforums also discussed composition practices. These data indicate how prevalent composition practices were discussed within chipmusic.org.

Composition Software

Members of chipmusic.org discussed using a variety of software to compose chiptunes in topics such as "WHAT ARE YOU FAVOURITE PROGRAMS FOR MAKING MUSIC?"[37] Within these discussions, members typically mentioned using trackers and Digital Audio Workstations (DAWs) to create chiptune compositions. I first provide an

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[36] The "Music" section is a dedicated space within chipmusic.org where members can post tracks and request constructive criticism. Although members discussed chiptune practices within this space, these stats are provided for context purposes only, as these discourses were excluded from the data extracted for this study. The music section is located at chipmusic.org/music

[37] chipmusic.org/forums/topic/12920/what-are-you-favourite-programs-for-making-music/

overview of trackers and DAWs to contextualize the composition practices that people engage in with such software. I will then discuss chiptune composition practices more specifically.

Trackers. Trackers (short for module trackers) were initially created by companies and demosceners[38] to assist with creating music through computer and video game hardware typically from the 1970s and 1980s. Trackers combine capabilities of music sequencers with synthesizers, often through a text-based interface, that allows someone to compose or perform live music. These interfaces often display the effects options (e.g., delay, pitch bend, vibrato, amplitude, etc.) in a column next to the notation column, providing effects control over each note (Carlsson, 2010; D'Errico, 2012), something a member of chipmusic.org described as "a standard music making interface."[39]

As seen in Figure 16, trackers such as Little Sound DJ (LSDJ) often display only a small number of notes at any given moment, which has the potential to prevent a composer from seeing the bigger picture (Paul, 2014) or influence tracker creations (Yabsley, 2007). The left image in Figure 16 displays the phrase screen where notes and parameters are sequenced vertically. Members of chipmusic.org often referred to similar tracker interfaces as the "score" and the text-based notes within the score as "patterns" or "notes." The center image in Figure 16 displays an instrument screen where users can adjust parameters of each instrument. Many trackers allow users to choose from, customize, or create a multitude of instrument samples or presets. The image farthest to the right in Figure 16 displays a sine wave in the wave screen. Chipmusicians are able to

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[38] See Chapter Two or Appendix C for a discussion on the demoscene.

[39] chipmusic.org/forums/topic/3711/so-how-did-you-learn-lsdj/

manually create or alter waveforms within this screen, which are triggered by sequences within the phrase screen.

Figure 16. Three images of the user interface for the tracker Little Sound DJ. Source: littlesounddj.com/lsd/index.php

The word "trackers" and its lemma (e.g., tracker and tracking) accounted for 7,627 word tokens with an overall dispersion of 0.783 across the discussion forum. If combined with lemmas from the two most popular trackers within chipmusic.org (Little Sound DJ and LittleGPTracker), "trackers" accounted for 25,906 word tokens with an overall dispersion of 0.869 across the discussion forum. This dispersion finding indicates members discussed trackers throughout the majority of the discussion forum rather than within isolated subforums, topics, or posts.

Little Sound DJ (LSDJ) is a tracker designed for the Nintendo Game Boy and Game Boy Color (handheld game consoles), and includes a sequencer, sound synthesis, samples, and synchronization capabilities for linking multiple Game Boys for more complicated compositions or performances. Although mostly discussed within the "Nintendo Handhelds" subforum, the acronym "LSDJ" and its lemmas (e.g., littlesound, littlesounddj, and LSDJ's) accounted for 15,001 word tokens with an overall dispersion of 0.765 across the discussion forum. This dispersion indicates members discussed LSDJ throughout the majority of the discussion forum. See Appendix C for more resources on LSDJ.

LittleGPTracker (LGPT), also referred to as "piggy" or "the piggy," is a music tracker with a user interface modeled after LSDJ. Unlike LSDJ, LGPT runs on several portable game consoles (e.g., Game Park's GP2X, Caanoo, PSP, and Dingoo), operating systems (e.g., Windows, macOS, and Linux), and their respective emulators.[40] LGPT had a dedicated subforum within chipmusic.org with 166 topics and 3,444 posts at the time of data extraction. The word "LGPT" and its lemmas (e.g., piggy, littlgegptracker, etc.) accounted for 3,278 word tokens with an overall dispersion of 0.508 across the discussion forum.

I was able to determine if a person used a tracker for composition (or performance) practices by analyzing tracker names or acronyms used within discussion forum posts. For example, when sharing compositions on chipmusic.org, some members included the software's name or acronym within their topic's title: "*LSDJ* [emphasis added]: FUNKY ASS FLYING BEAST."[41] Other members described software or composition processes used in each track's description. In Figure 17, a member describes the hardware and software they used for each track; for example, "PLUTO BLUE - This song is only on the cassette tape. It is an lsdj track slowed down using a modified DMG [an acronym used to indicate a Game Boy handheld console (see Appendix C)]."[42] However, many of the releases did not specify how a member created their music.

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[40] Emulators enable devices to run software originally designed for other hardware; for example, running a Game Boy game on a mobile phone.

[41] chipmusic.org/forums/topic/17503/lsdj-funky-ass-flying-beast/

[42] chipmusic.org/forums/topic/16230/deerbite-lofi-chiptune-1st-ep-out-now/

Inspired by Brother Android's album "October, November, December" I gave myself a deadline of 3 months to make an album. EP 1 is the result. It was all recorded on a cheap 4 track cassette player.

Here's a quick track by track rundown:

NEBULAE - Bleep Labs Nebulophone running through a homemade delay box and a homemade Korg MS-20 filter clone.

MIST TOWN - 2 x lsdj. Inspired by "Legend of Zelda 2" for the NES, which I was playing at the time.

ATARI SERENADE - this was a song that I had made earlier in the year using Paul Slocum's Synthcart for the Atari 2600. I slowed it down using my circuit bent 4 track for this ep.

BREAK LAKE - 1 x lsdj. My attempt at a little chipbreak.

E-WASTE - 1x lsdj plus a bunch of circuit bent/ handmade instruments I had lying around.

PLUTO BLUE - This song is only on the cassette tape. It is an lsdj track slowed down using a modified DMG.

FEBRUARY LULLABY - Another lsdj track slowed down using a modified DMG... running through the handmade delay and filter.

ICE NIGHTMARE - Another cassette only track. Another lsdj track slowed down, this time running through a homemade distortion pedal.

There might also be a short "secret track" somewhere on the cassette ... ... 🖼

Figure 17. An example post from a member describing software and practices used within each track of a release. Highlights added to demonstrate the prominence of LSDJ within this album. Source: chipmusic.org/forums/topic/16230/deerbite-lofi-chiptune-1st-ep-out-now/

Although members primarily discussed popular trackers like LSDJ and LGPT throughout the discussion forum, members also discussed using, modifying, or creating a wide range of trackers for a multitude of hardware. For example, some members provided updates on trackers they used;[43] others asked how to modify the source code of a tracker to alter, add, or remove functionality;[44] and some members created and shared their own trackers within the discussion forum.[45] Of the three ways members discussed engaging with a tracker (i.e., using, modifying, and creating trackers), the majority of discussions revolve around asking other members for suggestions on how to use trackers to create chiptunes. Such findings demonstrate the prevalence of tracker software within chiptune practices.

Members discussed how they learned to use trackers by experimenting with the program, using resources such as manuals and tutorials, and asking other members for help. If a member posted questions on how to make chiptunes with a particular tracker, other members provided a multitude of resources to assist with answering questions. For example, in the topic titled "NEW TO MAXYMISER- I THINK I MIGHT CRY,"[46] a member indicated they were unable to make music with an Atari ST (a type of gaming console) tracker known as "maxYMiser," so they requested advice from other members within chipmusic.org:

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[43] See topics such as "ACE TRACKER 2.0," "ATARI 800 POKEY (RMT TRACKER)," and "CHIPPER - ATARI LYNX SOUND GEN / TRACKER TOOL (EARLY BETA)."

[44] See topics such as "MIDI CHANNEL SWITCH ON THE FLY," "ARDUINOBOY CODE EDITING HELP," and "NES ROM TO NES CART.. HELP!"

[45] See topics such as "ATARI 2600 DRUMS," "YM2149 AND OPL2/OPL3 TRACKER NEW VERSION 04-11-2012," and "HOUSTONTRACKER 2 (TI-82/83/83+/84+)."

[46] chipmusic.org/forums/topic/18514/new-to-maxymiser-i-think-i-might-cry/

Hi :3 I usually use LSDJ and have been wanting to learn to make music for other

platforms, namely, the Atari ST. I only have a PC so I have installed the Steem

Emulator [which allows users to run Atari ST software on a PC] and am running

maxYMiser for the first time. I have been reading the manuals that come both

with MaxYMiser and Steem.

I can't even get the damn thing to make a sound. I swear I have set up an

instrument correctly and have got notes entered into the channels but I play the

song and hear nothing. Other Atari games and programs make a sound fine so I

am assuming the problem is with me. All these tutorials seem to assume I know

the basics of this program already! Please help, it's soul destroying! X[47]

Within this one topic, people responded with links to external resources, wrote text-

based descriptions on how to create music with maxYMiser, and created visual resources

to assist with answering the original and follow up questions (see Figure 18 for an

example). This example demonstrates how some members used the discussion forum to

learn how to create chiptunes with trackers. In addition, this example demonstrates

members responded with a multitude of resources to answer questions. The original

poster found these resources and the members of chipmusic.org to be helpful: "Thanks

again people I guess for me it is just a steep learning curve. I am determined to

master this eventually though. . . I love this forum because everyone is kind and

helpful!"[48]

[47] chipmusic.org/forums/topic/18514/new-to-maxymiser-i-think-i-might-cry/

[48] chipmusic.org/forums/topic/18514/new-to-maxymiser-i-think-i-might-cry/
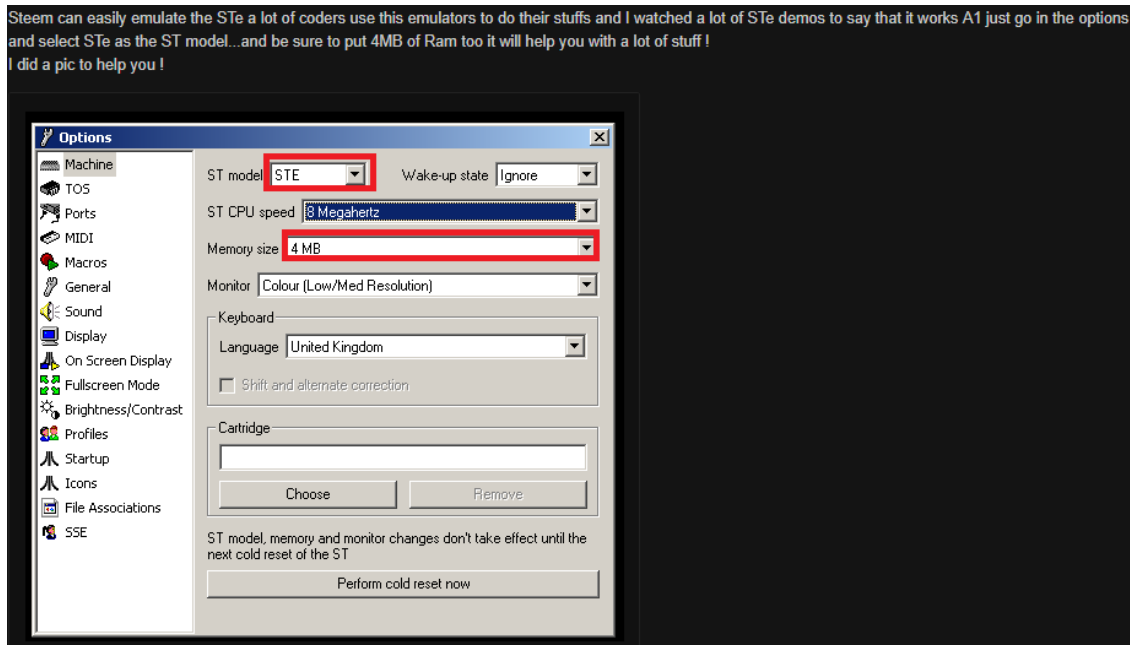
Figure 18. An example of a resource a member created to answer another member's question. Source: chipmusic.org/forums/topic/18514/new-to-maxymiser-i-think-i-might-cry/

Digital audio workstations. As indicated by my corpus analysis findings from phase one, trackers appeared to be the most commonly discussed software for composition practices. However, Digital Audio Workstations (DAWs) were the second most prominent type of software discussed in relation to composition practices. DAWs are electronic devices or software with features designed for recording, editing, and producing music or sound. Popular examples of modern DAWs include Ableton Live, Renoise, FL Studio, Logic Pro, Pro Tools, and GarageBand. These programs are used to create music compositions or productions, audio files, podcasts, or live music and audio effects processing. For example, people can use DAWs to record and edit individual instrumental or vocal tracks, add synthesized instrumental accompaniment through MIDI sequences, mix and master audio levels, then "bounce" or publish a song as an audio file.

The word "DAW" and its lemma (DAWs) accounted for 1,121 word tokens with an overall dispersion of 0.807 across the discussion forum. If combined with lemmas from the two most popular DAWs within chipmusic.org (Ableton Live and Renoise), "DAW" accounted for 3,510 word tokens with an overall dispersion of 0.814 across the discussion forum. This indicates lemmas for DAWs and two of the most prevalent DAW names were highly dispersed across the discussion forum and were not isolated to a small number of topics or posts. However, the number of word tokens and dispersion also indicate members discussed trackers more frequently than DAWs. Although, the distinction between DAW and tacker interfaces blur together in DAWs such as Renoise, which has a user interface with "a tracker-based approach."[49]

Although the frequency and dispersion rate for the word "DAW" and its lemmas indicate discussions occurred throughout the entire discussion forum, the "Audio production" subforum was largely dedicated to topics on DAW practices. To better understand which practices members discussed most, I used keyness techniques to reveal which words occurred more frequently in the "Audio production" subforum than in other subforums. Within WordSmith Tools, the BIC Score can assess keyness between discourse from one subforum with a reference corpus or corpora. A BIC Score greater than 10 indicates very strong evidence a word's keyness is greater in one subforum than the reference corpus. When assessing the "Audio production" subforum in comparison with all other subforums, high BIC Scores for words and their lemmas revealed DAW practices or features such as EQ (BIC Score of 1,198), mixing (BIC Score of 960.09), recording (BIC Score of 404.66), mastering (BIC Score of 303.55), and volume (BIC Score of 135.001). This indicates the "Audio production" subforum discussed these practices and features more frequently than other subforums. Each practice guided a

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[49] renoise.com/products/renoise

close analysis of discussions within the "Audio production" subforum and throughout the entire discussion forum.

Across the chipmusic.org discussion forum the majority of discourse involving DAW practices included discussions on recording, mixing, mastering, synthesizing chiptune sounds, sampling, or hardware specific questions. Members within the forum often posed questions about recording audio from devices in order to best capture the sounds from old video game and computer sound chips.[50] Topics on mixing often included discussions on mixing techniques for balancing recorded or produced channels, which may include acoustic instruments or vocals along with music and sounds created through a sound chip.[51] Discourse on mastering included discussions on maximizing the loudness of a track[52] as well as mastering for optimum sound quality on a particular platform such as Bandcamp[53] or SoundCloud.[54] Members asked each other how to reproduce or synthesize particular sounds within a DAW for use in their own chiptunes.[55] Some members created and shared sample packs,[56] asked others how to

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[50] See topics such as "RECORDING DMG !?," "RECORDING HELP WITH NOISE," and "HOW DOES ONE RECORD FROM AN EMULATOR?"

[51] See topics such as "LSDJ/GUITAR/VOCAL MIXING," "STEREO MIXING 8-BIT," and "MIXING."

[52] See topics such as "MASTERING FOR BANDCAMP."

[53] See topics such as "TWO RELATED QUESTIONS ABOUT MUSIC LOUDNESS/MASTERING."

[54] See topics such as "WHAT AM I DOING WRONG? (LSDJ MASTERING FOR SOUNDCLOUD ETC.)."

[55] See topics such as "[LSDJ] REPRODUCING TWO SOUNDS," "HOW CAN I REPRODUCE THIS SOUND," "WHAT TYPE OF SYNTH SOUND IS THIS?" and "HOW CAN I REPRODUCE THIS SOUND."

[56] See topics such as "FREE OLD CAMERA SAMPLE PACK" and "SCREAMFORME99'S SAMPLE PACK."

create their own samples,[57] or asked members to share where they find their samples.[58]

Members of chipmusic.org also asked what hardware other chipmusicians used with

their DAW.[59] The aforementioned examples demonstrates the wide range of composition

practices evident within DAW discourse. Through this discussion of trackers and DAWs,

I worked to provide context for understanding software and practices discussed in the

forum. In the following section I introduce the first theme, composition practices, which

typically involve use of trackers and DAWs to create chiptune compositions.

Composition Practices

Members of chipmusic.org discussed a multitude of composition practices

throughout the discussion forum. The majority of these practices included discussions on

music appropriations, sound synthesis and reverse engineering, compositional concepts

and tools, and whether certain practices qualified as chiptune practices. In order to

support understanding these composition practices, I provide selected examples of

discussion forum posts in each theme.

Chiptune appropriations

Members of chipmusic.org discussed a multitude of chiptune appropriations

throughout the forum. I thematically organize such appropriations within the practices

Tobias (2013) uses to describe the types of participatory engagement people employ with

popular music and culture. These practices are organized within discussions on (a)

sample-based producing, (b) covering and arranging, (c) remixing, (d), mash-ups, and

(e) commenting and discussing. Tobias (2013, p. 30) provides the following descriptions

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[57] See topics such as "BEST WAY TO RIP VOCALS OR SAMPLES?"

[58] See topics such as "TRACKER FOOD (SAMPLES)"

[59] See topics such as "WHAT STUDIO MONITOR SPEAKERS DO YOU USE?" "WHAT KINDS OF MIXERS ARE YOU ALL USING?," and "WHAT MIC DO YOU USE TO RECORD HANDHELDS? OR DO YOU PREFER LINE-IN?"

of his classification scheme: *Sample-based producing* involves "producing or performing different music by repeating, manipulating, or reordering musical content (samples) of the original." *Covering practices* involve "individuals or groups performing replications or variations of original songs, sometimes in new musical contexts" whereas *arranging practices* involve "reorchestrating an original work for new musical contexts, often making use of computer music applications." *Remixing practices* are described as "producing versions that maintain the original work's essence while adding musical content to change the context or genre, typically with technology." Similarly, *mash-ups* "[combine] elements of the original with one or more different songs through juxtapositions, or less traditionally [segue] between them, to create new composites and offer new ways of hearing the originals." Lastly, *commenting and sharing practices* involve "sharing comments and feedback related to original works, versions resulting from any of the preceding practices, or comments of others via social media, such as Twitter and Facebook, blogs, and website comment sections."

The following sections are presented in order of most frequently discussed practices in chipmusic.org, with sample-based producing being the most frequently discussed practice and mash-ups being the least frequently discussed. I conclude this section with examples of commenting and discussing practices because such practices occurred throughout each of the other practices. Note, however, not all of the participatory practices described by Tobias (2013) were as prominent or evident through discussion forum posts within chipmusic.org. For example, only one release described their album as "a satire on the modern game industry's release model of putting a game 80% complete out then selling you the remaining 20% as 'DLC.'"[60]

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[60] chipmusic.org/forums/topic/19640/dlc-the-ost-ep-8-bit-weapon/

Sample-based producing. In chipmusic.org, much of the software members discussed (e.g., trackers and DAWs) use samples to emulate or replicate the sounds of old computer and video game sound chips. Any chiptune composition which uses a sample from a sound chip to make music is an example of sample-based producing. Although not always explicit, some members described where they obtained their samples in the compositions they released: "i used Ableton for this release but most all of the instruments (not the drums) are SNES [Super Nintendo Entertainment Systems] samples and a few OS system sounds. there's some regular ol' guitar in there too"[61] (the SNES is a video game console). Other members specified not only the sound chip used, but also which games the sounds originated from: "I used . . . A bunch of percussion samples ripped out of various Sonic games (Mostly Sonic 2)."[62]

Covering and arranging. Although some members appeared to distinguish between covering and arranging, in a topic titled "DIFFERENCES BETWEEN COVERS AND REMIXES,"[63] and throughout much of the discourse on "covers," many of the members of chipmusic.org appeared to consider a reorchestration of a song within the chiptune aesthetic as a "cover" rather than an "arrangement." Aside from sample-based producing, it appears that members treated covers as a popular form of music engagement or practice where members often tried "to get as close to the original as possible."[64]

An example album by a member of chipmusic.org included covers of songs by The Ramones, Oasis, Deadmau5, Die Ärzte, Grandmaster Flash/Grover Washington Jr.,

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[61] chipmusic.org/forums/topic/20119/nmlstylconcat/

[62] chipmusic.org/forums/topic/19853/saskrotch-zones-act-1/

[63] chipmusic.org/forums/topic/14988/differences-between-covers-and-remixes/

[64] chipmusic.org/forums/topic/16436/cc-note-and-timing-issues-on-a-cover-song/

Natalie Imbruglia, and Less Than Jake.[65] Many of the covers in this album also included

vocal samples from the original artists, indicating members combined various types of

music appropriation practices. Some members of chipmusic.org labeled their music as

"arrangements" rather than "covers": "here's a brand new NES (2a03 + N163)

arrangement of the classic folk song House of the Rising Sun."[66] Other members asked

about recreating a genre or period of music within the chiptune aesthetic: "HAS

ANYONE TRIED TO CONVERT BAROQUE MUSIC TO CHIPTUNE?"[67]

      Members often described using covers as an entry-level step to creating

chiptunes. For example, using a cover to learn software: "I started off with a cover just to

be able to focus more on learning the software and playing with sounds."[68] Others used

covers as an exercise in learning how to compose chiptunes,[69] or to work through

"creative slumps": "also during creative slumps I find it a good idea to make covers so

that your musical brain still gets some exercise but your creativity is stretched minimally,

but enough to exercise it for later."[70] Another person responded and agreed: "covers can

really help take your mind off of your music while still creating music that is essentially

yours."[71] These discussions appeared to indicate practices such as covers acted as a

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[65] chipmusic.org/forums/topic/19851/littlesound-orchestra-new-bandcamp/

[66] chipmusic.org/forums/topic/18200/singles-release-mega-thread/

[67] chipmusic.org/forums/topic/19241/has-anyone-tried-to-convert-baroque-music-to-chiptune/

[68] chipmusic.org/forums/topic/19227/first-attempt/

[69]"See topics such as "HOW'S THE SOUND DESIGN IN THIS COVER?" and "MY CHIPTUNES DON'T GO ANYWHERE."

[70] chipmusic.org/forums/topic/8466/dead-topic/page/2/

[71] chipmusic.org/forums/topic/8466/dead-topic/page/2/

process for learning how to create chiptunes as much as they were about creating chiptune products.

Remixing. Members of chipmusic.org often created and shared remixes in the "Releases" subforum.[72] Occasionally, members asked others for material to remix; for example, in topics such as "GIVE ME 3 CHIPTUNE MELODY LOOPS AND ILL [*sic*] MAKE 3 BEATS OUT OF THEM."[73] Although most members did not explain why they wanted others to engage in this participatory practice, some indicated this process was "simply for the fun of it,"[74] while others mentioned they would like to see how others might improve upon an original musical idea:

> I made a song a while back and i was wondering if someone could do something
>
> with it and re upload it. i know it sounds like complete shit, but thats [*sic*] why
>
> I'm posting it. to see if someone could make it into something great.[75]

And some members shared their own project files and requested others to remix their own original creations.[76]

As with covers, people expressed interest in learning how to create chiptunes by remixing other people's project files: "I don't want to steal songs or anything. I just want

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[72] See topics such as "VAULT KID - TETRIS (DRUM AND BASS REMIX) 1XLSDJ," "8 BIT UNIVERSE REMIX OF DO YOU USE A KNIFE BY ALVEOLE," "SHRIMPS - STRUT THAT BUTT (REMIX) FEAT. SBTHREE," and "NEW RELEASE!!! BOBILOB - IT'S RAINING MEN REMIX! [THE WEATHER GIRLS]."

[73] chipmusic.org/forums/topic/10627/give-me-3-chiptune-melody-loops-and-ill-make-3-beats-out-of-them/

[74] chipmusic.org/forums/topic/16283/anyone-up-for-recreational-remixes/

[75] chipmusic.org/forums/topic/4358/can-someone-do-something-with-this/

[76] See topics such as "PLEASE REMIX MY SONGS," "SERIOUS REMIXERS WANTED - GAMEBOY RAP/HIP HOP," "REMIXES FOR MY SONG," and "MY LSDJ.SAV BACKUP IF YOU WANT. (REMIXES?)."

to dissect them and see how they're composed as a learning method."[77] Some released

their project files alongside an album because they wanted to encourage others to learn

through remixing:

> This album would not be possible without the sharing of information, tricks, and
>
> ideas. I still find myself learning things in LSDJ (someone showed me a new trick
>
> THIS WEEK). <u>For this reason I've decided to include the .sav files [project files]</u>
>
> <u>in my album.</u> Go ahead, learn, remix, be curious. There's no reason to have trade
>
> secrets in chiptune composing. I am extremely proud of what I've been able to
>
> accomplish with this album but it would not have happened without people
>
> showing me things first.[78] (original emphasis)

These discussions align with scholarship on the mod scene, which suggests novice coders

are more motivated when modifying a project file than starting from scratch (El-Nasr

and Smith, 2006), as well as scholarship on chipmusicians and demosceners sharing and

remixing project files (Carlsson, 2010; Lysloff 2003) or learning by copying other

chiptune practices or compositions (Polymeropoulou, 2014).

  Although many members valued remixing practices,[79] some cautioned against

remixing project files because "it would be mostly confusing for you to look at an

experienced user's LSDj .sav."[80] This concern was likely due to experienced

chipmusicians using combinations of interconnected effects or commands that might

overwhelm novice chipmusicians. Such comments suggest some members of

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[77] chipmusic.org/forums/topic/9170/dissecting-songs-in-lsdj/

[78] chipmusic.org/forums/topic/5552/ubi031-danimal-cannon-roots/

[79] See posts such as "LSDJ COMPOSITION GUIDANCE," "SO… HOW DID YOU LEARN LSDJ?" and "RELEASES THAT INCLUDE SOURCE CODE/PROJECT FILES."

[80] chipmusic.org/forums/topic/7770/does-lsdj-come-with-a-demo-song/

chipmusic.org considered whether certain practices were accessible to novice or experienced chipmusicians. This also suggests that learning how to create chiptunes is a social activity, which resembles descriptions of practice in the mod scene (see Jansz & Theodorsen, 2009; Scacchi, 2011; Sihvonen, 2011; Steinkuehler & Johnson, 2009).

Mash-ups. Although discussed significantly less common than the other participatory practices, some members created, shared, and discussed mash-ups. For example, using LSDJ to create a mash-up of Super Mario Brothers with Mega Man: "If Super Mario Bros. was a stage in Mega Man, I think the music might sound something like this. Made in LSDJ. What do you think?"[81] Other musicians discussed in-progress mash-ups that combined chiptunes with other genres of music, such as rap: "I'm currently working on a mashup album that combines classic video game soundtracks with rap vocals."[82] Or even requested a visual mash-up within the "Motion graphics" subforum: "Can we have a mashup of Joe Biden's mishap with your 'big fucking deal' visuals please?"[83]

Commenting and discussing. Although not all creations or appropriations shared as topics within the "Releases" subforum received replies, the average number of replies per topic within this subforum was 7.6. This figure suggests members regularly commented on and discussed creations and appropriations shared within chipmusic.org. While the majority of people appeared to appreciate the practices outlined above, some felt practices such as covers made the music "mechanical"[84] or feared chiptunes would

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[81] chipmusic.org/forums/topic/16312/super-mariomega-man-mashup/

[82] chipmusic.org/forums/topic/3367/wanted-artwork-for-video-game-mashup-album/

[83] chipmusic.org/forums/topic/14988/differences-between-covers-and-remixes/

[84] See topics such as "MY CHIPTUNES DON'T GO ANYWHERE."

not be "taken seriously"; "let's stop doing chip versions of shitty pop music so we, as a community, can be taken seriously."[85]

In some instances, members discussed whether chiptune appropriations maintained the "proper feel" from original pieces. For example, when a member posted a topic with an arrangement of Steve Reich's "Clapping Music" on Roland TR-626 and TR-505 drum machines, a member responded with the following comment:

> I guess you have to be familiar with the original piece to enjoy this? I don't get it... Is there some kind of technical feat that is being accomplished here that I'm missing? Or is this simply just a clapping sequence mapped to drum machine and nothing more? Am I not supposed to listen with headphones?
>
> I feel like I'd probably enjoy a live 'human clapping' version better. I do think it's cool that this is a classical piece, though, and apparently an effort well appreciated, so... good job. It was just too long for me to be able to really get into just the rhythms of a single type of sound. [86]

After another member responded by sharing a description of the piece within a YouTube performance with two percussionists performing the piece in a recital hall, this member responded with

> Ah, see now that explains why I couldn't get the proper feel from the drum machine performance. Needs music hall reverb . Anyhow, great job. An admirable tribute. I like all that stereoy stuff that's going on.

---

[85] chipmusic.org/forums/topic/9725/carley-rae-jepsen-call-me-maybe-sparrows-lets-get-chippy-remix/

[86] chipmusic.org/forums/topic/11680/steve-reich-on-drum-machines/

It's kind of like what happens when I play back my midi transcribed version of a song that has a non-rounded BPM, ⊟.[87]

The topic creator responded in agreement:

It is quite a monotone feat indeed, I grant you that.

I really enjoy Reich's phasing pieces. Drumming being one of the best, but hard to do on a drum machine…

So I thought I'd start with an easy one ☺

The piece does sound better with real clapping, the tiny variations in the sound and the hall reverb does add a lot to the sound.

A version like this really shows that music isn't just the sound of the music itself.

It was still fun to do tho ⊟[88]

These excerpts provide an example discussion around intentionality and understanding an arrangement. When a member replied they did not understand the arrangement, this led to a discussion about music hall reverberation and variations in the hand claps adding to the "proper feel" that the responder felt was lacking in the drum machine arrangement. The original member who posted their arrangement agreed but added "it was still fun" to create this appropriation. This example dialogue demonstrates some members of chipmusic.org were very intentional with creating, listening, and commenting on chiptune appropriations shared within the discussion forum.

Sound Synthesis

Members who created original and appropriated compositions in trackers or DAWs were able to synthesize each instrument's sound by modifying wave forms, adding

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[87] chipmusic.org/forums/topic/11680/steve-reich-on-drum-machines/

[88] chipmusic.org/forums/topic/11680/steve-reich-on-drum-machines/

96

effects, or altering the attack, decay, sustain, and release (ADSR) of any given sound.

ADSR shapes the sonic characteristics of a sound by controlling the amount of time it

takes to get to the initial peak of a given parameter (attack), the amount of time from the

initial peak to a sustained amplitude (decay), how long the sustained amplitude is held

for (sustain), and the amount of time it takes to decay from the sustained level to zero or

nil value of a parameter (release). For example, a person might adjust the ADSR of an

instrument's amplitude to create a sound with a short and loud attack with a quick

decay, sustain, and release to create a percussive instrument or sound (e.g., a snare

drum, hand clap, or finger snap). Sound synthesis techniques enabled members to create

or adjust the sonic characteristics of each sound or instrument that were then used to

create melodies, harmonies, or percussion grooves. The following paragraphs describe

some of the sound synthesis practices available in tracker and DAW software that

members discussed within chipmusic.org; however, these practices were not exclusive to

these two types of software.

The word "synthesize" and its lemmas (e.g., synth, synthesized, synthesizer,

synthesis, etc.) accounted for 5,441 word tokens with an overall dispersion rate of 0.866

across the discussion forum, indicating discussions about sound synthesis occurred

throughout much of the discussion forum. Upon further investigation of sound synthesis

discourses, members discussed a range of sound synthesis practices: wavetable

synthesis, frequency modulation (FM) synthesis, or subtractive synthesis.[89] Members of

chipmusic.org generally discussed the concepts, practices, and understandings related to

the sound synthesis methods available within a program used for creating chiptunes. For

example, people who created chiptunes through software with FM synthesis capabilities

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[89] To learn more about the basics of sound synthesis, visit theproaudiofiles.com/sound-synthesis-basics/

and not wavetable synthesis capabilities generally asked questions about the former

practices and not the latter. However, some members indicated generalized interest in

sound synthesis techniques outside of practices limited to specific software.[90] This

suggests that the type of synthesis available within software may guide discussions on

sound synthesis concepts and practices; however, some members discussed sound

synthesis concepts and practices without situating the discussions within a particular

program's sound synthesis methods or features.

While some members discussed recording acoustic instruments as samples for

their chiptunes,[91] most members engaged in discourse on synthesizing particular

instruments or sounds. For example, asking how to create a ride cymbal through a noise

channel,[92] creating a distorted guitar sound,[93] synthesizing a flute sound with a wav

instrument,[94] simulating a gunshot sound through the wav channel,[95] creating a piano

sound for the Nintendo Entertainment System (NES – a type of gaming console),[96] and

more.[97] In order to share understandings of sound synthesis, some members posted

examples through text (see Figure 19), while others shared pictures of their device

---

[90] See topics such as "QUESTION FOR PEOPLE WITH GENERAL CIRCUITRY KNOWLEDGE" and "ELECTRONIC DMG DETAILS + SYNTHETHIZERS THEORY?"

[91] See topics such as "HOW BAD WOULD RECORDED LIVE INSTRUMENTS SOUND ON GAMEBOY?"

[92] See topics such as "RIDE CYMBAL IN LSDJ."

[93] See topics such as "GUITARISH SOUND."

[94] See topics such as "WAV INSTRUMENT TUTORIALS FOR LSDJ."

[95] See topics such as "WEIRD QUESTION BUT…"

[96] See topics such as "GOOD WAY TO MAKE A PIANO SOUND WITH MML FOR NES ?"

[97] See topics such as "SEARCH FOR INSTRUMENT."

settings (see Figure 20). However, some voiced a preference for embracing chiptune timbres over emulating instruments through chiptune practices:

> The best response I can come up with to this thread is to not worry about trying to emulate other instruments too much in LSDJ, you'll always get disappointed (and other people will only hear "8bit" anyway). Instead, try to embrace the timbres and come up with wacky crazy sounds through trial and error - you'll have a lot more fun with happy accidents than trying to make a specific thing and failing at it[98]

```
/// Instrument screen ///      /// Synth screen ///         /// Table screen

                               SYNTH                        ABLE
   NAME                        WAVE      TRI                      VOL   TSP   CMD   CMD
   TYPE      WAVE              FILTER    LOWP            0    00    00    -00   PF0
                              Q         0               1    00    00    -00   -00
   VOLUME    3                 DIST      CLIP            2    00    00    -00   -00
   OUTPUT    LR                PHASE     NORMAL          3    00    00    -00   -00
   VIB.TYPE  HF                                          4    00    00    -00   -00
                               START:                   5    00    00    -00   -00
                               VOLUME    40             6    00    00    -00   -00
   SYNTH     0                 CUTOFF    FF             7    00    00    -00   -00
   PLAY      MANUAL            PHASE     00             8    00    00    -00   -00
   LENGTH    F                 VSHIFT    00             9    00    00    -00   -00
   REPEAT    0                                          A    00    00    -00   -00
   SPEED     4                 END:                     B    00    00    -00   -00
                               VOLUME    10             C    00    00    -00   -00
                               CUTOFF    FF             D    00    00    -00   -00
   AUTOMATE  OFF               PHASE     00             E    00    00    -00   K00
   TABLE     ON                VSHIFT    00             F    00    00    -00   -00
```
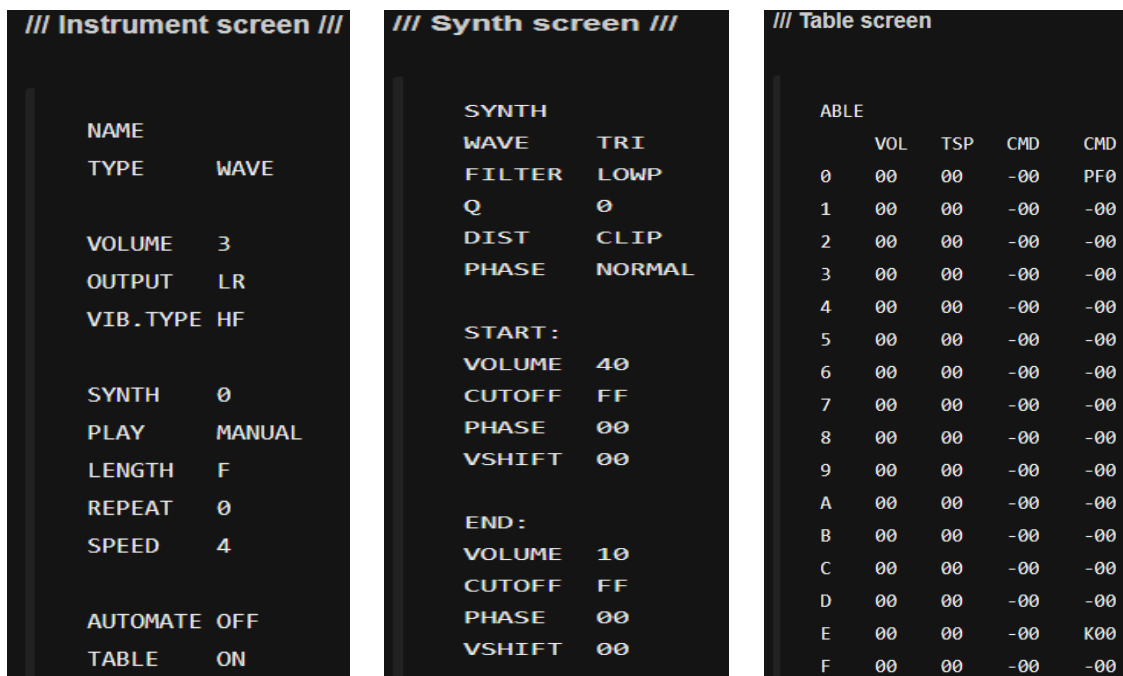
Figure 19. Three screenshots from a single post sharing how a member synthesized their bass drum (kick). Source: chipmusic.org/forums/topic/112/lsdj-huge-wave-kicks-please/

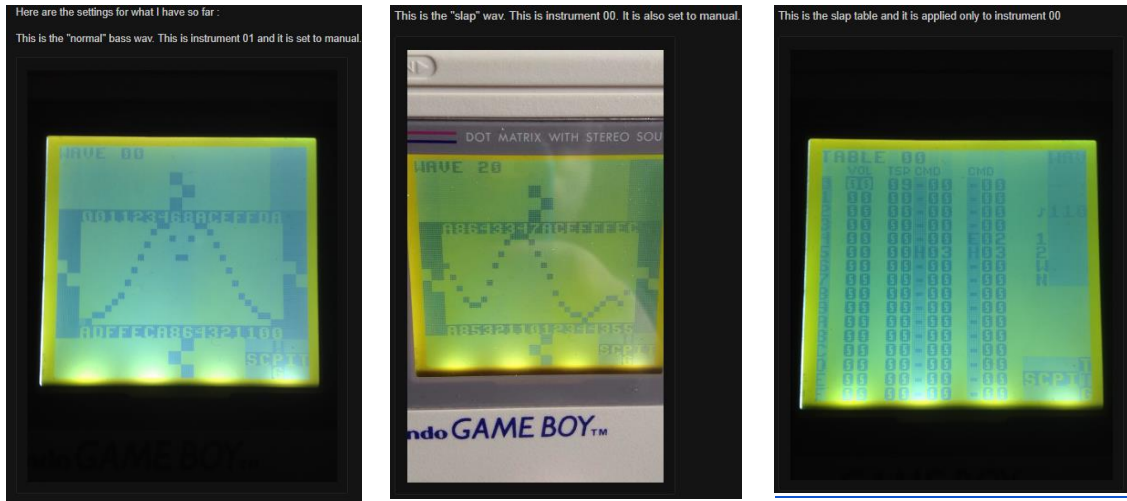[98] chipmusic.org/forums/topic/14721/wav-instrument-tutorials-for-lsdj/

Figure 20. Three screenshots from a single post sharing how a member synthesized a

slap bass sound. Source: chipmusic.org/forums/topic/16692/lsdj-slap-bass-

attempttutorial/

Although the majority of discourse on sound synthesis within chipmusic.org

involved synthesizing or emulating sounds of a particular sound chip, some members

discussed 1-bit music (also referred to as "beeper music").[99] As one member describes it,

1-bit music is

> music made from the speaker of a computer (no dedicated sound card), the state
>
> of the speaker can be 0 or 1. Generally it sounds very crude, like this:
>
> https://www.youtube.com/watch?v=1IOL4q5tDDQ (which can be cool too, this
>
> tune is so great).[100]

This approach to music making allowed some members to create or listen to low-fi music

compositions using the speaker or buzzer in an Arduino (an open source

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[99] See topics such as "KEEP ON BEEPING - NEW SCREENCAST ON 1 BIT MUSIC" and "1-BIT MUSIC GOES HANDHELD - SPECCY ROUTINES ON TI82," or read McAlpine's (2017) article on the 48k Sinclair AZ Spectrum for more information on 1-bit music.

[100] chipmusic.org/forums/topic/19450/1bit-music-on-arduino/

microcontroller)[101] rather than synthesizing instruments with software. Discourses on 1-bit music demonstrates some members discussed making music with hardware that had no dedicated sound chips. Members of chipmusic.org appeared to enjoy making music with hardware that have inherent limitations or constraints,[102] which is a finding that is consistent with related chiptune scholarship that indicate hardware limitations are enjoyable and can act as a stimulant for creating music (Carlsson, 2010; K. Collins, 2013; Yabsley, 2007) as well as scholars of digital musicianship who suggest a paradox of feeling liberated when creating music within constraints. As Hugill (2008) notes, "adopting a deliberately restricted process or pattern can trigger ideas and inspiration and is usually a good way to start to make music" (p. 107).

Reverse engineering. Reverse engineering is a process of using aural skills to recreate a sound through sound synthesis or audio production practices. Reverse engineering practices differ from transcribing in that the focus is on the sonic characteristics of a sound rather than specific pitches or rhythms. Members of chipmusic.org used terms such as "reverse engineer," "reproduce," or "recreate" to ask for assistance with reverse engineering a particular sound or instrument in a song. For example, reverse engineering a lead instrument in a song,[103] "melodic tom tom sound,"[104]

---

[101] See topics such as "1-BIT MUSIC ON ARDUINO."

[102] Members further discussed their interest in hardware limitations in topics such as "WHY DO YOU COMPOSE/LISTEN TO CHIP?" "RE: LIMITATION," and "WHAT IS YOUR MUSIC DOING FOR YOU?"

[103] See topics such as "LEAD INSTRUMENT TONE."

[104] See topics such as "GETTING A MELODIC TOM TOM SOUND."

a kick (bass) drum,[105] snare drum,[106] specific audio effects,[107] a robot voice,[108] specific synths,[109] "creating a warm pad sound,"[110] instruments from a specific chipmusician,[111] or even asking others to assist with reverse engineering a sound they made in an original song whose project files they no longer had access to.[112] When members responded with suggestions, they often included detailed descriptions or images demonstrating how to recreate a particular sound, see Figure 21. I found such practices of creating resources to respond to member questions throughout each theme in this study, which resembles scholarship about circuit-bending practitioners (Franklin, 2009), affinity spaces (Gee, 2004, 2008; Gee & Hayes, 2010; Lammers, Curwood, & Magnifico, 2012), and online communities (Durga, 2012; Smith, 2011; K. Miller, 2012; Steinkuehler & Duncan, 2008).

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[105] See topics such as "HOW TO MAKE A KICK LIKE THIS?"

[106] See topics such as "LSDJ SNARE HELP!"

[107] See topics such as "HOW DO I MAKE THIS SOUND ?"

[108] See topics such as "[QUESTION] HOW TO GET THE 'YEAH' SOUND LIKE BIT SHIFTER?"

[109] See topics such as "SYNTH BUILD QUESTION" and "[LSDJ] REPRODUCING TWO SOUNDS."

[110] chipmusic.org/forums/topic/7996/warm-pad-sound/

[111] See topics such as "HAS ANYONE CRACKED CHIPZEL'S CODE OF MAKING AWESOME INSTRUMENTS?"

[112] See topics such as "LOST AN INSTRUMENT, NEED HELP RECREATING IT."

WAV:
So for the WAV channel, I did this by "emulating" PWM. Technically it is PWM, but not as smooth as the 16 bit systems do it or whatever. You go into the wave screen, and manually enter a pulse wave that has a midpoint in the middle of the screen, and draw 2 more waves where the midpoint moves more toward the left. Set the instrument to manual in the instrument screen.

Then in a table put this:

F01 --
--   --
--   E02
F02 --
--   --
--   E01
F03   --
--   E00
H09 H09

Basically what that does is the F commands are telling the instrument to switch waveforms to the number indicated, in this case, shortening the PWM. What the E commands are doing are automating and emulating a lower envelope, so that it has a little bit of a decay in the note.

Pulse:
This one is a little bit simpler and less work, but it might be in the way of some other pulse instruments you have going on (that's why I also made a wav channel one). Make a pulse instrument with an envelope like 77 (that should be sufficient, just make sure the not will release) and make a table for it. The table should look like this:

W03
--
W02
--
W01
--
H06

W commands don't have numbers, but I don't know how to notate it. Use the third wave, then the second one, and then the first one (if you don't understand, I'll try to make a screenshot).

Figure 21. An example post where a member used text and images to demonstrate how to recreate a sound in LSDJ. Source: chipmusic.org/forums/topic/7598/lsdj-reproducing-two-sounds/

Similar to the learning practices evident through discourse on remixing, some members requested project files to better understand how to create their own instruments.[113] However, some members appeared to value listening to music in order to gain a better understanding of how to recreate a sound in a composition. For example, when a member requested project files to learn how to create instruments in LSDJ, a member responded "you might get more interesting results by listening to a song very, very carefully over and over and imagining how *you* might make the same sounds."[114] Hugill (2008) describes such practices as "technological listening" or "recipe listening," where a person is "disproportionately interested in *how* something was made technically, rather than the musical or sonic outcomes" (p. 20, original emphasis).

Composition Concepts and Tools

Throughout the discourse around music composition, members of chipmusic.org discussed a multitude of composition concepts and tools. Discussion topics ranged from simple to complex, and included topics such as asking general advice on composing in trackers such as LSDJ,[115] sharing percussion patterns,[116] creating quintuplets in a tracker,[117] writing chiptunes in time signatures other than 4/4,[118] and even creating metric modulation in a tracker.[119] The following sections describe revealed discourse on Western staff notation and music theory in relation to chiptune composition practices.

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[113] See topics such as "HOW TO STEAL INSTRUMENTS FROM GENESIS ROMS."

[114] chipmusic.org/forums/topic/9170/dissecting-songs-in-lsdj/

[115] See topics such as "LSDJ COMPOSITION GUIDANCE."

[116] See topics such as "THE LSDJ PERCUSSION THREAD."

[117] See topics such as "QUINTUPLETS IN LSDJ?"

[118] See topics such as "LSDJ ODD TIME SIGNATURES/POLYRHYTHMS."

[119] See topics such as "LSDJ ODD TIME SIGNATURES/POLYRHYTHMS" (forum page 6).

Western staff notation. The corpus analysis techniques I applied in phase one revealed patterns related to Western staff notation (an etic term). Some emic examples include "sheet music" (*n* = 82 tokens), "read music" (*n* = 22 tokens), and L1 collocates for "notation" (words directly preceding "notation") accounting for 31 word tokens: "music notation" (*n* = 14), "traditional notation" (*n* = 5), "musical notation" (*n* = 4), "standard notation" (*n* = 4), "classical notation" (*n* = 2), and "western notation" (*n* = 2). Within some of these tokens, members discussed being able to read Western staff notation;[120] however, many of the tokens indicated not using or reading Western staff notation.[121] For example, "I've done all of these by ear and *refuse to look up sheet music* [emphasis added] or use midi files as reference."[122] Of the chiptune practices associated with Western staff notation, most of the members who read or wrote Western staff notation when composing chiptunes did so for the purpose of transcribing music into MIDI or a tracker.[123]

While it appears members of chipmusic.org rarely used Western staff notation when creating chiptunes, members discussed other forms of music notation. For example, the word MIDI accounted for 12,145 word tokens with an overall dispersion of 0.697 across the discussion forum. In addition to MIDI, members frequently replicated

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[120] See topics such as "CAN YOU READ MUSIC?"

[121] See topics such as "ALL-TIME FAVOURITE CHIPTUNES!" (page 5), "BREAKING THE RULES OF TONALITY, HOW DO YOU DO IT 'RIGHT'?" and "WORST TRACKERS TO START CHIPTUNING WITH??" (page 4).

[122] chipmusic.org/forums/topic/6925/i-am-new-to-all-of-this-so-hello/

[123] See topics such as "8STATIC •8/14 • PHL• MR.SPASTIC, GLOMAG, NATTY, 8BK-OK, ENSO," "I'M ACCEPTING CHALLENGES![STARTED THE RNBWDRGNEYES ONE]," "SO... HOW DID YOU LEARN LSDJ?" (page 2), "DS-10 INTERACTIVE TUTORIAL SERIES," "LSDJ CHRISTMAS CAROLS NEED LSDSNG," and "SLOWER TEMPO??"

tracker notation[124] or used text-based notation[125] to share music ideas within the discussion forum. For example, using note names to transcribe a melody: "D# G# | D# (octave below) G# A# C C# D# | D# G# | D# (octave below) G# A# C C# D# F | D# C# C | A#"[126] As one member described it, other forms of notation such as MIDI notation are equivalent to "sheet music for Chiptune creators."[127] Interestingly, although most members did not appear to put high value on using Western staff notation to create chiptunes, many members recommended learning the basics of music theory:

> don't get caught up on notation, i.e. the way people transcribe music. stuff like grand staffs and treble clefs and bass clefs and stuff like that. a lot of people like to talk about music theory in terms of notation, but it's important to realize that a piece of music can be interpreted any number of ways, of which notation is but one. it's important to know, yes, but just know that it's just a visual representation of what is an aural experience.[128]

Music theory. Of the 1,593 tokens for the word "theory," L1 collocates (words directly preceding "theory") indicate the emic use of the term "music theory" accounted for 392 word tokens and "musical theory" accounted for 28 word tokens. Expanding the collocates ten positions to the left and right, "music" collocated with "theory" 625 times and "musical" collocated 44 times. However, some false positives may have occurred, as not all instances of discourse may have related to what members referred to as "music

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124 See topics such as "HI-HAT/SNARE/KICK/SYMBOL COMBINATIONS?"

125 See topics such as "MUSIC THEORY" and "MELODYS AND CHORDS" (page 3).

126 chipmusic.org/forums/topic/17242/need-help-figuring-out-the-notes-in-a-short-melody/

127 chipmusic.org/forums/topic/14663/looking-for-artists-for-kickstarter-project/page/3/

128 chipmusic.org/forums/topic/12988/theory-necessary-for-lsdj/page/2/

theory," and false negatives may have occurred when members discussed music theory without using the word "theory." Combined, "music theory" and "musical theory" had an overall dispersion rate of 0.6321 across the discussion forum, and the most frequent word clusters for these terms discussed knowledge of music theory (e.g., "know about music theory," "knowledge of music theory," or "know any music theory").

Although some members appeared to associate "music theory" with Roman numeral analysis of chords or scales,[129] others used the term as a catchall for Western European classical music labels for varied musical concepts and understandings. For example, members sometimes used the word "theory" in discussions on scales, chord progressions and structures, time signatures, and rhythms. Such an understanding of music theory concepts resembles discourse from related music genres such as electronic dance music (Snoman, 2014); however, the range of music styles members applied such concepts to were much broader than electronic dance music alone. For example, in addition to creating electronic dance music, members discussed or shared chiptunes created within styles such as rap, jazz, rock, metal, etc. Discussions on applying music theory concepts often occurred within topics dedicated to providing "constructive criticism"[130] or topics related to improving chiptune composing abilities.

Discourse on music theory appeared in discussion topics dedicated to music theory questions,[131] topics on musicianship and music experience,[132] as well as

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[129] See topics such as "MUSIC THEORY."

[130] Chipmusic.org has an entire subforum dedicated to constructive criticism, which I discuss later in this chapter: chipmusic.org/forums/forum/28/constructive-criticism/

[131] See topics such as "MUSIC THEORY," "BREAKING THE RULES OF TONALITY, HOW DO YOU DO IT 'RIGHT'?" "QUESTION FOR THE MUSIC THEORISTS AMONG US," and "MELODYS AND CHORDS."

[132] See topics such as "HOW DID YOU LEARN MUSIC?" and "I'D LIKE TO ASK YOU A FEW QUESTIONS A RESEARCH PAPER ON CHIPTUNES."

throughout much of the discourse on learning how to compose music.[133] Of these topics, music theory discourse appeared most frequently in discussions on composition practices, as members frequently recommended others study music theory to learn how to compose chiptunes; for example, "Having some knowledge in music theory will help tremendously. I've been studying it for about a year and personally my music has come out much better and more to how I want it to sound."[134] However, members who discussed music theory generally focused on how to use an understanding of scales, chords structures, and chord progressions to guide composition practices within a tracker or DAW; for example, "music theory isn't that important, just learn the scales. If you really feel the need to, learn the circle of fifths."[135]

There were few instances where members discussed using music theory concepts outside of topics related to creating chiptunes. While many of the members recommended studying the basics of music theory, some members suggested music theory was useful for describing music, but not for creating music:

> a lot of what jaffacakemexica's approach to music theory demonstrates is the (mistaken but understandable) belief that music theory is an objective, unchanging thing
>
> music theory wasn't created FOR music, it was created BECAUSE of music. it's merely a means to describe music to another person in a way that allows

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[133] See topics such as "HOW TO WRITE A CHIPTUNE SONG?" "NEED SOME FEEDBACK OTHER THAN 'WOW, THAT SOUNDS LIKE POKEMON'," "WANT SUGGESTIONS FOR STARTING TO MAKE MY OWN CHIPMUSIC" (page 2), and "HOW DO I GET BETTER AT WRITING MUSIC?"

[134] chipmusic.org/forums/topic/3955/want-suggestions-for-starting-to-make-my-own-chipmusic/page/2/

[135] chipmusic.org/forums/topic/9543/need-some-feedback-other-than-wow-that-sounds-like-pokemon/

conversation outside of pure aesthetics. so instead of talking about 'whoa wasn't it cool when the song sounded like this and then suddenly it sounded like that', we're talking in terms of chord progressions and cadences and phrases. music theory is just the reasoning behind why things sound the way they do; music theory is not THE REASON things sound the way they do. read that very carefully!

and in any case a lot of what people talk about when they mention music theory is literally just western notation. music can be notated in all sorts of different ways that still make sense to people. in fact a lot of modern music technology is revolutionary because it changes the way we think about music notation! otherwise we'd still be producing music in sibelius and who wants to do that it's really really important to keep this in perspective.[136]

These discussions contrast ludomusicology scholarship (e.g., K. Collins, 2005a, 2008; Shultz, 2008) that analyze or discuss video game music through Western European classical music theory. Although ludomusicologists might analyze or discuss chiptunes, they often do so from the perspectives of music theorists or musicologists rather than for creating chiptunes. In addition, ludomusicologists often write for academic contexts whereas members of chipmusic.org discussed chiptune-related practices within an informal, online space. However, member discussions on music theory appeared to resemble some literature on digital musicianship, which suggests using music theory to analyze Western staff notation "is usually inadequate to cover the complexities of timbre, timings, spectra and the rest, which are the elements of technological music-making" (Hugill, 2008, p. 122) and often positions "harmony and form above timbral shaping and expressive timing" (Zagorski-Thomas, 2016, p. 72).

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[136] chipmusic.org/forums/topic/18396/music-theory/page/2/

Beyond these concepts that members often refer to as "music theory" concepts, members recommended simply making music (i.e., composing or performing)[137] over an extended period of time to gradually improve abilities as a chipmusician. Recommendations like these place high value on creation practices and developing composition abilities over an extended period of time, rather than studying music concepts without application. However, some members questioned which creative practices constitute as legitimate forms of chiptune practices, an issue I discuss in the following section.

Fakebit

As noted by Carlsson (2008, 2010), Pasdzierny (2013), Paul (2014), and Polymeropoulou (2014), some chipmusicians distinguish between fakebit as a genre that emulates chiptune aesthetics, and chiptunes as a medium which uses computer and video game sound chips to create music. Members of chipmusic.org questioned whether any of the aforementioned composition practices were considered fakebit or chiptune, as evidenced by 577 word tokens and an overall dispersion rate of 0.638 across the discussion forum for the word "fakebit."

These discussions often questioned the processes and practices (i.e., medium) in relation to an end product (i.e., genre).[138] For example, asking questions such as "[is] it normal to post-process (editing, mixing etc) chip music or is it like against the idea behind chiptune,"[139] posting topics with titles such as "I MAKE CHIPTUNES WITH

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[137] See topics such as "THEORY NECESSARY FOR LSDJ?"

[138] See topics such as "NEW TO GENRE AND WOULD LIKE CC," "WAYS TO DESCRIBE MY MUSIC OTHER THAN JUST 'CHIPTUNE'," "IS IT 8BIT OR ELECTRONIC MUSIC?" "HARDWARE VS. SOFTWARE," and "SOFTWARE VS HARDWARE - TIME TO MOVE ON?"

[139] chipmusic.org/forums/topic/18940/help-recording-general-and-specific-questions/

REASON [a DAW]… AM I A CHEATER OR SOMETHING,"[140] and more.[141] Although there was no general consensus on whether chiptunes were a genre or medium, many of the members of chipmusic.org appeared to value the end musical product more than the processes and practices used to create a product: "it's all about creating music, not the methodology or tools."[142] Some members even challenged the notion of "fakebit"; "don't say 'fakebit.' You write music-don't think the way you write it makes it any less meaningful!"[143]

Discussions on "fakebit" demonstrated some members of chipmusic.org were concerned whether the composition practices a member used were considered proper chiptune practices. For example, questioning if sample-based producing in a DAW was considered "fakebit" because the music was not created with a tracker and original sound chip. Most responses to these concerns indicated members value chiptune compositions based on how they sounded rather than what hardware or software was used to create the music. The responses to the notion of "fakebit" may explain why there were a variety of topics related to composition practices discussed within chipmusic.org; i.e., because there was not a "right" and "wrong" way to make chiptunes, members were free to discuss a broad range of topics on composition practices. The general responses to the notion of "fakebit" resemble Partti and Westerlund's (2012) discussion of digital

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[140] chipmusic.org/forums/topic/6453/i-make-chiptunes-with-reason-am-i-a-cheater-or-something/

[141] See topics such as "8-BIT MUSIC = RETRO MUSIC?" "DEFINITION OF CHIPTUNE, CHIPMUSIC, 8-BIT SOUND," "OPINIONS ON USING USING MORE MODERN DEVICES FOR CHIP MUSIC." and "AM I MAKIN 8BIT, CHIPTUNE OR FAKEBIT ?"

[142] chipmusic.org/forums/topic/15683/new-member-here-presenting-my-work/

[143] chipmusic.org/forums/topic/6925/i-am-new-to-all-of-this-so-hello/

musicians who made connections across music practices rather than viewing a single set of practices as "authentic."

Summary of Composition Practices

The forum members of chipmusic.org primarily discussed chiptune composition practices using software such as trackers and DAWs. Within these discussions, members created and shared resources to answer questions, provided suggestions, or engaged in general discussion on a particular topic. A common practice when using these software was creating music appropriations such as sample-based productions, covering and arranging, remixing, and mash-ups. When a member shared an original chiptune composition or appropriation, other members often responded with comments that sometimes led to discussions on compositional practices or understandings. Much of the discussions around composing involved sound synthesis practices, reverse engineering a sound or audio production practice, or musical concepts and tools. Throughout these discussions on musical concepts and tools, members used forms of music notation that tended to match the software used to create music; for example, discussing MIDI notation with DAWs and text-based notation with trackers. In many of the posts on musical concepts and understandings, members discussed whether music theory was useful for creating chiptunes. A recurring discussion around the notion of "fakebit" suggested some members questioned whether certain composition practices constituted as chiptunes; however, many members recommended focusing on making chiptunes without worrying about whether a process was considered "fakebit."

<div align="center">

Performance Practices

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Although discussions of composition practices occurred more frequently than any of the other themes revealed through this study, members also regularly engaged in discussions of performance-related practices. For example, members shared and discussed upcoming and past chiptune events, videos of performing chiptunes on stage

or for streaming platforms, engaged in discussions on busking as a chipmusician, and provided suggestions for performing for audiences. Although many members shared video and audio examples of their performances and performance practices, members also discussed performing at events. Such performance practices are growing in popularity across the chipscene (Pasdzierny, 2013; Paul, 2014; Yabsley, 2007).

There were two subforums dedicated to chiptune events within chipmusic.org: "Upcoming events" and "Past events." Topics within the "Upcoming events" subforum were promotions and discussions for upcoming chiptune shows, livestreams, festivals, etc. with confirmed venues.[144] When an event date passed, moderators moved topics from the "Upcoming events" subforum into the "Past events" subforum, where members could continue discussing an event. At the time of extraction, the "Past events" subforum contained 1,640 topics and 18,776 posts. During or after an event, members shared live streams,[145] video or audio recordings of performances,[146] pictures (see Appendix D),[147] and media related to prior events.[148]

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[144] See the topic titled "RULES AND GUIDELINES FOR POSTING UPCOMING EVENTS."

[145] See topics such as "[TOKYO] 1/26, CHEAPBEATS 6, HALLY, ALICEFFEKT, MINIKOMI &MORE" (page 2) and "[MTL] AUGUST 9-10 - TOY COMPANY FESTIVAL 2013" (page 3).

[146] See topics such as "9/27 - 28 : SQUARE SOUNDS TOKYO 2014" (page 2), "[JP] TOKYO • 2012 10 20-21 • BLIP FESTIVAL TOKYO 2012 @ KOENJI HIGH" (page 5), and "[US, D.C.] MAGFEST 11 - CHIPMUSIC SHOWCASE | JAN 4-5 2013" (page 3).

[147] See topics such as "[US, NY] 12/20 - KICK.SNARE: SPUNKY BREWSTER, CORSET LORE, BINARPILOT" (page 2), "BRKFEST HAPPENINGS THREAD" (page 3), "[JP] TOKYO • 2012 10 20-21 • BLIP FESTIVAL TOKYO 2012 @ KOENJI HIGH" (page 7), and "UI AT GAMEXPO (VENEZUELA)" (page 2).

[148] See topics such as "// ROCHESTER CHIP FEST 2013 - DECEMBER 14, 2013 //" (pages 1 and 2).

Lemmas for the word "perform" (e.g., performance, performing, performer, performed, etc.) accounted for 3,484 word tokens with an overall dispersion rate of 0.722 across the discussion forum. In addition, some of the 23,911 tokens for "play" and its lemmas (e.g., played, plays, playing, etc.) indicated discourse on performing. For example, clusters for "play a show" (n = 115), "playing a show" (n = 80), "played a show" (n = 48), "play an instrument" (n = 31), "playing an instrument" (n = 24), or "show I played" (n = 22). However, the majority of the tokens for "play" and its lemmas were unrelated to performance practices; for example, music and video playlists, playing around with something, playing a game, pressing a play button on hardware or software, etc. Such data indicated some members discussed performing instruments and at shows; however, the number of word tokens indicated members appeared to discuss performance practices less frequently than composition practices. If members were discussing performing instruments and at shows, what instruments did chipmusicians tend to discuss performing with and where did they perform? The following sections answer this question.

Using a Game Boy as a Performing Instrument

Nintendo's Game Boy (DMG[149]) is a handheld gaming console released in the late 1980s. Of the hardware discussed in chipmusic.org, the emic acronym "DMG" and its lemmas (e.g., game boy, gameboy, clearboy, gb, gbc, etc.) ranks 50 out of 149,362 words and lemmas on the discussion forum's word list, with 32,649 word tokens and an overall dispersion rate of 0.726 across the discussion forum. The "Nintendo handhelds" subforum has 2,703 topics and 38,515 posts, and accounted for 16,979 word tokens for "DMG" and its lemmas, with an overall dispersion rate of 0.941 across the subforum.

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[149] DMG is an acronym for "Dot Matrix Game," Nintendo's original codename for the Game Boy.

This subforum alone accounted for 14.89% of the topics and 15.71% of the discussion forum posts within chipmusic.org, second highest percentage in both categories. Such data indicate members frequently discussed using a DMG in chiptune-related practices.

While the previous theme outlined how members used tracker software such as LSDJ to compose music with a DMG, many of the members of chipmusic.org also used a DMG as a performing instrument;[150]

> Remember, these are musical instruments. Similar to guitar, you wouldn't learn how to play a couple chords then say you were ready to move on to the next thing. You'd write a song, you'd perform it, you'd record it. . . Treat that DMG as an instrument, not as a self-contained universe.[151]

Member discussions on using DMGs as performing instruments corresponds with Pasdzierny's (2013) discussion of a DMG as "the most prominent form of live performed chipmusic" (Kindle Location 2391). Pasdzierny (2013) notes that people around the world use DMGs to perform a multitude of genres or styles as both soloists or in small ensembles (e.g., brass bands and rock bands). To enable performance practices with a DMG, trackers — such as LSDJ and others — have modes specifically designed for live performing.

Although trackers like LSDJ enable performing chiptunes with a DMG, members of chipmusic.org discuss modifying their DMGs to improve sound quality or add audio effects; I describe these modifications practices in the following theme on maker practices. As one member described, many chiptune performers modified their DMG for

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[150] See topics such as "I'D LIKE TO ASK YOU A FEW QUESTIONS A RESEARCH PAPER ON CHIPTUNES." "HOW'S THE SOUND DESIGN IN THIS COVER?," "MASTERING OR STRAIGHT SOUND?" (page6), and "GAME BOY SPILLS, DROPS. BREAKAGE STORIES."

[151] chipmusic.org/forums/topic/15707/lsdj-and-nanoloop-mastered-where-to-go-next/page/2/

performance specific purposes: "we treat our Gameboys as more than just playthings, they are instruments. And your average instrument is a DMG, prosound mod, maybe a backlight, soldering iron + flux, an EMS cart, cables, and probably a LSDJ license."[152] This quote describes a modified DMG with improved audio quality and less noise (unwanted audio signals or interference) through a "prosound mod" (i.e., a modification that bypasses the internal amplifier), an increased screen resolution or brightness through a "backlight," using a soldering iron and flux to alter the circuitry of a DMG, and using an EMS cart with cables, which is a DMG cartridge that has a mini USB port to allow people the ability to install games or software such as LSDJ onto the cartridge, which can then run on a DMG. These modifications make it easier to use a DMG as a performing instrument by allowing for improved audio quality, better screen resolution or brightness, and chiptune-related software such as LSDJ. Such intentional appropriations of a DMG as a performing instrument resembles DJ culture's intentional appropriation of technology designed for playing records (i.e., turntables) as a performing instrument (Webber, 2008), as well as video game musicians who appropriate contemporary video game software and hardware (i.e., not chiptunes) to make music (O'Leary & Tobias, 2016). For example, O'Leary and Tobias (2016) discuss video game musicians who create a "gun beat" through in-game sounds and vocals,[153] use car horns and other in-game sound effects to recreate the theme song from the television show *Game of Thrones*,[154] or create music through modified floppy drives.[155]

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[152] chipmusic.org/forums/topic/5607/why-do-we-settle-for-ems/

[153] youtu.be/k3hZDwlcw3k

[154] youtu.be/ZnZ5Mit2Q24

[155] youtu.be/m5k1giMq1rM

Because of the performance capabilities of such hardware and software, this may indicate some of the tracks in the "Releases" subforum and "Music" section of chipmusic.org were created by performing rather than composing; for example, some members may have included a recording of a live chiptune performance on an album with chiptunes composed without performance practices. However, discourse on the aforementioned composition practices was more prominent than discourse on performance practices. The following subsections describe performance practices related to live performing, recording performances, performing with acoustic and electronic instruments, and general discourse on performance practices. Each subsection includes examples of using a DMG, gaming hardware, or sound chip as a performing instrument.

Live Performing

Of the performance practices evident through discussion forum posts within chipmusic.org, members most frequently discussed live performance events. These live events typically occurred on stages or in a performance venue; however, some members discussed busking,[156] which is the practice of performing music in a public space (e.g., subway, street corner, park, etc.) for voluntary donations. Many members shared videos of their performance practices rather than discussing them, which limited data analysis to the few posts with text-based discourse. However, I watched many of the shared videos in order to better understand chiptune performance practices. I provide footnote links to YouTube videos shared within the "LIVE FOOTAGE EXCHANGE"[157] topic in the following paragraph to provide context for live chiptune performance practices.

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[156] See topics such as "PORTABLE AMPS/AMP MODULES FOR BUSKING," "BATTERY POWERED AMPS," and "BATTERY POWERED AMPS FOR BUSKING?"

[157] Several examples for each category are linked as videos within this topic: chipmusic.org/forums/topic/5914/live-footage-exchange/

Based on both text-based discourses and YouTube footage, live performances often included an individual performing live music, an individual performing an instrument alongside pre-composed music, or small ensemble performances. When performing live, individuals often used software, such as trackers and DAWs, with hardware such as DMGs, mixers, or effects processors to create and modify sounds.[158] These performances often included video game imagery,[159] or what appear to be video mixing practices;[160] I later describe video mixing in the visual art practices theme. Some musicians performed instruments such as guitars alongside precomposed music.[161] And others performed in small ensembles that included a range of instruments; for example, trombone, drums, bass, guitar, keyboard, vocals, and DMG;[162] or tuba, banjo, voice, and DMG.[163] Each performer or group drew from styles such as rap, metal, electronic dance music (EDM), or punk. Interestingly, one post regarding an event encouraged members who could read string and horn sheet music to join them on stage for a live show: "I'll also be carrying sheet music for string and horn players for anyone who want to join me onstage!"[164] Many of these live performance practices resemble "live coding" practices where people perform live music by writing in lines of computer code to generate live

[158] youtube.com/watch?v=DT8W7p3s7ak

[159] youtube.com/watch?v=SW_eKG29U3s

[160] youtube.com/watch?v=fVy2pJx1x-M

[161] youtube.com/watch?v=WMWFRZUXSvA

[162] youtube.com/watch?v=kp8zLK_Sung

[163] youtu.be/zF_NgqFPKa8

[164] chipmusic.org/forums/topic/10222/want-to-play-a-show-in-portland-or-on-march-28th/

music.[165] In particular, live coders also use a multitude of performing instruments, software, and hardware to perform on stage as soloists or in small ensembles, and often include digital media projected on the performer(s) or a screen.

Recording Performances for Streaming and Sharing

Although most posts on performing were on performing for live audiences, some members discussed and shared links to recorded video performances of themselves or other chipmusicians. Many of these recordings appeared to be from a person's living space (e.g., a bedroom, workshop, living room, etc.), and not always for live venues or audiences. For example, performing in a room with a DMG, Kaoss Pad, laptop, and a guitar controller designed for the video game Guitar Hero.[166] This range of physical or virtual performance locations is also common among digital musicians (Hugill, 2008) and electronic dance musicians (Snoman, 2014); however, the range of styles members discussed or shared were much broader than the electronic dance music genre.

Performing with Acoustic and Electronic Instruments

Chiptune practices generally involve creating music through electronic means (i.e., using or emulating computer and video game sound chips) (D'Errico, 2012); however, members of chipmusic.org also occasionally shared and discussed performing acoustic instruments along with electronic instruments. Such a finding is congruent with scholarship on digital musicians, who also perform with a mix of acoustic and electronic performing instruments (Hugill, 2008). For example, a member shared a YouTube link of a video performance using a DMG, guitar, rubber bands, springs, a skull, a modified computer keyboard with keys in the shape of a piano, and what appears to be homemade

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[165] See Magnusson (2014a), McLean (2014), or Wang and Cook (2004) for discussions on live coding practices.

[166] See topics such as "GUITAR HERO GUITARS AND OTHER PLASTIC INSTRUMENTS."

mbiras to live loop music.[167] Of the acoustic instruments most discussed in discourses on

live performance practices, the word "guitar" and its lemmas (e.g., guitars, guitar's) were

the most prominently discussed instrument in relation to performing (n = 3,256 word

tokens, but not all word tokens were associated with performing). However, the word

"drums" and its lemmas (e.g., drum, snare, percussion, kick, etc.) were the most

discussed instrument in relation to composing (n = 8,009 word tokens, but not all word

tokens were associated with composing).

In addition to performing in ensembles with acoustic and electronic instruments,

members often used several acoustic or electronic instruments to create chiptunes.[168] For

example, the topic titled "POST YOUR GIG/HOME SETUP!"[169] contained hundreds of

pictures of the various instruments and hardware people used to create music. These

pictures embody a recurring form of engagement evident through many members'

discussion forum posts over time: many of the members of chipmusic.org appeared to

value making music through a variety of performing instruments, software, and

hardware.

Discourse on Performance Practices

Members of chipmusic.org asked each other varied questions about performance

practices. These questions included topics such as using a DMG with Ableton Live (a

DAW),[170] performing acoustic instruments alongside a DMG,[171] performing with two

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[167] chipmusic.org/forums/topic/19676/umin-live-looping-w-lsdj-acoustic-instruments/

[168] See topics such as "LITTLE PAW : SPACE CORGI - FINALLY RELEASED!"

[169] chipmusic.org/forums/topic/166/post-your-gighome-setup/

[170] See topics such as "DMG AND ABLETON FOR LIVE PERFORMANCES. WHAT DO I NEED?"

[171] See topics such as "I DON'T UNDERSTAND LIVE AUDIO SETUPS."

DMGs and other hardware,[172] performing in specific types of venues (e.g., nightclubs),[173] general questions about using a tracker's live performance mode (which is a program mode with features designed for live performing rather than composing) during a live show,[174] and general tips for performing live.[175]

Discussions on stage presence and performing were a common topic related to performance practices. Many of these discussions questioned how to "perform" when using largely precomposed works. D'Errico (2012) notes that the most common feedback from audience members during such performances was "it looks like you're just pressing buttons" (para. 1).[176] Some members of chipmusic.org discussed similar feedback and questioned whether or not pressing play on a composition at a live performance constituted as a "performance" or if a chipmusician should add more performative aspects:[177] "I still feel like pressing play on the trackers isn't right... What options do I have?"[178] Suggestions within these discussions included adding visuals or dance; live triggering, mixing, or manipulating sound and music through DAWs and various hardware; live editing and creating in a tracker; performing with other instruments; combining a variety of the suggested methods; and other tips on stage presence.

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[172] See topics such as "PERFORMANCE INQUIRIES."

[173] See topics such as "PLAYING LSDJ IN NIGHTCLUBS."

[174] See topics such as "WHAT DO I NEED FOR LSDJ LIVE SHOWS?"

[175] See topics such as "ADVICE FOR FIRST GIG?" and "TIPS FOR MY FIRST LIVE PERFORMANCE?"

[176] Similar feedback and discussions exist in the performance practices of live coding (Salazar, 2017; Salazar and Armitage, 2018) and DJ culture (Montano, 2010).

[177] See topics such as "LIVE MODE: IS IT A MUST FOR LIVE SHOWS? IS SONG MODE CHEATING?," "PERFORMANCE SET UP" (page 2), "ANoVA'S BUSKING AND PERFORMING THREAD," and "HOW DOES ONE PLAY LIVE AMIGA MUSIC?"

[178] chipmusic.org/forums/topic/5525/how-does-one-play-live-chip-music/

However, some questioned whether "deliberately complicating the presentation of the music just for the sake of having something to do and be able to say 'See, I AM performing' *really* make[s] LSDJ performance more noble than simply pressing Play"[179] (original emphasis). Others suggested context determined whether an audience expects live interaction:

> C64[180] [Commodore 64] scene tools and lsdj cater to two very different markets though. C64 trackers are usually written by demosceners[181] for demosceners, hence there's really no need for a lot of live interaction when the music is only ever going to be played in sequence. you either work around that limitation or write a new one I'm afraid.[182]

Both of these excerpts demonstrate members of chipmusic.org not only critically reflected on the value of the aforementioned performance practices, but contextualized these practices within their historical context and hardware limitations. These discussions demonstrate some members engaged in critical reflection on chiptune performance practices.

Another recurring topic within these discussions on stage presence and performance practice is performing chiptunes for people unfamiliar with chiptune practices or music.[183] In general, some members recommended focusing on having fun regardless of the audience's reaction, treating the performance as an opportunity to introduce others to chiptunes, or exercising caution:

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[179] chipmusic.org/forums/topic/5525/how-does-one-play-live-chip-music/page/9/

[180] C64 is an abbreviation for the Commodore 64, an early home computer.

[181] See Appendix C for a definition.

[182] chipmusic.org/forums/topic/6834/lsdj-style-tracker-for-c64/

[183] See topics such as "PLAYING TO THE UNINTERESTED" and "GIG HELP??"

I think a healthy level of selfawareness needs to be practiced when you're taking this stuff to the public. I think within chip (or actually, electronic music overall) it's harder to justify this approach because of the fact that most of the audience doesn't know what you're doing. So all they really interpret is 'someone flailing around while a track plays,' which is unfortunate because then they might go home with that impression, taking away from the music. Where in a different setting of the busking performer being a bit more reserved they might ask themselves, "what's really going on there?"[184]

Discussions like these demonstrate some members of chipmusic.org also considered their audience's familiarity with chiptunes and suggested changing performance practices to match the audience or context.

Although members frequently discussed a variety of performance practices, few discussions mentioned improvisational practices when performing. Concordance analysis for the word "improvise" and its lemmas (e.g., improvised, improvisation, improvising, etc.) revealed 227 word tokens with an overall dispersion of 0.710 across the discussion forum. Discourse on improvisation included improvising during a live set,[185] improvising for generating new ideas,[186] sharing improvised compositions,[187] or discussing creating hardware designed for improvising.[188] Such data and example

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[184] chipmusic.org/forums/topic/8110/battery-powered-amps-for-busking/page/2/

[185] See topics such as "12 MINUTES OF IMPROVISED NANOLOOP TECHNO."

[186] See topics such as "MELODYS AND CHORDS" (page 2)

[187] See topics such as "OUT NOW!! NANOLOOP LONG-FORM MINIMALISM COMPILATION" (page 3).

[188] See topics such as "WHAT WOULD YOU LIKE IN A CHIPTUNE HARDWARE SYNTH."

discussions may indicate that members of chipmusic.org tended to perform already-known chiptunes more than engaging in improvisational practices.

Summary of Performance Practices

The forum members of chipmusic.org discussed and shared live, streamed, and recorded chiptune performances. Although multiple subforums and topics were dedicated to sharing and discussing chiptune events and performances, performance practices were not discussed as frequently as composition practices. Members performed as soloists or in small ensembles with a wide range of electronic and acoustic instruments; however, most members discussed performing with a DMG. Performance spaces ranged from bedroom recordings, to busking on street corners, to performing on stages for a crowd. Throughout many of the subforums in chipmusic.org, members often asked for advice on performance practices with a multitude of instruments and for varied audiences or venues.

<div align="center">

Maker Practices

</div>

The original video game and computer hardware used for composing and performing chiptunes have limited sound output and quality due to hardware designs intended for headphones or small speakers. Many members of chipmusic.org discussed modifying hardware to enhance the sonic capabilities of a device; for example, a "prosound mod" that bypasses the internal amplifier within a DMG to obtain an audio signal with less noise (unwanted audio signals or interference) allows for better sounding recordings and performing. Hardware modifications such as these are referred to as "mods" by members of chipmusic.org, and are a common practice among digital musicians, who create digital or "extended" instruments "to suit the needs of the user" (Hugill, 2008, p. 128)

Within chipmusic.org, the word "mod" and its lemmas (e.g., mods, modding, modder, modded, etc.) accounted for 8,565 word tokens with an overall dispersion rate

of 0.787 across the discussion forum, indicating discussions about modding occurred throughout much of the discussion forum. People within the mod scene categorize mods as "hard mods" (hardware mods) and "soft mods" (software mods) (Schäfer, 2011). I use these terms throughout this document to distinguish between the two categories of mods discussed within chipmusic.org.

In the mod scene, soft mods are more pervasive than hard mods; however, within chipmusic.org, discussions about hard mod practices incorporate practices found in maker or DIY cultures, and are more pervasive than discussions on soft mods. In addition, while soft mod practices within the mod scene focus on modifying video game software, the vast majority of soft mod practices within chipmusic.org discussed modifying open source[189] music software (e.g., trackers). Although discourse on the mod scene and discourse within chipmusic.org used similar terminology and practices, practices within chipmusic.org focused on mods relevant to music making through computer and video game sound chips typically from the 1970s and 1980s, while practices within the mod scene focus on mods for video games themselves. These distinctions acknowledge scholarship about maker, mod, and chiptune cultures, and are key to understanding why I describe practices within chipmusic.org as "music-centered making" and not "music-centered modding."

People who engage in mod scene practices often assemble their own computers with already manufactured components. Although some members of chipmusic.org followed similar practices, others discussed building or manufacturing new hardware, and not just modifying hardware. Maker culture practices can incorporate modification practices found in the mod scene; however, maker culture practices include

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[189] Open source software is software with freely available source code that can be redistributed or modified.

manufacturing or creating new hardware, while mod scene practices do not. In addition, people who engage in mod scene practices (modders) tend to engage in video game modifications (i.e., changing a game's code), while members of chipmusic.org created and modified music software (e.g., trackers). I discuss soft mod practices in the following theme on coding practices; however, maker and coding practices intersect when people create or modify software for modified or created hardware. These distinctions between modifying and manufacturing/creating is one reason why I use "making" rather than "modding" when broadly describing chiptune-related practices ("music-centered making") or this theme ("maker practices"); however, based on discourse within the discussion forum, members of chipmusic.org might label these practices as "modding practices" and not "maker practices." The following subsections describe discourse on both aesthetic and functionality mods, as well as discourse around perspectives on hard mods and learning to mod.

Hard Mods

Aesthetic mods. Aesthetic mods are modifications for changing a hardware's appearance, but not necessarily functionality. A common aesthetic mod within chipmusic.org was a "case mod" for a DMG, which are physical alterations to a case which houses the electronic hardware used to create music. The most common case mod within chipmusic.org involved painting or dying the case of a DMG to change the color or appearance (see Figure 22); however, other case mods included laser engraving, adding LEDs, adding accessories (e.g., jewelry), and other physical alterations to a case. Some mods functioned as aesthetic and functionality mods; for example, a backlight mod uses colored LEDs to change the color and brightness of a DMG's screen, which changes the appearance (aesthetic mod) and can make the screen easier to see in a dark performance space (functionality mod). See Appendix E for example pictures and descriptions of

aesthetic mods within chipmusic.org or visit the "CUSTOMIZED GEAR THREAD"[190]

topic for posts discussing and sharing hard mods. Members appeared to engage in

aesthetic mods as a mode of expression or artistic outlet.

Figure 22. An example image that demonstrates several DMG case mods. Source:

chipmusic.org/forums/topic/155/new-lots-of-new-dmgs-pg2/

Functionality mods. Functionality mods are modifications for changing how a

piece of hardware functions. However, many functionality mods also change the

appearance of hardware; for example, by adding toggle switches, potentiometers

(knobs), and audio jacks (see Figure 23). The most common functionality mod within

chipmusic.org, known as a "prosound" mod, involves bypassing the internal amplifier

within a DMG to obtain an audio signal with less noise (unwanted audio signals or

interference). However, other examples included adding backlighting to change the color

and brightness of a screen, changing the clock speed of a device to alter a hardware's

speed and pitch (a process known as "clocking" or as a "pitch mod"), circuit-bending (see

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[190] chipmusic.org/forums/topic/7345/customized-gear-thread/

the subsection below), and other functionality mods. Figure 23 demonstrates a DMG with an added toggle switch and potentiometer (knob) that controls the pitch of the DMG ("pitch mod"), and a prosound audio jack. In addition to these functionality mods, this DMG has a painted case (case mod) and LEDs behind the start and select buttons (the two buttons in the center near the bottom), which are two types of aesthetic mods. See Appendix E for more example pictures and descriptions of functionality mods within chipmusic.org or visit the "CUSTOMIZED GEAR THREAD"[191] topic for posts discussing and sharing hard mods. Members appeared to intentionally engage in functionality mods to alter the capabilities of hardware for chiptune-related purposes.

Figure 23. A DMG with artwork (aesthetic mod), LEDs behind the start and select buttons (the two buttons in the center near the bottom), prosound audio mod (audio jack on the bottom left), and a clock mod (also known as a "pitch mod") with switch and potentiometer (on the bottom right). Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/59/

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[191] chipmusic.org/forums/topic/7345/customized-gear-thread/

In addition to using hard mods to add functionality, some members asked questions on how to repair lost functionality from failed modding attempts or accidents.[192] Posts like these suggest that some members repaired their damaged or malfunctioning hardware. However, these posts also suggest a failed hard mod could result in a damaged device.

Electrical engineering practices. In much of the discourse on hard mods, members discussed various practices or concepts used in electrical engineering. Within these discussions, circuit diagrams, schematics, and general discussions around parts of a printed circuit board (PCB) occurred regularly. A circuit diagram is a graphical representation of an electronic circuit, while a schematic uses common symbols to represent various components and connections within an electronic circuit (see Figure 24).[193] The word "circuit" and its lemmas (e.g., circuits, circuit's, circuitry, PCB, PCBs, and PCB's) accounted for 4,455 word tokens with an overall dispersion rate of 0.708 across the discussion forum. The word "schematic" and its lemmas (e.g., schematics and schematic's) accounted for 646 word tokens with an overall dispersion rate of 0.619 across the discussion forum. These word token frequencies and dispersion rates indicated members discussed electrical circuitry practices and concepts throughout much of the discussion forum; however, these data also indicated members may have discussed mods more frequently than electrical circuitry and schematics.

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[192] See topics such as "DMG BROKEN 'LEFT' ON D-PAD." "I JUST BLEW UP MY DMG!" "BIVERT MOD HELP," "JUST WON A BROKEN DMG GAMEBOY. WHAT COULD BE WRONG WITH IT?" and "SCREEN REPLACEMENT?"

[193] See the following link for more information on circuit diagrams: en.wikipedia.org/wiki/Circuit_diagram
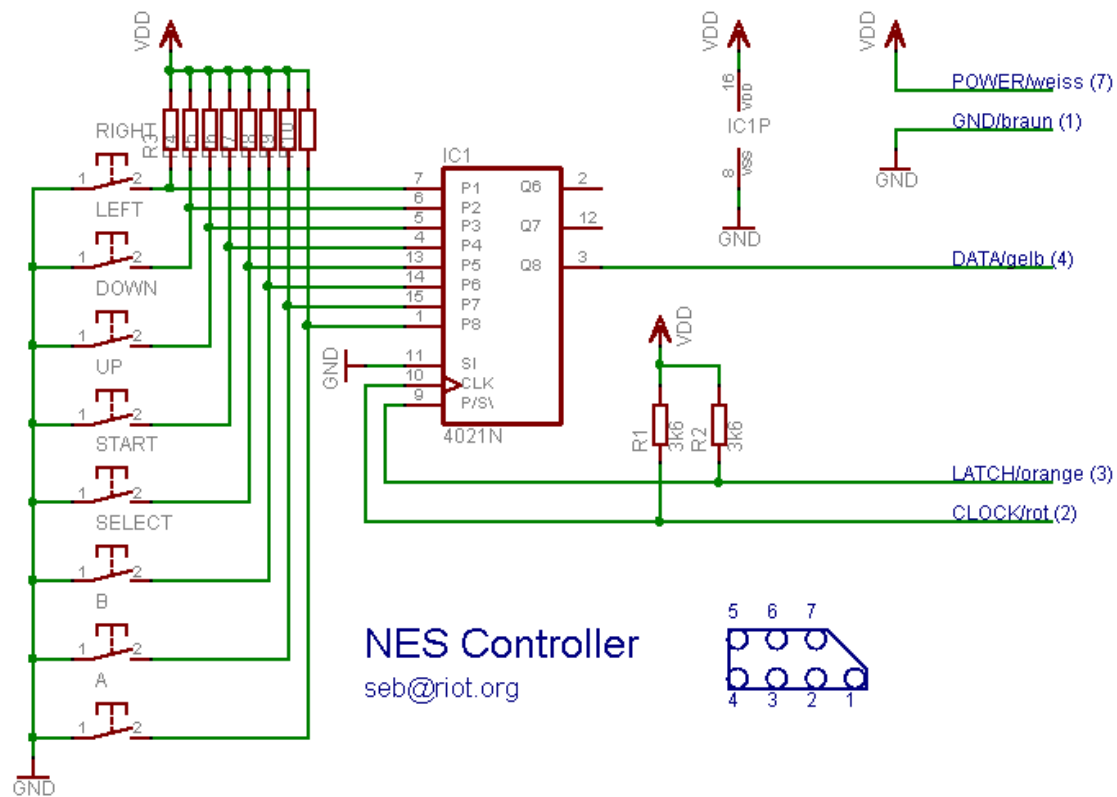
Figure 24. An example image of a shared schematic of the Nintendo Entertainment System's controller. Source: chipmusic.org/forums/topic/11361/control-a-gameboy-with-nes-controller/

When discussing electrical circuitry, members frequently requested or shared images and diagrams of various electronic circuits. For example, requesting circuit diagrams to figure out how to fix short circuits,[194] sharing original or created schematics,[195] creating and sharing hand drawn diagrams to answer a member's question

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[194] See topics such as "NEED SCHEMATIC CIRCUIT DIAGRAMS FOR GAMEBOY MICRO AND SP."

[195] See topics such as "CONTROL A GAMEBOY WITH NES CONTROLLER," "C64 POT CONTROLLER - NEW CIRCUIT," "SEGA GENESIS GLITCH VIDEO DEVICE," "SEGA GENESIS LINE OUT MOD?," and "GB-303 BUG FIXES, FEATURE REQUESTS, OPEN SOURCE." (page 8)

(see Figure 25 for an example),[196] or even reverse engineering schematics by looking at an original circuit.[197] Throughout many of the discussions on hard mods, members often used schematics to determine which capacitors or resistors to use in order to complete a particular mod.[198] Discussions regarding the use of resistors or capacitors did not always rely on diagrams or schematics. For example, discussing replacing resistors and capacitors to fix a problem with a particular mod:

> Put a larger resistor in series with each color. For example, replace 150 ohms with 180 ohms and replace 150 ohm with 170 ohm. (those are the next size up in the standard E12 series.) Or, put a 22 ohm resistor in series with the common lead. . . Add a 100 uF or bigger value, 6.3 V or greater rated, capacitor across +5V and Gnd. in doing so, you need to make sure you find one that fits physically.[199]

Within these discussions, it is clear members used specialist language and understandings to read or create circuit diagrams and schematics, or to engage in discussions on electrical circuitry practices. These discussions demonstrate members had expertise in areas other than music making; however, members discussed their expertise in relation to chiptune-related practices or purposes. In other words, members utilized a multitude of expertise when engaging in music-centered making. However, it is not known whether members obtained expertise in such practices before or after engaging with chiptunes.

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[196] See topics such as "FAMIIDI: MIDI FOR THE NES / FAMICOM (PLUS A WII NUNCHUK INTERFACE!)."

[197] See topics such as "DMG MAIN BOARD SCHEMATIC & CIRCUIT (+ARDUINOBOY)."

[198] See topics such as "ARDUINOBOY PARTS LIST / POWER SOURCE …"

[199] chipmusic.org/forums/topic/14685/dmg-audio-degration/
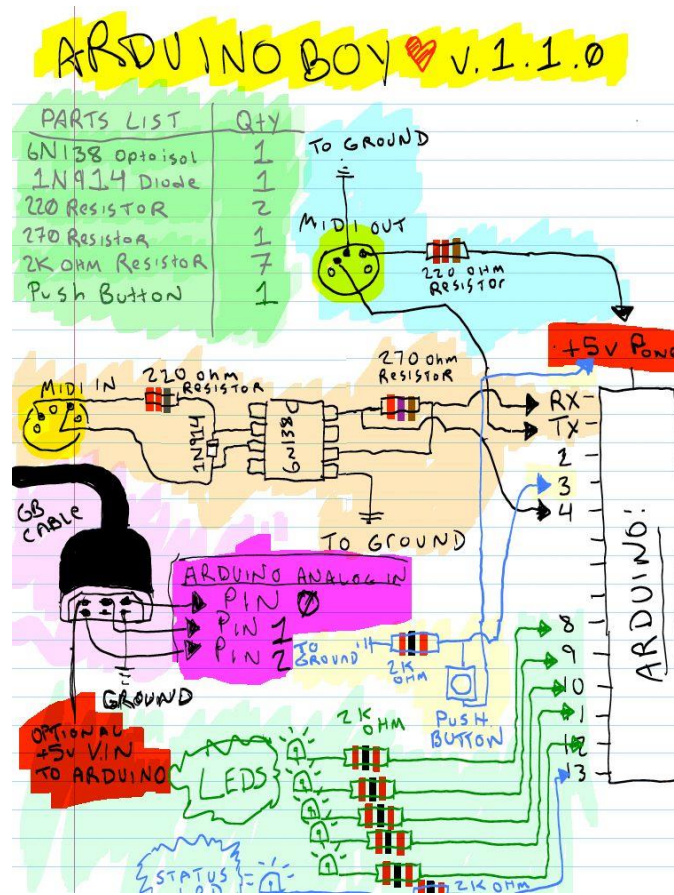
Figure 25. A hand drawn diagram used to answer a member's question about a particular device. Source: chipmusic.org/forums/topic/18305/help-with-arduinoboy-basics/

Circuit-bending. As mentioned in <u>Chapter Two</u>, circuit-bending is a process of intentionally short-circuiting electronic hardware to produce new sounds (K. Collins, 2013). Figure 26 displays an example image of a circuit-bent SEGA Megadrive (a video game console) shared in the "Circuit bending" subforum.[200] The member who bent this device mentioned in the original post the red buttons were wired to sound glitches and the toggle switches were wired to video glitches. A video demonstration[201] of this device was included on the member's website, which was linked in the original post. The text in the original post, and the video demonstration, both demonstrate that circuit-bending practices can create distorted or "glitchy" video and audio effects.

Figure 26. An example of a circuit-bent SEGA Megadrive. This member added red buttons to trigger sound glitches and switches to toggle video glitches. Source: chipmusic.org/forums/topic/14965/circuit-bent-megadrive-lotus-ii-rewire/

The "Circuit bending" subforum within chipmusic.org contained 87 topics with 674 posts; however, a concordance analysis for "circuit ben*" (e.g., circuit bending and circuit bent) accounted for 545 word tokens with an overall dispersion rate of 0.757 across the entire discussion forum, indicating discourse on circuit-bending occurred both within and outside the "Circuit bending" subforum. Although some members used circuit-bending techniques with video game consoles and handhelds, many members used circuit-bending techniques on a multitude of electronic devices. For example, circuit-bending a synthesizer keyboard,[202] video game consoles,[203] children's toys or figures,[204] or other electronic devices.[205] Of these examples, children's toys were

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[202] See topics such as "CIRCUIT BENT CASIO SK-5/SA-1 WITH VIDEO OUT."

[203] See topics such as "CIRCUIT BENT MEGADRIVE LOTUS II REWIRE," "CIRCUIT BENT AUDIO VISUALIZE VIDEO EP, SNES/MEGADRIVE/ATARI," and "DOOMTENDO PROJECT - RELAY CIRCUIT-BENDING."

[204] See topic such as "POST YOUR CIRCUIT BENT STUFF!" "BENT CIRCUITS BY GREIGHTBIT," "CIRCUIT BENT STYLOPHONE BEATBOX / CIRCUIT BENT TOY GUN," and "CIRCUIT BENT SLIME-ON COWELL TALKING FIGURE!!"

[205] See topics such as "CIRCUIT BENT KORG MONOTRON/STYLOPHONE SEQUENCERS."

frequently discussed or shared. For example, Figure 27 displays an image of a toy gun with "Mods -Voltage starve control,pitch down switch,loop switch,1/4 inch jack socket."[206] This description indicates the potentiometer (knob) controls the voltage, which changes the pitch; one of the switches toggles moving the pitch down; another switch toggles looping; and the ¼" jack allows the member to record or amplify the output sound. A video demonstration[207] of this device was included on the member's website, which was linked in the original post. Although a single example, many of the other topics on circuit-bending included similar modifications or bends.

Figure 27. Adding a potentiometer (knob) to control the pitch, toggle switches to pitch down or loop, and a ¼" audio jack to a toy gun. Source: chipmusic.org/forums/topic/14499/circuit-bent-stylophone-beatbox-circuit-bent-toy-gun/

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[206] chipmusic.org/forums/topic/14499/circuit-bent-stylophone-beatbox-circuit-bent-toy-gun/

[207] youtu.be/TopJdKQVuSY

Rather than adding potentiometers (knobs), toggle switches, or buttons to hardware, some members created external devices for circuit-bending practices. For example, a "Universal Bend box" designed for easily experimenting with circuit-bent devices (see Figure 28):

> The idea behind this box is that by simply wiring up to 24 points on a circuit bendable device (typically something like a drum machine, or like a casio sk-1) to a simple DB25 connector. You plug this bad boy in and you have all sorts of fun. :-D[208]

This quote suggests the "Universal Bend box" is able to work with any circuit-bendable device that uses a DB25 connector (a common serial connector used on hardware such as printers or computers). In Figure 29, there are two sets of wires converging into a DB25 connector, which allows this box to connect with other devices with a complimentary connector (i.e., if this box has a female DB25 connector, any device with a male DB25 connector could plug into it). By plugging in another device that is wired with a DB25 connector, a person can use cables to plug into the various ports on the box, flip switches, and turn the potentiometers (knobs) to bend the circuits of a capable device. Because this box uses a DB25 connector, it allows a person to easily swap out hardware without having to add ports, toggle switches, or potentiometers (knobs) to every device. The "Universal Bend box" provides an example of how some members created devices that assisted with circuit-bending varied electronic hardware.

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[208] chipmusic.org/forums/topic/1121/universal-bend-box/

Figure 28. An image of a "Universal Bend box," which enables experimentation with connecting or altering up to 24 bend points on a circuit-bendable device using a common serial connector (DB25). Source: chipmusic.org/forums/topic/1121/universal-bend-box/

Figure 29. An image of the wiring of the "Universal Bend box." Source: chipmusic.org/forums/topic/1121/universal-bend-box/

Members did not appear to question why someone wanted to bend a device, but encouraged others to be creative and experiment. Although most functionality mods were for a specific purpose with a known outcome or effect (e.g., a brighter screen, better audio quality for recording, or ability to control the pitch of a device), discussions on circuit-bending suggested some members of chipmusic.org appeared to enjoy experimenting with hardware circuitry to create new sounds or images.

Soldering. Members discussed soldering throughout much of the discourse related to electrical engineering, circuit-bending, and hard mods previously mentioned. Soldering is a process of joining two or more conductive items (usually a wire and a point on a circuit) by melting a conductive material with a low melting point (usually flux). In chipmusic.org, members often discussed soldering when engaging in circuit-bending practices (to create semi-permanent bends that firmly join two or more conductive parts of a hardware) or desoldering (the removal of solder, typically to break a connection point) when discussing repairs or alterations. The word "solder" and its lemmas (e.g., soldered, soldering, desolder, and desoldering) accounted for 3,370 word tokens with an overall dispersion rate of 0.621 across the discussion forum, indicating members discussed soldering throughout most of the discussion forum, although less frequently than other maker practices. Much of the discussions involved asking how or what to solder,[209] what to purchase to learn how to solder (e.g., soldering irons,[210] flux,[211] specific

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[209] See topics such as "RCA MOD FOR GBA" and "HOW TO MAKE CV TO GBA LINK CABLE."

[210] See topics such as "11W IRON SOLDER FOR DMG GAMEBOY."

[211] See topics such as "CALLING ALL PCB DESIGNERS: WHAT DESIGN RULES DO YOU USE?" and "GAMEBOY COLOR FRONTLIGHT MOD FAILURE - COULD USE SOME HELP!"

wires and gauges,[212] etc.), and specific soldering points for mods.[213] It appears that some members who posted on the forum viewed soldering as a skill that chipmusicians should practice.

> Members encouraged others by indicating soldering is easier than it seemed:
> If you are unsure of your modding skills, go to a dollar store and buy a cheap kids toy or keyboard or something. Desolder a bunch of points then resolder them and see if it still works. That way you get a little practice. But even if you don't do that, a backlight and a prosound are both easy. That will be just 5 solder points on the board.[214]

These discussions on soldering demonstrate how some members modified hardware or electrical circuits. Similar to the discussions on circuit diagrams and schematics, members mentioned soldering practices when discussing some forms of music-centered making.

Perspectives on modding. Modding practices appeared to be considered commonplace within chipmusic.org. For example, the suggested template for the "Product reviews" subforum included a section on reviewing a product's "Ease of Modification": "How easy is it to modify? Can items be purchased such as backlights/buttons/sync kits/etc? Can you potentially create custom mods yourself such as adding functionality to the existing circuit (Korg Monotron, Speak&Spell, Gameboy, etc)?"[215] This template suggests some members wanted to know before purchasing a

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[212] See topics such as "BEST WIRE TYPE FOR MODDING DMG" and "GOOD WIRE FOR FINE SOLDER POINT MODDING..?"

[213] See topics such as "BEST PLAY TO SOLDER FOR BACKLIGHT" and "WHERE TO SOLDER 10K TRIM FOR LTC 1799?"

[214] chipmusic.org/forums/topic/10193/pay-for-a-dmg-mod-or-do-it-yourself/

[215] chipmusic.org/forums/topic/13040/product-review-rulesguidelines/

product how easily it could be modified. In addition, members suggested mods when people posed questions about hardware-related problems. For example, suggesting replacing capacitors to fix a filter in a particular sound chip,[216] retrofitting a new video cable for use with an older computer,[217] or converting an older computer from the European standard for video encoding (PAL) to the Americas standard (NTSC).[218] Each suggestion involved a member encouraging another member to engage in a mod to solve hardware-related problems, which demonstrates some members appeared to view modding practices as commonplace.

Some members of chipmusic.org engaged with modding practices when burned out with another chiptune practice, such as creating chiptunes through LSDJ.[219] However, many appeared to consider modding as part of the enjoyment of making chiptunes: "Modding is really fun. For me, it's part of the enjoyment of making music on Game Boys."[220] Others posited mods were a requirement for making chiptunes: "Game musicians require mods to make the act of recording and performing music created using [*sic*] them easier."[221] These statements indicate some members appeared to view modding as a necessary step for turning a gaming device into a music making tool or instrument. However, a very small number of members mentioned they visited chipmusic.org for the mods rather than the chiptunes: "I don't like chiptune. I don't hate

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[216] See topics such as "COMMODORE 64 OR 128."

[217] See topics such as "HELP WITH VIDEO CABLE FOR C64."

[218] See topics such as "SID-WIZARD: TOP/BOTTOM OF SCREEN CUT OFF."

[219] See topics such as "GAMEBOY + ARDUINOBOY + DAW?"

[220] chipmusic.org/forums/topic/10193/pay-for-a-dmg-mod-or-do-it-yourself/page/2/

[221] chipmusic.org/forums/topic/12082/is-anyone-else-here-only-for-the-hardwaremods/page/3/

it but I don't enjoy listening to it. I'm only here for the Game Boy related hardware

projects and mods. Is there anybody else in my situation?"[222] Posts like these suggest a

small number of members engaged in modding practices for the sake of modding, and

not for chiptune-related purposes. In instances where people were modding for purposes

unrelated to chiptunes, I would consider such practices as "making" rather than "music-

centered making."

Some members discussed buying or selling mods from other members or

companies. Members often asked who to purchase mods from and discussed the quality

and reliability of modders who sold their services to others.[223] Some members posted

pictures of their purchased devices to ask other members to verify whether a device had a

mod they paid for; unfortunately, some people did not receive what they paid for.[224]

Other members sold modding services to other members,[225] or asked whether there was

a potential demand for modding services.[226] Within these discussions, members

questioned whether "it is a better idea to mod a DMG yourself, or pay for an already

modded one?"[227] Many members suggested learning how to mod rather than paying for a

professional; however, some felt the quality and reliability of a professional mod was

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[222] chipmusic.org/forums/topic/12082/is-anyone-else-here-only-for-the-hardwaremods/

[223] See topics such as "RECOMMENDATION WHERE TO ORDER MODDED GAME BOY PLEASE" and "BEST PLACE TO SEND MY DMG FOR LIGHTING MODS."

[224] See topics such as "DOES THIS GAMEBOY HAVE PROSOUND?"

[225] See topics such as "MODIFICATION PRICING" and "LASER ENGRAVING, TAKE TWO" (page 4).

[226] See topics such as "INTEREST IN RECHARGEABLE ARDUINOBOY?" and "IS THERE A MARKET FOR CUSTOM PAINTED DMGS?"

[227] chipmusic.org/forums/topic/10193/pay-for-a-dmg-mod-or-do-it-yourself/

worth the money. These topics suggest some members of chipmusic.org valued modding practices so much that they were willing to pay someone else to mod their hardware.

Learning how to mod. Many of the members of chipmusic.org discussed learning how to mod by asking questions and sharing understandings within the discussion forum. Example questions included asking for suggestions on potential mods for a project;[228] questions about aesthetic[229] and functionality mods;[230] modifying accessories;[231] removing a mod from a purchased DMG;[232] or even asking about attaching an electronic cigarette to a DMG.[233] Within these posts, and as individual topics, members shared video tutorials or demonstrations of mods,[234] descriptive text and pictures on how to complete a particular mod,[235] as well as failures with modding attempts.[236] In addition to learning how to mod within the discussion forum, there was a

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[228] See topics such as "GAMEBOY MODS," "GAMEBOY POCKET MODS," "WHAT SHOULD I DO WITH MY NES?" and "WHAT I CAN DO WITH SNES?"

[229] See topics such as "MODDERS, WHAT IS YOUR PAINTING PROCESS?" "BACKLIGHTING BUTTONS?" "IF ONE WERE TO ATTEMPT TO MAKE A WOODEN DMG CASE...," "NES BUTTONS IN DMG POSSIBLE?," and "SCREEN PRINTING ON AN NES?"

[230] See topics such as "DMG PROSOUND WITH SPEAKER OFF," "REMOTE RESET BUTTON MOD, WITH A TWIST." "INTERNAL PRO-SOUND HELP," and "PITCH MOD WITH SPEAKER?."

[231] See topics such as "COULD YOU SWAP A DRAGNDERP CIRCUIT BOARD INTO A STANDARD GAMEBOY CART."

[232] See topics such as "REMOVING A VARIABLE CLOCK MOD."

[233] See topics such as "SO I WANT TO MAKE A NEW MOD FOR THE DMG."

[234] See topics such as "GAMEBOY MODIFICATION VIDEO TUTORIALS" and "JUST MADE MY FIRST ARDUINO SYNTH."

[235] See topics such as "GAME BOY COLOR: KITSCH-BENT FRONT-LIGHT MOD," "GAMEBOY ADVANCE SP PRO SOUND," "HOW TO INSTALL A SWITCHABLE CLOCK." and "CUSTOMIZED GEAR THREAD" (page 11).

[236] See topics such as "DON'T FRONTLIGHT!" "WHAT IS LIKELY A VERY NOOBISH CIRCUITRY ERROR," and "FAMICOM VIDEO MOD HAS 'WAVES'."

promotional post for an in-person "modathon" where people collaboratively built an arcade machine, programmed games, and modded DMGs.[237] These discussions suggest some members of chipmusic.org learned how to mod by asking questions to other members, as well as by attending events dedicated to learning how to mod. In addition, these discussions also demonstrate members created and shared resources to answer these questions or openly share understandings.

Although members frequently encouraged others to learn how to mod, some members cautioned against starting with difficult mods:

> its [*sic*] great that that info is out, but things like datasheets and serial numbers are still gibberish to people who don't understand electronics, and that has blocked people from attempting mods before they know more, which i think is a good thing. people shouldn't be spoon fed tutorials, they should learn step by step so they know what to do if something goes wrong. you wouldn't like the idea of some kid doing brain surgery based on a tutorial on the internet?![238]

In addition to cautioning against difficult mods, this quote demonstrates some members suggested processes for learning how to mod. In this example quote, a member suggested other chipmusicians should gradually learn more complicated modding practices and understandings rather than relying on tutorials that demonstrate how to complete a specific mod.

In addition to cautioning against difficult mods, some members refused to post requested information or tutorials on difficult mods. The most common rationales for refusing to create tutorials on difficult mods were members who "didn't want it to be

---

[237] See topics such as "[MI] MODATHON EXTREME 1/26/13."

[238] chipmusic.org/forums/topic/9315/gameboy-pocket-screen-transplant-to-dmg/page/2/

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commercialized (spirit of DIY),"[239] or out of fear of less experienced modders

accidentally ruining their devices:

> anyone who has done this or attempted this will know it is a fiddly job, i have
>
> been emailed by lots of enthusiastic modders who have attempted things way
>
> beyond their limits and destroyed gameboys in the process. my aim was to
>
> prevent damage to DMG and pocket gameboys.[240]

These rationales demonstrate some members feared others might capitalize on freely

shared modding practices, as well as concern over novice modders unintentionally

damaging chiptune-related hardware.

Manufacturing or building new devices.

In addition to modifying devices, a smaller number of members manufactured or

built their own devices for creating chiptunes. Members most frequently discussed using

an Arduino[241] (1,958 word tokens with an overall dispersion rate of 0.620) when creating

new devices such as the "Arduinoboy" (2,682 word tokens with an overall dispersion rate

of 0.550) (see Figure 25 for a hand drawn Arduinoboy diagram): "Arduinoboy is software

for the Arduino hardware platform that allows serial communication (MIDI) to the

Nintendo Gameboy for music applications such as LittleSoundDJ, Nanoloop., [*sic*] and

mGB."[242] In addition to using an Arduino to create an Arduinoboy, other Arduino

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[239] chipmusic.org/forums/topic/9315/gameboy-pocket-screen-transplant-to-dmg/

[240] chipmusic.org/forums/topic/9315/gameboy-pocket-screen-transplant-to-dmg/

[241] An open source microcontroller that allows people to build and code digital devices,
which are often used by members of chipmusic.org to create chiptunes. Find out more
information by visiting: arduino.cc/

[242] github.com/trash80/Arduinoboy

projects included creating 1-bit music,[243] discussing or creating synthesizers,[244] creating

MIDI interfaces between consoles and a MIDI keyboard,[245] or asking for Arduino project

ideas.[246] These example topics demonstrate some members not only modified retro video

game and computer hardware, but created new chiptune-related hardware through

modern devices such as an Arduino.

Some members designed, manufactured, built, coded, and sold their own devices

specifically designed for creating chiptunes. For example, a member created a PCB (see

Figure 30) designed to act as a MIDI interface between a SEGA Genesis[247] (a video game

console) and Ableton Live using custom MAX/MSP patches[248] (see Figure 31), or

through a standalone editor (see Figure 32). This member, and other members who built

similar devices, built and sold their creation to other members within the forum and

provided support through continuous updates over multiple years. Unfortunately,

members sometimes abandoned work on hardware projects, which left members upset

at unfilled orders or the lack of developer support and updates. Interestingly, it appears

someone else manufactured and sold replicas of the aforementioned device, which led to

discussions on whether members could violate intellectual property rights by replicating

and selling another person's product when someone either abandons a project or fails to

---

[243] See topics such as "1-BIT MUSIC ON ARDUINO."

[244] See topics such as "OPA MULTI-TIMBRAL FM SYNTHESIZER" and "JUST MADE MY FIRST ARDUINO SYNTH."

[245] See topics such as "[SEGA MASTER SYSTEM] HOW TO: MAKE A SEGA MASTER SYSTEM MIDI INTERFACE" and "YM2151 SHIELD FOR ARDUINO."

[246] See topics such as "GAMEBOY + ARDUINOBOY + DAW?"

[247] SEGA Genesis is the North American name for the console; however, the console is named the "Mega Drive" outside of North America.

[248] MAX/MSP is a graphical programming platform that allows users to create audio and visual programs or interfaces.

fulfill orders after taking money.[249] Several other examples of sharing built or

manufactured devices existed within the discussion forum.[250] Within similar topics,

some members discussed the intellectual property rights of hardware as derivative

works. For example, discussing when and how members should credit original hardware

creators when sharing and discussing derivative hardware.[251] These examples

demonstrate members of chipmusic.org not only modified hardware, but created new

hardware for chiptune-related practices and discussed when and how other members

should give credit when creating derivative hardware.
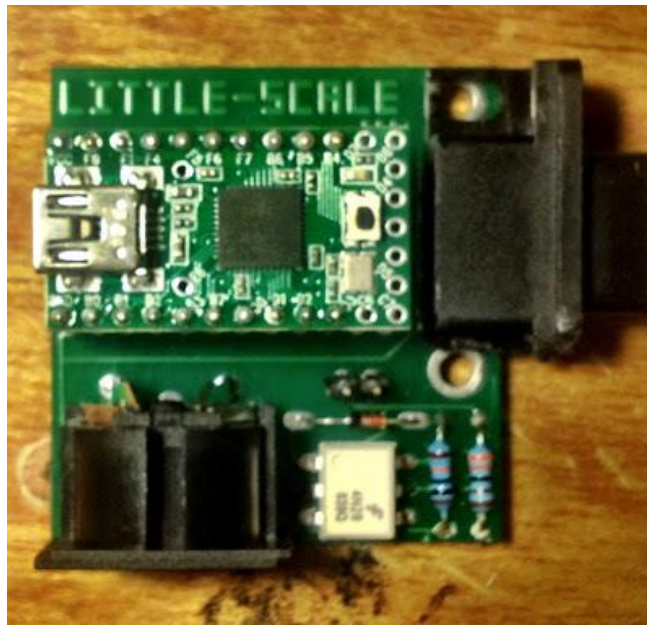
Figure 30. An image of the custom PCB MIDI interface. Source:

chipmusic.org/forums/topic/562/sega-md-gen-genmdm-sega-genesis-mega-drive-midi-

interface/page/64/

---

[249] See topics such as "[SEGA MD / GEN] GENMDM SEGA GENESIS / MEGA DRIVE MIDI INTERFACE" (page 81).

[250] See topics such as "VGX LIVE PERFORMANCE TOOL FOR THE SEGA MEGA DRIVE / GENESIS," "TINYBOY," and "BLIP FESTIVAL TOKYO 2011 VIDEOS!" (page 4).

[251] See topics such as "NINSTRUMENT BLOG UPDATED." (page 8).

Figure 31. An image of one of several MAX/MSP patches, which are virtual interfaces that allow users to interact with a console using Ableton Live. Source: chipmusic.org/forums/topic/562/sega-md-gen-genmdm-sega-genesis-mega-drive-midi-interface/page/17/

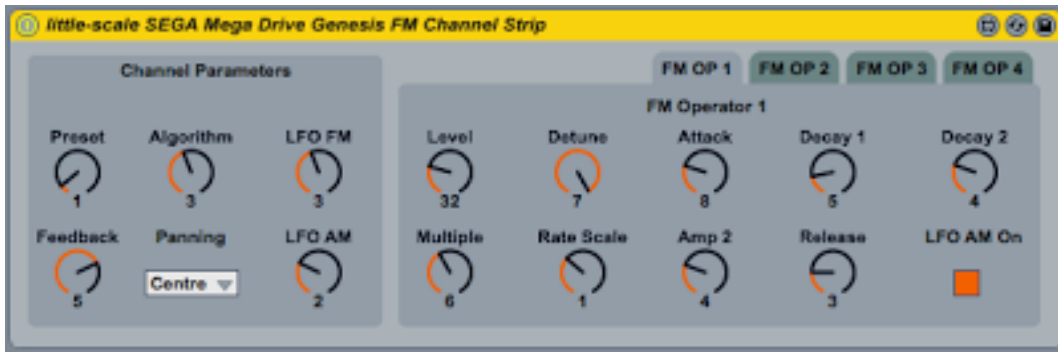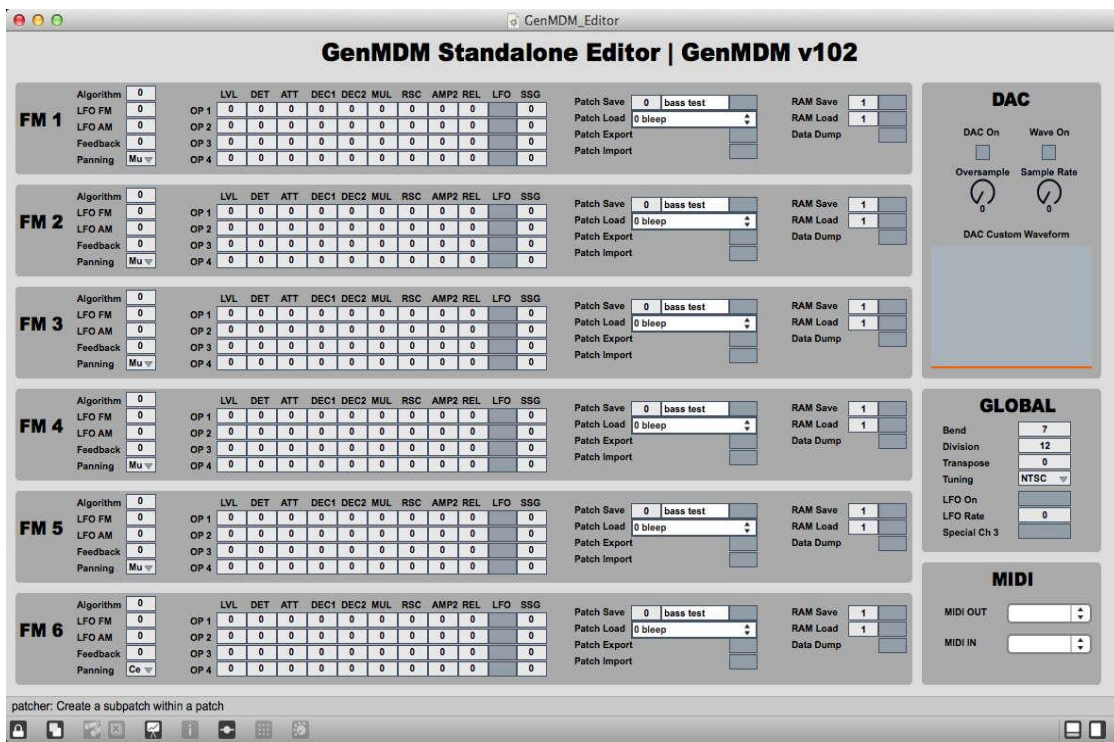*Figure 32.* An image of the standalone editor built using MAX/MSP. Source: chipmusic.org/forums/topic/562/sega-md-gen-genmdm-sega-genesis-mega-drive-midi-interface/page/50/

Summary of Maker Practices

The forum members of chipmusic.org often discussed modifying or building

hardware for chiptune-related practices such as composing or performing. Modifications

included aesthetic mods that changed a hardware's appearance, or functionality mods

that changed how a piece of hardware functioned. Although presented as two categories

of mods, many members engaged in both aesthetic and functionality mods for a single

device. In addition to modifying existing devices to add, remove, or repair functionality,

some members manufactured or built new devices for chiptune-related practices. These

hardware creations often augmented the capabilities of original chiptune hardware; for

example, allowing contemporary computers to interface with original chiptune hardware

such as the SEGA Genesis.

Coding Practices

The original video game and computer hardware used in chiptune practices have

a limited number of software designed for composing and performing chiptunes.

However, many of the members of chipmusic.org discussed modifying or developing

software specifically designed for chiptune practices and hardware. In order to modify

and create these chiptune programs for existing and newly manufactured devices,

members engaged in coding practices.

Coding, also known as computer programming, is the process of using a graphical

or text-based programming language to sequence together a series of instructions for a

computer to execute. Within chipmusic.org, the word "code" and its lemmas (e.g., coder,

coding, script, scripts, etc.) accounted for 5,371 word tokens with an overall dispersion

rate of 0.727 across the discussion forum, indicating discussions on coding occurred

throughout much of the discussion forum; however, such discussions on coding practices

occurred less frequently than the other practices I introduced previously. Within

discourse on coding practices, members discussed topics such as soft mods, source code, software development, and learning how to code.

Soft Mods

Although not as prominent as hard mods, some members discussed engaging in soft modding practices. It appears some members considered soft mods as a common practice when they suggested modifying code to create a desired outcome.[252] For example, some members discussed and shared modified code (see Figure 33 for an example) to either add or remove capabilities for various hardware[253] or software.[254] Other members modified code in order to fix errors in a program, such as modifying the code of a tracker in order to fix tuning errors.[255] Members also engaged in soft mod discussions with the developers of various chiptune related software, who often explicitly encouraged members to modify their code: "don't hesitate to grab the source and tweak it."[256] Or even encouraged members to ask questions if unsure how to modify source code: "you can modify it in any way you want if you have coding skills… If not, tell me your problem here."[257] In some of these discussions, members posted how they were attempting to modify the code for particular software, and developers responded with

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[252] See topics such as "GAMEBOY MUSIC VISUALIZER."

[253] See topics such as "MIDI CHANNEL SWITCH ON THE FLY," "CUSTOMIZE ARDUINOBOY CODE HELP," "ARDUINOBOY CODE EDITING HELP," and "DMG/POCKET VIDEO CAPTURE WITH ARDUINO OR TEENSY?" (page 10).

[254] See topics such as ".PRG EXPORT FROM GOATTRACKER."

[255] See topics such as "GOATTRACKER 2.71 TUNING," "C64 OUT OF TUNE...?" and "NES ROM TO NES CART.. HELP!" (page 2).

[256] chipmusic.org/forums/topic/13624/picoloop-nanoloop-clone/

[257] chipmusic.org/forums/topic/17070/sid-wizard-w-kerberos-midi-sync-is-this-possible/

suggestions for fixing or improving their soft mod (see Figure 34 for an example).[258] These topics demonstrate members not only modified hardware, but modified chiptune-related software by altering a program's code. In addition, the encouragement from software developers suggests soft modding practices were valued by chipmusicians and software developers. In order to complete any of these soft mods, members needed access to a software's source code.

```
Here's how I'd do it, starting with the version at https://github.com/trash80/Arduinoboy;

In the file Mode.ino edit the function switchMode() as follows;

void switchMode()
{
  switch(memory[MEM_MODE])
  {
    case 0:
      modeLSDJSlaveSyncSetup();
      break;
    case 1:
      modeMidiGbSetup();
      break;
  }
}

And in the file Arduinoboy.ino, change the line;

#define NUMBER_OF_MODES 7    //Right now there are 7 modes, Might be more in the future

to:

#define NUMBER_OF_MODES 2


That should pretty much do what you want.
```

Figure 33. An example of members sharing code within chipmusic.org when discussing soft mod practices. Source: chipmusic.org/forums/topic/19543/arduinoboy-code-editing-help/

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[258] See topics such as "ARDUINO BOY - LSDJ MASTER SYNC PROBLEM" and "OPA MULTI-TIMBRAL FM SYNTHESIZER" (page 3).

```
add the line:

tcflush(handle, TCIFLUSH);

before:
if (tcsetattr(handle, TCSANOW, &config) < 0) {

So it makes:

// Timeouts configuration
   config.c_cc[VTIME] = 1;
   config.c_cc[VMIN]  = 0;
   //fcntl(handle, F_SETFL, FNDELAY);
// Validate configuration
   tcflush(handle, TCIFLUSH);
   if (tcsetattr(handle, TCSANOW, &config) < 0) {
      close(handle);
      return 0;
   }
   com->handle = handle;
   return 1;
}
```

Figure 34. An example of a developer responding to a member with how to modify their

software. Source: chipmusic.org/forums/topic/18171/opa-multitimbral-fm-

synthesizer/page/3/

Source Code

Source code are the modifiable files (or lines of code) written in a programming

language used to create software. When developers and companies release software, they

often release a version of the software that is easy to use but difficult to modify. To

prevent people from modifying software, and to translate code into a format for

computers, developers run code through a compiler. A compiler translates the source

code (readable by a human) into a language easily read by a computer, which also limits

or attempts to prevent the ability for a user to modify the software. When a developer or

company releases the source code in addition to the compiled code, this allows people to easily engage in the soft mod practices pervasive of the mod scene, as described in Chapter Two. Although some members of chipmusic.org attempted to modify the compiled code (code written in a machine language that can be read by a computer)[259] — a process that involved altering the compiled file one bit at a time in order to reveal what each bit did (see Figure 35) — most members of chipmusic.org discussed using source code (code written in a programming language that can be read by a human) with soft mods.

Figure 35. A short excerpt of a lengthy post, which includes comments explaining different parts of a compiled file, so members can attempt a soft mod. A note on reading the entire post: the compiled code is located on the left side (e.g., $097D) and the member's comments are on the right side after the semicolon. Source: chipmusic.org/forums/topic/17587/gameboy-camera-force-trippy-h/page/3/

---

[259] See topics such as "NES/SNES SEQUENCER CART" (page 6) and "GAMEBOY CAMERA - FORCE TRIPPY H" (page 2).

Kow and Nardi (2010a) and Laukkanen (2005) posit modders share code and content freely among mod communities. Like the mod scene, members of chipmusic.org often shared source code for in-development (i.e., not completed) or completed software. Examples of discussions on in-development or completed software include: sharing the source code and schematics for creating an Arduinoboy on a Teensy (another type of microcontroller),[260] sharing code for various chiptune software,[261] sharing code to turn a graphing calculator into a 1-bit synthesizer,[262] for creating harmonies in Renoise (a DAW),[263] for demos on hardware,[264] for hardware built by members,[265] sharing reverse engineered code,[266] and sharing scripts for ignoring other members' posts within chipmusic.org.[267] Within these discussions on source code, some members asked for suggestions to improve their code[268] and some members responded with suggestions or corrections.[269] The wide range of discussions around sharing and using source code for a

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[260] See topics such as "TEENSYBOY RELEASED."

[261] See topics such as "GAMEBOY AS A USB CONTROLLER" and "NES/SNES SEQUENCER CART" (page 10).

[262] See topics such as "HOUSTONTRACKER 2 (TI-82/83/83+/84+)" and "[TI 82/83/83+/84+] HOUSTON… WE HAVE A TRACKER."

[263] See topics such as "SCRIPTING FOR HARMONY."

[264] See topics such as "'THE BEST INTRO EVER' SMALL MUSIC DRIVER (C64)," "DEMOSCENE SOURCE," and "WALLFLOWER - VISUAL/AUDIO DEMO IN 23 BYTES."

[265] See topics such as "NANOLOOP GROUND LOOP ISOLATOR."

[266] See topics such as "SID ANALYZER?"

[267] See topics such as "MY USERSCRIPTS FOR CHIPMUSIC.ORG" and "-<< CMO IGNORATOR V1.1 >>-."

[268] See topics such as "LSDJ-SAV-UTILS - CALL FOR SCRIPT SUGGESTIONS."

[269] See topics such as "FAMIIDI: MIDI FOR THE NES / FAMICOM (PLUS A WII NUNCHUK INTERFACE!)" (page 2).

multitude of software (e.g., various trackers and DAWs) and hardware (e.g., Arduino, Teensy, graphing calculators, and various video game consoles) suggests that this practice was not isolated to one particular type of software or hardware.

Some members who developed software shared their source code in their initial post about their software, upon request from another member of chipmusic.org, or when abandoning work on a project. In general, members expressed gratitude when members shared source code: "I'm glad the code is open sourced,[270] just nice to see, and if for whatever reason you do have to stop development someone else could potentially pick it up. Though I do hope you continue!"[271] Others expressed a desire for more software developers to release source code when a developer abandoned a project:

> I wish it was a standard practice for people that abandon projects to be forced to release source. If you are too lazy/busy to finish such amazing software you should pass it off to someone more reliable/capable/willing to follow through.[272]

However, some members disagreed with this sentiment: "Since it's an unpaid labor of love he can do exactly whatever he wants with it."[273] Although most discussions on source code were positive, some members indicated source code intimidated them: "unfortunately my programming skills are really far from capable. just looking at the arduinoboy source code freaked me the hell out!"[274] This diverse range of perspectives on

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[270] Open source software is software with freely available source code that can be redistributed or modified.

[271] chipmusic.org/forums/topic/4050/furious-advance-tracker-gbatracker/page/3/

[272] chipmusic.org/forums/topic/177/m4g-tracker-gba-tracker-by-smiker-and-ilkke/page/27/

[273] chipmusic.org/forums/topic/177/m4g-tracker-gba-tracker-by-smiker-and-ilkke/page/27/

[274] chipmusic.org/forums/topic/16788/gb303-bug-fixes-feature-requests-open-source/page/10/

source code suggests mixed reactions about whether software developers should release source code or when a member was able to look at source code.

Within the mod scene, modders often take over work on popular mods when a modder abandons a project that is taking too much time or that is no longer of interest (Kow & Nardi, 2010a, 2010b). Members of chipmusic.org also discussed resuming work on abandoned projects with shared source code. For example, a member resumed development on someone else's wavetable synthesizer for a DMG when the original developer shared their source code: "The source has been posted by the author into the public domain. The terms and conditions of github are clear and a programmer as experienced as Furrtek will be fully aware of them."[275] This quote posits that because the original creator publicly shared their source code on GitHub,[276] they are indicating anyone can redistribute or modify the program. Discussions on resuming work on someone else's abandoned software demonstrated a strong desire for some members to provide continuous software updates and support, as well as fluidity of authorship in software development when the people who develop a particular software changed over time. Within discussions on abandoned projects and general software development, members shared bugs, suggested new features, assisted with the development process, and tested out new updates. I describe these practices in the following section on software development.

Software Development

As discussed in the "Composition Practices" theme, members of chipmusic.org used a variety of software to create chiptunes. Much of the chiptune software discussed

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[275] chipmusic.org/forums/topic/16788/gb303-bug-fixes-feature-requests-open-source/

[276] GitHub is a web-hosting service that allows members to find, share, and discuss source code and documentation. Visit GitHub at github.com/

within the forum were created by members within chipmusic.org or within the larger chipscene. Because members could easily engage in discussions with software developers, members engaged in a wide range of discourse around software development practices.

Developers who were members of chipmusic.org often created topics within the discussion forum about their software. Within these topics, developers often asked other members to test and report errors:[277] "Guys, don't forget that you can use this thread to ask questions, report bugs and suggest improvements!"[278] When members reported errors, developers often engaged in dialogue with members to resolve the error.[279] As a result of these suggestions and discussions, developers often posted software updates with patch notes, which are descriptions of software fixes and added features within a software update.[280] These discussions demonstrated that many software developers viewed their software as works-in-progress and relied on other chipmusicians to assist with finding and reporting errors, which are practices also associated with the mod scene and online gaming communities (Lee, 2012).

A common practice evident within discourse on software development was asking about, or requesting, features for chiptune related software. Members either replied to developer topics or created their own topics related to particular questions and requests for chiptune-related software[281] or the discussion forum itself. When developers denied

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[277] See topics such as "COMEBACK TRACKER BETA - LOOKING FOR MUSICIANS," "POWER-FM (FM SYNTHTRACKER) FIRST PUBLIC BETA," and "MINOR PIGGY UI USER EXPERIENCE IMPROVEMENTS."

[278] chipmusic.org/forums/topic/673/klystrack-chiptracking-for-your-netbook/page/2/

[279] See topics such as "PICOLOOP NANOLOOP CLONE."

[280] See topics such as "NEW GHETTO UPDATED: 1.3K_04F."

[281] See topics such as "LITTLEGPTRACKER FANTASY LIST."

feature requests, members sometimes created workaround solutions. For example, multiple people requested the ability to ignore certain members within the discussion forum;[282] however, one of chipmusic.org's moderators responded by suggesting "either you learn to live with the people you have around you, or you find/make a script to ignore users."[283] As a result, some members created and shared their own scripts (code) for ignoring certain members of chipmusic.org.[284] Another example of members using code to solve a perceived problem with chipmusic.org included creating an iOS app for listening to music uploaded on chipmusic.org.[285] These examples demonstrate members of chipmusic.org not only provided suggestions or feature requests to software developers, but created their own software or features when a request was denied or ignored.

While many developers requested feedback on in-development software, some members requested ideas before creating software; for example, within topics such as "LOOKING FOR GAMEBOY MUSIC PROGRAM IDEAS/REQUESTS…"[286] Other developers asked members if they liked their idea before beginning the software development process:

Something I've been thinking about for a while so I thought I'd see if there'd be any interest in it.

[282] See topics such as "IGNORE FUNCTION" and "USER IGNORE FUNCTION."

[283] chipmusic.org/forums/topic/10323/user-ignore-function/page/4/

[284] See topics such as "MY USERSCRIPTS FOR CHIPMUSIC.ORG" and "-<< CMO IGNORATOR V1.1 >>-."

[285] See topics such as "CHIP MUSIC APP (SOLVED)" and "CM FEED, IOS APP (V1.0.3)."

[286] chipmusic.org/forums/topic/9469/looking-for-gameboy-music-program-ideasrequests/

I've got some cool ideas on how to make quite a smart drum machine on the NES.

It would be a 16-step (or less) pattern based thing with simple song structure

(just a string of patterns with a repeat count). The cool thing is that on each step

you will be able to assign settings for all five NES voices and also on each step

you'll be able to modify parameters such as envelope, amplitude, duty, pitch

sweep, (simple) table etc. for all five voices simultaneously.

What do you think - any interest?[287]

And some members suggested ideas to the community with the hope that developers

would create their proposed software. For example, a member suggested an idea for

creating a "lightwall"[288] using the Nintendo Entertainment System (NES), but knew

"next to nothing about NES roms or programming [and] was just kind of throwing this

out there, seeing what people think."[289] Over the course of 353 posts, members

collaborated on developing the software,[290] reported bugs and updates,[291] shared source

code,[292] and even shared pictures of members using the software in live performance

settings (see Figure 36). These topics and examples demonstrate that some software

developers actively sought ideas from other members of the community, as well as

proposed and developed software collaboratively.

---

[287] chipmusic.org/forums/topic/2813/next-project/

[288] Some members referred to the software as "litewall" rather than "lightwall."

[289] chipmusic.org/forums/topic/1714/Project ideas-concept-for-vj-oriented-nes-rom/

[290] chipmusic.org/forums/topic/1714/lightwall-concept-for-vj-oriented-nes-rom/page/4/

[291] chipmusic.org/forums/topic/1714/lightwall-concept-for-vj-oriented-nes-rom/page/12/

[292] chipmusic.org/forums/topic/1714/lightwall-concept-for-vj-oriented-nes-rom/page/14/

Figure 36. A photo of a member performing with software developed collaboratively by members of chipmusic.org. Source: chipmusic.org/forums/topic/1714/lightwall-concept-for-vj-oriented-nes-rom/page/10/

Software developers often spent a significant amount of time developing software for free. Despite the unpaid work over an extended period of time, some developers indicated they enjoyed the work: "Maybe the best hobby I've ever had in my life ⊡."[293] However, some members abandoned projects due to not having enough time or generally feeling unappreciated for their efforts. For example, in a multi-topic discussion spanning across multiple years, a reluctant tracker developer eventually abandoned work on a project, indicating:

> I wasted years on the project, implementing requests that are useless for me, writing 100K docs in foreign language (had to learn it in process) that nobody reads, providing support through answering questions that are answered in the docs, and what I get is 'interface never improved much' and things like that. Great, thanks.[294]

---

[293] chipmusic.org/forums/topic/13624/picoloop-nanoloop-clone/page/15/

[294] chipmusic.org/forums/topic/8243/what-happen-to-vgm-music-maker/

While many people responded with appreciation for the developer's efforts, some people suggested developers "have to put up with a certain amount of dumb questions and confusion,"[295] or that the developer should learn to take criticism "with a grain of salt."[296] Discussions like these appeared to suggest that some members valued the practice of providing feedback on software and that software developers should expect feedback and requests, regardless of if they desired such feedback.

Learning How to Code

Members of chipmusic.org often assisted each other with learning how to code by sharing resources or discussing approaches for learning how to code.[297] Members responded with a wide range of suggestions that included learning different programming languages, starting with easier projects, engaging in discussions with other members, sharing thought processes for modifying another person's source code (see Figure 37), searching on developer forums or websites, or by encouraging others to engage in soft modding practices. For example, one member suggested other members who wanted to learn how to code should

> look for someone who has made for example an arduino sampler, study the code
>
> and apply it to your own project. Most people starting out with microcontrollers
>
> will take someone elses examples and just modify the code/circuit to see what

---

[295] chipmusic.org/forums/topic/8243/what-happen-to-vgm-music-maker/page/2/

[296] chipmusic.org/forums/topic/8243/what-happen-to-vgm-music-maker/page/2/

[297] See topics such as "WHERE TO START LEARNING CODE SO I CAN MAKE A SYNTH/ TRACKER FOR 3DS?" "GAMEBOY DEVELOPERS? IDEA/ BOUNTY," "CAN ANYONE CREATE AN UNSIGNED 4-BIT AUDIO RIPPER FOR SEGA CONSOLES?" "AMIGA CODING TUTORIALS," and "NES ROM TO NES CART.. HELP!" (page 2).

happens. It may seem a little daunting at first, but honestly it is alot easier than it

seems and is really rewarding.[298]

Many of these suggestions included words of caution that learning how to code takes a

significant amount of time: "But dude, it's no summer project… It's not going to be done

quickly. Just saying."[299] Such statements demonstrate that some members valued,

encouraged, and assisted with learning how to code, but with the caveat that

understanding and engaging in coding practices can take a significant amount of time to

develop.

```
first, i added two variables for the horizontal and vertical positions of the sprite right after the variables that were already listed:


    buttons EQU $20              ; variables for the buttons
    oldbuttons EQU $22
    justpressed EQU $24

    v_position EQU $6000
    h_position EQU $6001


then i modified the rom header information to support the MMC1 mapper.


        .ORG $7ff0              ; start at $7ff0 - 16 byte .NES header (iNES format)
    Header:                     ; this is used only for emulators
        .db "NES", $1a
        .db $02
        .db $01
        .db %00000010
        .db %00000000
            .db $00
            .db $00
            .db $00
            .db $00
            .db $00
            .db $00
            .db $00
```

Figure 37. A member shares their thought processes about learning how to modify

source code. Source: chipmusic.org/forums/topic/3181/nes-audio-

programming/page/2/

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[298] chipmusic.org/forums/topic/10345/a26f-atari-2600-midi-music-interface/page/3/

[299] chipmusic.org/forums/topic/14482/always-wanted-to-make-a-gameboy-game/

Another method for learning how to code, and for supporting others with coding, was looking at another person's source code and reading comments embedded within their code that documented how each part of their software worked together. Comments – as a common coding practice – make it easier for people to modify code and to learn how to code by modifying worked examples (i.e., modifying code that works correctly to see if it continues to work properly after changes are made to the code). Comments are typically found either above a section of code or to the right of individual lines of code, and are indicated by a semicolon (;); hash (#); two forward slashes (//); or a forward slash with an asterisk (/*) to indicate the start of a multiline comment, which are eventually followed by an asterisk with a forward slash to indicate the end of a multiline comment (*/).[300] If members released source code without comments, some members posted requests for comments in order to better understand how to modify the code: "Can you comment your pygame code for me? I need to modify it to accomadate [*sic*] whatever data I send, but I don't know all of what is going on. Comment it for the laymen, k?"[301] These practices were commonplace among software developers and may mention a desire for software developers to discuss or explain their understanding of coding with other people interested in coding. In the demoscene, demosceners also learn how to code by analyzing source code (Carlsson, 2010). Although the chipscene is now a distinct subculture that emerged out of the demoscene, members of chipmusic.org continue to discuss practices used by the demoscene.

Some members of chipmusic.org created projects for themselves to learn how to code. For example, in the initial post for the aforementioned "lightwall" software, the

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[300] Visit the following link to learn more about general commenting practices: en.wikipedia.org/wiki/Comment_(computer_programming)

[301] chipmusic.org/forums/topic/14029/dmgpocket-video-capture-with-arduino-or-teensy/page/13/

original poster mentioned using this as a possible project for learning how to code: "I will possibly have a try at this as a first programming project at the end of the year and start looking at the NESDev boards."[302] Other examples included topics such as "WHERE TO START LEARNING CODE SO I CAN MAKE A SYNTH/ TRACKER FOR 3DS,"[303] questions about learning how to code plugins, [304] trackers,[305] how to program a game,[306] or other chiptune related coding projects.[307] Within these discussions, some members mentioned they learned how to code as a result of these projects: "I learned how to write assembly code and program by means of this project."[308] As suggested by these example topics, some members of chipmusic.org engaged in chiptune-related software development in order to learn how to code.

Members appeared to use social participation within the forum throughout the process of learning how to code by discussing resources or approaches for learning how to code, analyzing source code, and engaging in chiptune-related projects to learn how to code. Scholars investigating media arts coding practices among youth (Kafai & Peppler, 2011; Maloney, Peppler, Kafai, Resnick, & Rusk, 2008; Peppler & Kafai, 2007a, 2007b), and game design communities (Duncan, 2012a) reported similar findings. For example, 93.8% of posts analyzed within one online discussion forum were coded as "social

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[302] chipmusic.org/forums/topic/1714/Project%20ideas-concept-for-vj-oriented-nes-rom/

[303] chipmusic.org/forums/topic/16739/where-to-start-learning-code-so-i-can-make-a-synth-tracker-for-3ds/

[304] See topics such as "HOW TO WRITE A PLUGIN?"

[305] See topics such as "CODING A TRACKER: WHERE TO START?"

[306] See topics such as "ALWAYS WANTED TO MAKE A GAMEBOY GAME."

[307] See topics such as "NES ROM TO NES CART.. HELP!"

[308] chipmusic.org/forums/topic/20456/prodigy-source-code/

knowledge construction" (Duncan, 2012a, p. 66). I discuss such forms of community-based learning in the final theme presented in this chapter.

Other Coding Practices

While the majority of coding practices discussed above involved soft mods, source code, software development, and learning how to code, a small number of members engaged in other forms of coding practices. For example, rather than discussing creating software that makes music, some members discussed using code to make music.[309] Although other platforms exist for making music with code,[310] such topics demonstrate a unique approach to creating chiptunes by writing out lines of code rather than using software dedicated to making music (e.g., trackers and DAWs). In addition, some members used common programming syntax (a programming language's rules) or concepts when responding to other members. For example, the comment in Figure 38 used common programming syntax and concept (if/else conditional statements) to convey the following message: you should call a song a remix if your new song's material minus the target song's material is greater than 25%, otherwise you should call it a cover. Comments like these not only demonstrated a member's understanding of programming syntax and concepts but assumed others within the space understood it as well.

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[309] See topics such as "USING PYTHON TO WRITE CHIPTUNE," "EXAMPLES OF GENERATIVE CHIPMUSIC?," and "EXPERIMENTAL MUSIC FROM VERY SHORT C PROGRAMS" (page 2).

[310] See scholarship such as Aaron, Blackwell, and Burnard (2010); J. Bell and T. Bell (2018); Blackwell and N. Collins (2005); N. Collins (2011, 2016); Magerko et al. (2013); Magnusson (2014a, 2014b); Manaris, B. Stevens, and Brown (2016); Ogborn (2016); or Ruthmann, Heines, Greher, Laidler, and Saulters II (2010) for some examples.

Figure 38. An example of a member using programming syntax to respond to a discussion about the differences between remixes and covers. Source: chipmusic.org/forums/topic/14988/differences-between-covers-and-remixes/

Questioning the Relevancy of Coding Practices

Although many of the software developers created and shared music within the "Releases" subforum or the "Music" section of chipmusic.org, one of the tracker developers indicated creating software but not being "good enough" to make music with the software: "i have made several tracker [*sic*] for different sound chip [*sic*] and computer, I do not make music my self, because I [*sic*] not good enough for it."[311] With statements like these, people might ask whether all of the aforementioned coding practices were forms of music-centered making. In fact, one member who engaged in a discussion about coding practices with another asked whether the discussion was "on" or "off" topic:

> This kind of topic is not really music-releated [*sic*] and so if a moderator wants to move it I don't mind. Maybe it's worth having a coding/programming section? I know it's slightly off-topic for the whole board but it has a tangential connection. Nick's chord program and also probably things like Litewall could be moved there.[312]

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[311] chipmusic.org/forums/topic/5148/ym2149-and-opl2opl3-tracker-new-version-04112012/

[312] chipmusic.org/forums/topic/3181/nes-audio-programming/

Interestingly, a member responded by saying "I think its [*sic*] more than on topic, and interesting to read, even if [I] barely understand anything."313 In addition, another member shared their appreciation for the topic: "wow. thank you 2 for this public conversation. i have no idea what just happend [*sic*] but maybe when i learn more coding i will figure this out and actually post something relevant."314 These comments demonstrate that some members of chipmusic.org appeared to value and encourage discussions on coding practices related to chiptunes.

Member perspectives on coding practices within chipmusic.org resonate with Hugill's (2008) assertion that there is a strong connection between some forms of digital musicianship (a music culture with many parallels to the chipscene) and coding: "the decisions of the programmer of the controller, therefore, play a major role in determining the eventual outcome, so a mastery of a least some aspects of programming are more or less essential to success in this field" (p. 125). For example, in a series of interview responses in Hugill's (2008) book on digital musicians, some digital musicians indicate coding is considered an essential skill:

> I think knowledge of a programming language and sounds physics is the most
> important. . . In order to escape the limitations that commercial software imposes
> on the musician, I think it is important to be able to work in an environment
> where you are free to compose your own instruments or tools. (p. 209)

In addition, member perspectives on coding practices relates to Shaked's (2013) conclusion that some "musical computer-scientists" (p. 14) with a serious music-making avocation find ways to concurrently engage in both coding and music making and learning, and that "study participants have acknowledged that their concurrent

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313 chipmusic.org/forums/topic/3181/nes-audio-programming/

314 chipmusic.org/forums/topic/3181/nes-audio-programming/page/2/

engagement has occasionally informed their thinking and learning paradigms at work" (p. 321). Along similar lines, Magnusson (2014b) posits that code can be viewed as a new form of musical notation that affords opportunities "for indeterminacy, non-linearity and liveness" (p. 269).

As someone with experience in both music education and computer science education, I agree with the quotes above which indicated coding practices can be "on topic" or essential for some forms of music making, and further suggest these discussions and practices could occur within music education contexts and curricula. However, coding practices are rarely discussed in music education contexts or curricula. I elaborate on this topic in Chapter Six.

Summary of Coding Practices

The forum members of chipmusic.org discussed using coding practices to modify or develop chiptune software for a multitude of hardware. Members engaged in soft modding practices to add or remove functionality in a program, or to fix errors. These practices often included discussing and sharing source code, which many members recommend for learning how to code. In addition to modifying code, some members provided feedback on, or developed, chiptune-related software. Although many of these projects involved a small number of software developers working on a program, members of the community often provided feedback and requests. This communal approach to software development allowed for a range of input and expertise from chipmusicians with little understanding of coding practices, to experienced software developers. Although coding practices were not discussed as frequently as some of the other themes, members of chipmusic.org appeared to value these practices and discussions.

Entrepreneurial Practices

Members of chipmusic.org engaged in a multitude of practices I describe as "entrepreneurial practices." Entrepreneurial practices were the business-related practices an individual engaged in; for example, promoting and selling a manufactured product. Although not as commonplace as other themes previously mentioned, members often engaged in entrepreneurial practices in conjunction with the aforementioned themes. The following subsections describe how members engaged in promoting and marketing chiptune-related media, events, services, or merchandise.

Promoting

I describe "promoting" practices as those that increase publicity or awareness of an event, release, product, or service. Chipmusic.org dedicated two subforums for promoting chiptunes. The "Releases" subforum promoted released albums or tracks, while the "Upcoming events" subforum promoted upcoming events. Within the "Releases" subforum, members promoted releases with varying combinations of album descriptions, quotes from reviews, audio excerpts, album covers, and video promotions.[315] Members promoted events through similar means,[316] as well as shared

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[315] See topics such as "'ANOTHER' BY TEN THOUSAND FREE MEN & THEIR FAMILIES," "8BP118 V/A - REFORMAT," and "DISKETTE DELUXE - SPACE TOURISM (CHEAPBEATS)."

[316] See topics such as "[MI] MODATHON EXTREME 1/26/13," "[RUSSIA] 8BIT TOUR WITH NORDLOEF," "DANIMAL CANNON TOUR FEB-MARCH NYC TO AUSTIN +MIDWEST!" and "[EVANSVILLE, IN] LITTLE SOUND ASSEMBLY (AUG 8-9)" (page 3).

pictures of hardware,[317] merchandise,[318] awards,[319] or raffle prizes.[320] In addition,

members promoted events by crowdsourcing events into a shared calendar,[321] making it

easy to see upcoming events. Although it appeared to be common practice to promote

releases and events, most topics had little (less than ten) to no replies; however, these

topics often had hundreds or thousands of views (as indicated by the topic statistics

within each subforum). Such discussion topics suggested members wanted to share their

chiptune creations and upcoming events with others; however, these topics often

generated few replies from other members.

Selling, Buying, and Trading

Within maker culture, products are often "meant to be shown, used, sold, or

shared" (Sheridan et al., 2014, p. 529). Members of chipmusic.org engaged in similar

practices through the selling, buying, and trading services or goods. Of these practices,

members most frequently mentioned selling released music through digital platforms

that supported downloading or streaming music. Although many members released their

music for free, or for a set price, some released their music through a "pay what you

want" model,[322] where people chose how much to pay for a release: "This soundtrack is

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[317] See topics such as "LIVE VIDEO - PLAYED A SET IN WELLINGTON NZ" and
"◀◀ SHADOWTRAVEL U.S. TOUR 2014 ▶▶" (page 3).

[318] See topics such as "MODATHON EXTREME II - APRIL 12TH-14TH ANN ARBOR,
MI." (page 2).

[319] See topics such as "05/18/2011 2010 TCTD AWARDS // BLIP FESTIVAL OPEN MIC"
(page 3)

[320] See topics such as "8STATIC•5/19•PHL•MINUSBABY,BUBBLEGUM
OCTOPUS,CHIP'S CHALLENGE,VBLANK"

[321] chipmusic.org/forums/topic/6198/chipmusic-around-the-world-calendar/

[322] See topics such as "SASKROTCH - ZONES: ACT 1" "MY.EXPLOSION - RAMPANT
EP," "ONE DECK DUNGEON OST - SNES RPG ALBUM," "SASKROTCH - IN DA
CLUB," and "HAVOCCC - DIURNAL COURSE."

free or 'pay what you want': thanks for your support, please spread the word!"[323] Others

released their music for free and charged a small fee for the project files:[324] "Each song

can be downloaded individually for free, but if you pay the 2 dollars, you get the LSDJ

.sav too!"[325] Discussion forum posts that mentioned specific types of payment methods

demonstrated multiple models for payment of goods and suggested some members tried

to profit from their chiptune creations. Although members bought and sold goods

though a multitude of payment methods, there were not enough data to ascertain how

much money some members made from these products or to what extent members

engaged in chiptune practices for leisure rather than as a source of income.

Selling physical releases. Although not as common as releasing music for

downloading or streaming platforms, some members released their music on "physical

albums" through video game cartridges (see Figure 39), vinyl records,[326] or cassette

tapes.[327] Others marketed their services for releasing other members' music on physical

"albums."[328] Within the "Releases" subforum, the word "physical" accounted for 238

word tokens with an overall dispersion rate of 0.868 across the subforum, indicating a

relatively small number of discussions around physical releases occurred throughout the

subforum. Within such discussions, some members of chipmusic.org posted topics such

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[323] chipmusic.org/forums/topic/17233/my-free-ost-for-varuna-oldschool-shootem-up-pcengine-genesis-b/

[324] See topics such as "NONSYNTHS - SYNTHETIC NONSENSE (CHIPBASS INSTRUMENTAL)" and "STORM BLOOPER - JAWN-DIS."

[325] chipmusic.org/forums/topic/19338/lsdjfree-powersupply-tree-songs/

[326] See topics such as "MARSHALL ART + CORY JOHNSON - TIMELINE 10" VINYL VGM EP"

[327] See topics such as "8BIT MUSIC ON TAPE / CASSETTES :) :) :)."

[328] See topics such as "SOME GUY MAKING TAPES. DEFINITELY NOT A 'LABEL'."

as "HELP PLANNING 2A03 CART RELEASE"[329] or "GETTING MY MUSIC ON A

NINTENDO CARTRIDGE"[330] to inquire about releasing music on a cartridge, while

others marketed pre-orders to determine how many cartridges to make for a physical

release.[331] These discussion forum topics demonstrated members not only sold digital

products, but also created and sold tangible products.

Figure 39. An image of a custom-made SEGA Genesis cartridge with music from several

members of chipmusic.org. Source: chipmusic.org/forums/topic/19540/preorders-live-

ym2017-genesis-compilation

Trading post. The "Trading post" subforum consisted of 2,107 topics with

20,874 total posts. Within this subforum, and across the discussion forum, members

engaged in discussions on selling,[332] buying,[333] trading,[334] requesting,[335] or giving away

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[329] chipmusic.org/forums/topic/19068/help-planning-2a03-cart-release/

[330] chipmusic.org/forums/topic/15992/getting-my-music-on-a-nintendo-cartridge/

[331] See topics such as "SEGA MEGADRIVE/GENESIS EP ON A CARTRIDGE."

[332] See topics such as "10K T-SHIRTS" and "NEW ARDUINO BOY PREORDER."

[333] See topics such as "BLIP MERCH THREAD - POST YO SHIT."

[334] See topics such as "STUFF FOR TRADE."

[335] See topics such as "I REQUIRE THE SERVICES OF A MASTER GAMEBOYSMITH."

goods or services.[336] These discussions often included pictures or videos to demonstrate current conditions or quality, as well as links to online stores or websites.[337] The majority of posts within the "Trading post" subforum appeared to focus on products and services related to the DMG. Although occurring much less frequently than other practices, some members used this space to determine market interest for a product or good:

> if I built more of these, would anyone want an LSDj Keyboard & PS/2 to DMG adapter set? What would that be worth to you?

> I remember seeing unpainted PS/2 cable replacement ones go for $50 back in the day, but I am not sure what the market rate is these days.[338]

This quote, and the aforementioned topics, demonstrates a range of transactions and marketing tactics occurred within the "Trading post" subforum.

Members who used the "Trading post" subforum followed explicit rules established by the "Chipmusic Staff" for trading, selling, or buying, as well as leaving feedback on experiences.[339] If a trade did not go as expected, members often left feedback within the original topic[340] or within a dedicated topic[341] that moderators used to compile feedback into a master list.[342] When one seller received negative reviews, they

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[336] See topics such as "FREE/PAID ARTWORK" and "CUSTOM GRAPHICS."

[337] See topics such as "ZAXXON'S CUSTOM GAMEBOYS," "[FS] TIMBOBS CHIPSHOP CLEARANCE SALE! (LOTS OF PARTS, MODDED SGB, ETC)," and "KITSCH-BENT.COM UPDATES (LATEST NEWSLETTER!)."

[338] chipmusic.org/forums/topic/7615/semicustom-lsdj-keyboards-research-thread/

[339] The "Trading post" rules are found at chipmusic.org/forums/topic/4040/trading-post-rules/

[340] See topics such as "FOR SALE: NINTENDO GAY BOY."

[341] chipmusic.org/forums/topic/4664/leave-feedback-read-first/

[342] chipmusic.org/forums/topic/140/feedback-master-list-updated-22916/

tried to improve their rating by giving away free goods in a contest.[343] This member's response to negative feedback may indicate feedback influenced the practices of a buyer or seller. Such discussions demonstrated self-regulated behavior within the "Trading post" subforum resulted from rules established by the "Chipmusic Staff,"[344] as well as community norms and expectations.

Summary of Entrepreneurial Practices

The discussion forum members of chipmusic.org discussed practices I describe as "entrepreneurial practices." The most common practice involved promoting chiptune compositions or events through various forms of media. In addition, members sold, purchased, and traded many of the aforementioned products created by members of chipmusic.org. Although these practices were evident across the entire discussion forum, there was an entire subforum with rules on such practices and the opportunity to leave seller feedback.

<div align="center">

Visual Art Practices

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Members of chipmusic.org appeared to value visual art and media practices. Within chipmusic.org, there is a "Visual arts" category with two subforums. The "Motion graphics" subforum contained 235 topics with 2,078 posts, and the "Graphics, artwork & design" subforum contained 281 topics with 5,646 posts. Within these subforums, and throughout the discussion forum, members discussed an assortment of visual art practices. I divide this theme into three practices: pixel art, video mixing, and databending. Although these practices often involved creating visual art rather than

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[343] See topics such as "RADLIB'S **FREE** OPL3 LAPTOP GIVEAWAY !! WINNERS CHOSEN !!"

[344] chipmusic.org/forums/topic/4040/trading-post-rules/

music, members frequently used these practices in conjunction with the aforementioned themes.

Pixel Art

Pixel art is a form of digital art using individual, square pixels to create artwork in a visual style based on computer and video games from the 1970s and 1980s (see Figure 40). Because chiptunes and pixel art both originate from computer and video games from the 1970s and 1980s, members sometimes described chiptunes that accompanied non-pixelated imagery as a mismatch. For example, when a member shared a live action video accompanied by chiptune music, some members responded by indicating the sound and images did not match unless they listened to the music while looking at a screenshot from a retro video game:

> If the music was accompanied by some sweet Hero Core-esque pixel action, or the movie was accompanied by some sweet dramatic action music, then It'd be cool. . . See, I just listened to the tune while staring at a screenshot of Ninja Gaiden and it was just great.[345]

Such statements demonstrate some members expected historically situated continuity between chiptune-related imagery and music or sound.

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[345] chipmusic.org/forums/topic/7783/taking-chip-to-the-next-level-or-is-it-too-much-for-the-world-already/

Figure 40. An example of DMGs as pixel art. Source:

chipmusic.org/forums/topic/489/a-pixel-art-drop-box/page/57/

Although members discussed other forms of visual art or design,[346] the word

"pixel" and its lemmas (e.g., pixels, pixelated, and pixel's) accounted for 2,228 word

tokens with an overall dispersion rate of 0.623 across the discussion forum. Not all uses

of the word "pixel" related to pixel art; however, the word "art" collocated with the word

"pixel" and its lemmas 768 times (within a ten word spread to the left or right). The word

"art" also collocated with other words such as "chiptune" (n = 79 word tokens),

"chipmusic" (n = 49 word tokens), "8-bit" (n = 28 word tokens), "8bit" (n = 19 word

tokens), "chiptunes" (n = 18 word tokens), and "fakebit" (n = 2 word tokens); however,

the word "pixel" collocates with "art" more than all of these words combined. Such data

indicate members discussed pixel art throughout the discussion forum; however, these

discussions occurred less frequently than the previously introduced themes.

Members of chipmusic.org created and shared pixel art in topics dedicated to

pixel art,[347] as artwork for album covers,[348] as aesthetic hard mods (see Figure 41), or as

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[346] See topics such as "ATTRACTIVE WATCHES" and "PHOTOGRAPHY."

[347] See topics such as "A PIXEL ART DROP BOX"

[348] See topics such as "YMCK - FAMILY SWING" and "UBI031 DANIMAL CANNON - ROOTS."

member avatars.[349] Similar to composition practices, members created pixel art through a multitude of software products, such as Microsoft Paint, GIMP, PhotoShop, etc. Discussions on pixel art demonstrate a connection between chiptunes and video game inspired imagery as a closely related artform with shared historical and technological origins.

Figure 41. An image of a DMG with a pixelated cover mod. Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/42/

Video Mixing

Within the "Motion graphics" subforum, the word "mixer" had a dispersion rate of 0.728 and tended to cluster with "video mixers"[350] or "dirty mixers."[351] A "dirty video mixer" combines two or more analog video sources into one output by using a potentiometer (knob) to switch between, or blend, both video sources. This process often

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[349] chipmusic.org/forums/members/

[350] See topics such as "SMALLEST VIDEO MIXER?"

[351] See topics such as "KARL KLOMPS AWESOME VIDEO MANGLERS."

creates glitches or distortions in the output video signal. A parallel to dirty video mixers is a crossfader on a turntable, which allows a DJ to switch between, or blend, two audio signals into a single output. Within discussions on video mixing, some members of chipmusic.org discussed using circuit-bending to create video glitches or distortions,[352] or using emulators[353] (e.g., glitchNES) to simulate circuit-bending and video mixing techniques.[354]

Members discussed or shared videos of using video mixing and circuit-bending practices during live shows.[355] These discussions demonstrated some members combined practices from various themes (e.g., maker and performance practices) with visual arts practices, which may indicate a strong connection between visual arts and chiptunes. Such connections between media and chiptune-related practices with blurred disciplinary boundaries demonstrate an example of intermedia, which are "media and media engagement that are interconnected and combine or straddle between multiple media or media forms" (Tobias, 2014, p. 107).

Databending

Within the "Graphics, artwork & design" subforum, the audio editor known as "Audacity" occurred 62 times, had a dispersion rate of 0.422, and was in the top 50 keywords with a BIC score of 117.95, indicating this program was a keyword within this subforum. Because the subforum focused on art rather than audio, this word stood out as

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[352] See topics such as "DOOMTENDO PROJECT - RELAY CIRCUIT-BENDING."

[353] See Appendix C for a definition.

[354] See topics such as "QUESTIONS ABOUT DOING LIVE VISUALS ON A NES."

[355] Watch youtu.be/fVy2pJx1x-M for an example shared on the following page: chipmusic.org/forums/topic/5914/live-footage-exchange/page/11/

peculiar. Upon further investigation, members appeared to use Audacity and other software to "databend" images to create glitchy artwork (see Figure 42).[356]

Figure 42. A databent image of a person holding a DMG. Source: chipmusic.org/forums/topic/10075/any-databenders-here/page/4/

Databending is the practice of using software not designed for image editing to create artwork by manipulating or disrupting raw data within an image file (Barness, 2015; Geere, 2010). For example, members loaded an image file as a raw data type within Audacity, edited the file using any of the audio editing techniques available, exported the file as a raw data file, then opened the new file in an image viewing program. One member described how they used the effects in a program similar to Audacity to create the image:

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[356] See topics such as "AMATEUR DATA BENDERS HERE? :O" and "ANY DATABENDERS HERE?"

Used Mac's Amadeus Pro (exactly like Audacity) for this one. I've never done this stuff, but it's actually a lot of fun!!

btw, reading this whole thread... Everything I did in Amadeus Pro (Audacity) to the Audio unit plugins, I did for a specific reason. A 16th or 32nd note delay yielded me more repeats of the chains in this picture. whole note delay didn't work so I knowingly altered it. Also, I chose the specific point in the waveform to edit specific sections of the picture. I adjusted the EQ levels in the audio units to produce the desirable 'washout' of the lady's skin.

I'd say this method is totally not random. The nobs [*sic*] and levels allow you to adjust intensities (gain, delay, feedback, high pass freq, low pass freq, etc.). Gain levels washed out the background more... a HUGE boost in gain (+20.0) totally turned half (or wherever I applied it along the waveform) the picture grey. A HUGE drop of gain (-20.0) sent it back to normal. Same theories apply to colour

saturation with the EQs, etc. It's all just learning what does what, and it's memorizable.[357]

This process of appropriating music software to create art resembles the larger chiptune practice of appropriating video game hardware and software to create music. Both practices involved creating media through an appropriation of hardware or software not originally designed for such artistic practices, which relates to much of the aforementioned scholarship about maker culture and the mod scene.

Members indicated they liked the semi-experimental nature of this approach to creating glitchy artwork: "I absolutely love the imperfection that comes with glitching up an image. Although you know what each individual effect does, there's still an excitement that comes with waiting for the image to save just to see the outcome."[358] These practices demonstrate some members of chipmusic.org engaged in experimental artwork that resembled glitches or visual distortions, and not just using pixelated imagery that resembled early video game and computer graphics. When a member used video mixing and databending practices to create these visual distortions, this artwork might be categorized as "glitch art," which is a broader category of art than databending (Mason, 2012). People create glitch art by intentionally corrupting image data or manipulating an electronic signal to generate visual distortions or errors,[359] which are practices found in both video mixing (manipulating an electronic signal) and databending (corrupting image data).

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[357] chipmusic.org/forums/topic/12708/amateur-data-benders-here-0/page/3/

[358] chipmusic.org/forums/topic/10075/any-databenders-here/

[359] More information on glitch art can be found here: en.wikipedia.org/wiki/Glitch_art

Summary of Visual Art Practices

The forum members of chipmusic.org discussed visual art practices in relation to chiptune compositions or performances, maker practices, or as a standalone practice. The most frequently discussed visual art practice is pixel art, which members used for album covers, member avatars, within aesthetic hardware modifications, or as general artwork. Members also discussed using visual art practices such as video mixing, often as imagery for live performing. Video mixing practices often included maker practices to create circuit-bent or distorted imagery. In addition, some members engaged in databending practices to create glitchy artwork.

Community Practices

I describe the final theme as "community practices," which are practices related to how members interact or communicate with each other within the discussion forum. The word "community" is borrowed from the emic use of the term to describe chipmusic.org itself. For example, the home page of the discussion forum describes chipmusic.org as

> an *online community* [emphasis added] in respect and relation to chip music, art and its parallels. We are working hard to add features that will indubitably inspire and encourage *our community* [emphasis added], but feel free to join us now as we aim to find a comfortable balance between the ethereal and nonsensical. [360]

The following sections describe collective learning, constructive criticism, collaborating, competitive events, and collective efficacy evident throughout the discussion forum. Each practice occurred frequently and were interconnected with much of the previously

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[360] chipmusic.org/forums/

introduced themes; however, I present this theme at the close of the chapter to provide sufficient context for each topic discussed.

Collective Learning

Members of chipmusic.org chose when and how to share their knowledge and understandings through tacit (e.g., sharing project files, compositions, performances, video demonstrations, etc.) and explicit means (e.g., creating tutorials, describing processes, answering questions, providing constructive criticism, etc.). When sharing knowledge and understandings with other members of chipmusic.org, I describe these practices as "collective learning," which is the practice of large groups of individuals engaging in activities that revolve around "sustained, enjoyed participation within [a] community over time" (Kafai & Peppler, 2011, p. 19). Although "collective learning" is an etic term, members occasionally referred to the community as "collective brains" when asking for help on the discussion forum: "I figured I would pick your *collective brains* [emphasis added] before shelling out, though."[361]

I might also describe the collective learning practices as collective intelligence, collective wisdom, or collective knowledge. Drawing from the work of Pierre Lévy (2000), H. Jenkins, Clinton, Purushotma, Robison, and Wiegel (2009) define collective intelligence as "the ability to pool knowledge and compare notes with others toward a common goal" (p. 4). Such a description of distributed and dispersed knowledge resembles key characteristics of affinity spaces (Gee, 2004, 2008; Gee & Hayes, 2010; Lammers, Curwood, & Magnifico, 2012), and may lead to collective wisdom when utilized over an extended period of time within a community (Gan & Zhu, 2007). As another potential descriptor for the community-based learning practices evident within chipmusic.org, Kafai and Peppler (2011) describe collective knowledge as knowledge:

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[361] chipmusic.org/forums/topic/19486/tips-on-removing-primer/

stored on the main site or with links to other off-site information (perhaps a how-to webpage) and is readily accessible to the community to have large-scale impact. Collective knowledge is also distributed among individuals, commonly separated in time and space. Knowledge usually has some institutional memory as old-timers remain in the group, and CSCL [computer-supported collective learning] Communities typically create shared artifacts to share tips with other [*sic*]. (p. 20)

Each of the aforementioned themes demonstrated discourse on collective learning. For example, asking members for assistance with using trackers to create compositions, asking for performance practice advice, asking other members how to mod a particular device, discussing and sharing source code to create new chiptune software, crowdsourcing seller feedback and event listing, or engaging in discussions on how to databend an image to create visual art were all forms of collective learning. In addition to the examples evident within each of the aforementioned themes, other examples included members asking for assistance with various projects,[362] asking for hardware recommendations,[363] software recommendations,[364] music

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[362] See topics such as "OPL2 STAND-ALONE PROJECTS?" "ARDUINO EXPERTS, SUGGEST ME A PROJECT," "MAKING A PASSIVE MIXER." "BUILDING AN ADJUSTABLE LOW-PASS/HIGH-PASS FILTER," and "GUITAR HERO SYNTH?"

[363] See topics such as "THE CHIPMUSIC DJ / STUDIO MIXER GUIDE." "MULTIMBRAL MAYHEM: A GUIDE AND LIST OF MULTITIMBRAL SYNTHS," "WHAT HEADPHONES ARE YOU USING?" "MINI MONITORS," "ZERO BUDGET SETUP?," and "BATTERY POWERED AMPS FOR BUSKING?"

[364] See topics such as "NEED SUGGESTIONS FOR WINDOWS BASED DAW," "GOOD CHIP PLUG-INS?," and "YOUR FAVORITE SEQUENCER? FAVORITE VST SYNTHS?"

recommendations,[365] identifying songs or artists,[366] identifying hardware from pictures,[367] identifying and responding to intellectual property rights violators,[368] reviewing products in the "Product reviews" subforum,[369] or even asking for members to determine an artist name for a member,[370] software name,[371] or song titles.[372] This wide range of examples demonstrates members of chipmusic.org frequently relied on the community to learn chiptune-related practices.

Constructive criticism. In addition to collective learning practices, chipmusic.org had an entire subforum dedicated to constructive criticism for the purpose of refining chiptune-related practices. The "Constructive criticism" subforum[373] contained 668 topics with 4,693 posts. Within this subforum, members shared and discussed in-progress or completed chiptunes in order to receive constructive criticism

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[365] See topics such as "WHAT ARE YOU LISTENING TO RIGHT NOW?" "WHAT PLAYS WHILE YOU WORK?" "TRANCE/PROGRESSIVE HOUSE/DNB CHIPMUSIC?" "AMBIENT/ EXPERIMENTAL CHIP MUSIC?" and "8 BIT REGGAE."

[366] See topics such as "HELP TO FIND THIS CHIP MUSICIAN?" "DOES ANYONE KNOWS THIS SONG?" "DOES ANYONE KNOW THIS SONG?" "DO YOU KNOW THIS SONG?" and "SOMEONE KNOWS THIS SONG."

[367] See topics such as "FOUND A KEYBOARD ON SOMEONE'S YARD...," "CAN SOMEONE IDENTIFY THIS MIXER?" and "HELP IDENTIFYING STUFF!"

[368] See topics such as "MUSIC THIEF ON BANDCAMP!" "THIS GIRL IS STEALING CHIPT0oNS." "YET ANOTHER RIP OFF," and "WHAT DO YOU DO WHEN YOUR TRACKS GET USED WITHOUT PERMISSION?"

[369] chipmusic.org/forums/forum/34/product-reviews/

[370] See topics such as "HELP NAME ME" and "DECIDING ON A NAME!"

[371] See topics such as "PULSAR: WHAT'S IN A NAME?"

[372] See topics such as "4 TRACKS - GAMEBOY LSDJ / TITLES?"

[373] chipmusic.org/forums/forum/28/constructive-criticism/

(abbreviated as "CC") from other members. Members within this subforum often described themselves as having little experience creating chiptunes;[374]

> I just recently started screwing around with LSDJ. Last night I made these two (very short and repetitive) tracks. I play bass and drums, so I have a pretty decent idea of composition and music theory and whatnot, but I'm a scrub at chiptune/LSDJ. Some CC would be greatly appreciated.[375]

This subforum suggests some members valued and requested feedback from other members.

When seeking feedback, members asked for constructive criticism on topics such as song structure,[376] length or repetitiveness,[377] melodies,[378] sound design,[379] audio

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[374] See topics such as "MY FIRST TRACK WITH LSDJ FOR A GAME WE'RE CURRENTLY MAKING," "NEW TO GENRE AND WOULD LIKE CC," "MY FIRST LSDJ SONG EVER," "HOW TO MAKE REALLY REALLY NOOB TRACK BETTER?" "FIRST SONG I'VE EVER POSTED. WOULD LOVE SOME FEEDBACK!" and "STARTING OUT. WOULD LIKE CRITICISM."

[375] chipmusic.org/forums/topic/16501/my-first-attempts-at-chiptune-lsdj-cc-please/

[376] See topics such as "WHAT DO YOU THINK OF THE SONG STRUCTURE IN THIS ELECTRONIC TRACK?"

[377] See topics such as "IS THIS TRACK TOO LONG-WINDED?" and "IS THIS LSDJ SONG TOO REPETITIVE?"

[378] See topics such as "NEED OPINION ON MY MELODIES" and "HOW CAN I IMPROVE THE MAIN MELODY?"

[379] See topics such as "MISSING SOME REAL SINE WAVE BASS" and "LSDJ SOUND DESIGN FEEDBACK PLEASE?"

production,[380] musical tension,[381] and other general topics.[382] Although the majority of the topics within the "Constructive criticism" subforum focused on compositions, some members asked for constructive criticism on recorded performances,[383] hardware used for live performances,[384] ASCII art,[385] t-shirt designs,[386] website designs,[387] website translations,[388] or even the definition of "chiptune" and "fakebit" on Wikipedia.[389] In addition, feedback and constructive criticism were evident throughout other subforums. The prevalence of constructive criticism suggests members valued and requested constructive criticism from other members on a variety of topics in addition to chiptune compositions.

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[380] See topics such as "LOOKING FOR MIXING TIPS ON MY LSDJ TRACKS," "PANNING AND VOLUME: HOW SHOULD THEY INTERACT?" "MASTERING THE MASTERING - HOW TO MASTER FAKECHIP SONGS?" and "WHAT DO YOU GUYS THINK OF THE MASTERING ON THIS?"

[381] See topics such as "DELIVERING TENSION PAST THE 2 MINUTE MARK!"

[382] See topics such as "I SUCK AT DRUM AND BASS, HOW CAN I IMPROVE THIS? (2XLSDJ)."

[383] See topics such as "CAN I GET SOME FEEDBACK ON THIS SET?" "VIDEO OF MY BAND, REVENGINEERS," "LIVE PERFORMANCE - PLEASE GIVE FEEDBACK!" and "A VIDEO OF MY 'LIVE PERFORMANCE'."

[384] See topics such as "ADVICE ON LIVE SET (SOFTWARE/HARDWARE)."

[385] See topics such as "ASCII ART VIDEO HELP."

[386] See topics such as "WHICH ONE OF THESE DESIGNS WOULD YOU LIKE TO SEE ON A T-SHIRT?"

[387] See topics such as "HOW CAN MY WEBSITE BE MADE MORE 8-BIT."

[388] See topics such as "NEED HELP WITH MY WEBSITE [TRANSLATION]"

[389] See topics such as "WIKIPEDIA DEFINITIONS FOR CHIPTUNE AND FAKEBIT."

Some members indicated fear of critical feedback through topics such as "NERVOUSLY REQUESTS CC..."[390] or "I'M NEW, GO EASY ON ME!!"[391] While other members specifically requested critical feedback:[392] "Please don't hold back if its garbage then please let me know, as my musical theory knowledge isn't that developed although I think I have a general understanding."[393] Within the feedback, members provided praise or constructive criticism, suggested the music would sound better with continued practice, or provided critical feedback. Members often noted the subjective nature of feedback and positioned their comments as "my opinion": "But that's just, like, my opinions, man."[394] When members gave overly critical feedback, other members often came to the defense of the original poster:

> yeah, that was an excessively harsh response to a track thats [*sic*] not bad...
> its [*sic*] a pretty simple song, but that can be good.. i think maybe a few extra
> variations on each part and a little tweaking of the instruments could make the
> difference (those square waves are maybe a little cleaner than they should be)[395]

Like the "Trading post" subforum, statements and discussions like these suggest members self-regulated the kind of feedback given when another member requested constructive criticism.

Constructive criticism is evident within other online music communities such as Mikseri.net, where members discussed, rated, and commented on each other's music

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[390] chipmusic.org/forums/topic/16936/nervously-requests-cc/

[391] chipmusic.org/forums/topic/18510/im-new-go-easy-on-me/

[392] See topics such as "DOES THIS SUCK?" and "MY FIRST CHIPTUNE TRACK."

[393] chipmusic.org/forums/topic/7126/my-first-4-tracks-ep-am-i-doin-it-right/

[394] chipmusic.org/forums/topic/14917/please-help-me-improve-0/

[395] chipmusic.org/forums/topic/14483/how-to-make-really-really-noob-track-better/

compositions and blogs (Partti, 2012). Within chipmusic.org, constructive criticism is evident throughout each theme, as members sought and provided feedback or constructive criticism on compositions, performances, software development, hard mods, or visual art. Magnifico, Curwood, and Lammers (2015) found feedback between fanfiction writers and reviewers largely consisted of a reviewer's experience with the writing rather than feedback on the writing. Lammers (2013) suggests that although some fanfiction writers want more specific feedback to improve their writing style, they also acknowledge generic praise indicates people are reading and appreciating their work. However, within chipmusic.org, feedback consisted of both generic praise and specific feedback. The type of feedback members provided is similar to scholarship about the mod scene, which indicates modders provide feedback in the form of praise and by offering suggestions (Sotamaa, 2010b).

Collaborating

The "Collaborations" subforum contained 379 topics with 8,812 posts; however, many of the posts within this subforum were requests for paid or unpaid services from other members. For example, requesting chipmusicians to create music for a game,[396] jingles,[397] intro and outro music for a podcast,[398] to perform at live events,[399] remix

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[396] See topics such as "WE NEED GREAT MUSIC FOR ONE 8 BIT HORROR GAME! - DEADLINE : OCTOBER 15" "COMPOSERS NEEDED! (OPEN UNTIL SEPTEMBER 15)," and "GAME NEAR COMPLETION - NEEDS MUSIC - MONETARY COMPENSATION."

[397] See topics such as "20 $ FOR CREATING A JINGLE WITH 4 NOTES MAX - CLOSED."

[398] See topics such as "LOOKING TO COMMISSION AN ARTIST FOR INTRO/ENDING MUSIC FOR A PODCAST."

[399] See topics such as "LOOKING FOR MORE CHIPTUNE ARTISTS [NW REGION]."

music,[400] or create pixel art.[401] Although the previous themes mentioned collaborations on software such as the "lightwall," members also collaborated on album compilations or individual chiptunes.

Compilations were albums with individual tracks from multiple members within chipmusic.org. Members proposed and created a range of compilations. For example, compilations of chiptunes no longer than one second in length,[402] songs created through databending,[403] chiptunes for holidays such as Halloween[404] and Christmas,[405] using a specific set of samples for each track,[406] a six-hour compilation of minimalist music,[407] a compilation of chiptunes based off a random article on Wikipedia,[408] compilations for

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[400] See topics such as "REMIXERS WANTED FOR CHIP-INFLUENCED GAME OST," "ANYONE UP FOR RECREATIONAL REMIXES?" and "DOES ANYONE WANT TO REMIX MY STUFF? LSDJ 3.5.1."

[401] See topics such as "PIXEL ARTIST WANTED - 16-BIT LOW COLOR STYLE," "LOOKING FOR PIXEL ARTISTS," and "ARTS FORE HIRE."

[402] See topics such as "1-SECOND COMPILATION ROUND 2" and "ONE-SECOND SONGS COMPILATION!"

[403] See topics such as ".RAW IMAGE DATA MUSIC COMPILATION!"

[404] See topics such as "ALL HALLOWS EVE IN 8BIT HELL VOL. 2," "HALLOWEEN 24HR COMPO," and "HEEBIE-GBS: HALLOWEEN COMPILATION ALBUM ON A CARTRIDGE."

[405] See topics such as "MERRY CHIPMAS 2011," "THE CHRISTMAS BEFORE NIGHTMARE COLLAB," and "CHIPMUSIC CHRISTMAS SONGS 2012 (SPEED COMPO)."

[406] See topics such as "SAMPLE PACK-BASED COMPO (MUSIC & SOUND RE APPROPRIATION ASSOCIATION)."

[407] See topics such as "OUT NOW!! NANOLOOP LONG-FORM MINIMALISM COMPILATION."

[408] See topics such as "WIKIPEDIA RANDOM ARTICLE COLLABORATION."

specific charities, [409] and many more. These examples demonstrated a wide range of compilation themes where members worked together to create an album.

Rather than compiling individual submissions from multiple chipmusicians into a compilation, some members sought to collaboratively create individual tracks with other members:[410] "Hey, I'm a rhymer and I'd love to have my rhymes set over chiptune beats. Here's me @ 120 BPM: http://soundcloud.com/mekk_pilot/warfarmer Anyone wanna collaborate?"[411] After initially using the discussion forum to find other members to collaborate with, it appears most members communicated outside of the discussion forum during their collaboration process. However, some members later posted they learned a lot through such collaborations: "I learned so much from my brief time spent working on the litewall project with him."[412] Although most of the discussions within chipmusic.org focused on online interactions, some members expressed interest in collaborating in-person:[413]

> I just moved to the Cincinnatti [*sic*] area and I don't know anyone up here and I
> would love to work on music with someone. Any kind of music, I just want to

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[409] See topics such as "BREAST CANCER RESEARCH CHARITY ALBUM [RELEASED!!!]," "CHILD'S PLAY CHARITY COMPILATION CONTEST!," and "80'S REMIX COMPO FOR CHARITY!"

[410] See topics such as "NEW STYLE OF CHIP RAP," "YUME NIKKI TRIBUTE, ANYONE?" and "YO, ANYONE WANNA COLLAB WITH ME?"

[411] chipmusic.org/forums/topic/8215/collab-with-a-rapper/

[412] chipmusic.org/forums/topic/2004/blargg-bootstrap-usb-cartridge-famicom-prototype-beta-1-built/page/15/

[413] See topics such as "CHIPTUNE ARTISTS IN NORTH CAROLINA (RDU AREA)," "ANY CDA/SPOKANE AREA MUSICIANS IN THE HOUSE?" "CHIPMUSIC COMPOSERS IN ITALY WANTED!" and "INDIANA CHIP ARTIST COLLAB."

work with someone besides myself. If you live in the area and are looking to

collaborate with anyone I am up for that.[414]

Such statements suggest some members preferred working one-on-one with another

chipmusician either online or in-person.

Collaborative practices are similar to findings by media arts coding scholars, who

found youth learned about programming through social participation (Peppler & Kafai,

2007a), as well as mod team scholars, who found modders worked together on complex

projects (Jansz & Theodorsen, 2009; Sotamaa, 2010b). However, discussions on

collaboration occurred less frequently within chipmusic.org than discussions on

collective learning, which aligns with findings on a video game discussion forum

(Steinkuehler & Duncan, 2008). In addition, both participation in chipmusic.org and

collaborations with other members were voluntary, which is a characteristic among

virtual communities (V. Miller, 2011), digital music cultures (Partti, 2012), and affinity

spaces (Gee, 2004, 2008; Gee & Hayes, 2010). Such a characteristic differs from

formalized educational spaces that mandate the ways people collaborate or engage with

music.

Competitive Events

Members occasionally created what they referred to as "challenges" or

"competitions" for other members of the discussion forum. Members who created such

competitive events articulated a set of rules for other members to follow (see Figure 43).

Lammers (2013) indicates contests and community activities within an affinity space are

examples of pedagogic discourse as they establish valued knowledge and skills that are

reinforced through a challenge. Meaning, competitions can indicate what practices are

valued within a place or space.

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[414] chipmusic.org/forums/topic/13071/chip-in-cincinnatti-ohio/

Within chipmusic.org, competitive events included making pixel art[415] or music[416] in under 48 hours, remotely participating in a music or art competition hosted at a live event,[417] creating music for a given theme in under two weeks,[418] or asking members to challenge them to write music while they are sick in bed.[419] Another, similar practice referred to as "battling" involved members competing in a judged competition based on a given theme.[420] Competitive events occurred significantly less frequently than most of the other community practices. These competitive events demonstrate some members appeared to enjoy engaging in creative challenges or competing with other chipmusicians for recognition or status, rather than making music solely for oneself.

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[415] See topics such as "48HR PIXEL ART CHALLENGE: ILKKE'S TURN!"

[416] See topics such as "48 HOUR CHALLENGE ME - VOL. 3 FINISHED" and "48 HOUR CHALLENGE [NICKMAYNARD ACCEPTED]."

[417] See topics such as "REALTIME MUSIC COMPETITION ON CHAOS CONSTRUCTIONS 2016"

[418] See topics such as "THE NEW BI-WEEKLY COMPETITION THREAD (ENTER #10 NOW!)."

[419] See topics such as "I'M ACCEPTING CHALLENGES![STARTED THE RNBWDRGNEYES ONE]."

[420] See topics such as "::VOTE FOR THE FINAL BATTLE :: SASKROTCH'S WEEKEND BATTLE CHALLENGE" and "CHIPTUNE BATTLE CHALLENGE."

Here's my proposed reorganization for the rules:

1. The challenge passes from the last person who made a picture to the next person. IE, if you were the last person to complete a challenge you get to pick the next person/topic/restrictions.
2. You must pick from someone who has expressed interest in being picked. Preferably in the order requested in this thread.
3. Upon completing the challenge, post the picture here.
4. You have 48 hours from when you see you've been challenged to get it done.
5. When you challenge someone, you MUST put out a public post here, as well as a PM just in case he doesn't see this thread.
6. If the person being challenged takes more than 24 hours to acknowledge that he's seen the challenge, the challenger can pick another and/or change the type of challenge.
7. You can't get picked to do another challenge unless there is nobody waiting to do one.

NEW RULE: If you can't do it properly you can pass and the challenger gets to pick someone else.

Figure 43. Rules for the 48-hour pixel art challenge. Source:

chipmusic.org/forums/topic/522/48hr-pixel-art-challenge-ilkkes-turn/

Collective Efficacy

Bandura (1997) describes collective efficacy as "a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce given levels of attainment" (p. 477). A group's knowledge and competencies, structure and activities, leadership, and level of interaction contribute to their collective efficacy (Bandura, 1997, p. 478). Members engaged in discursive acts of collective efficacy within chipmusic.org. Although anyone could register with chipmusic.org through free membership and participate within the discussion forum, moderators enforced the forum rules[421] that community members agreed to follow when they signed up for membership. However, members could debate or seek clarification of rules within the "Rules & announcements" subforum (19 topics with 515 posts). For example, when moderators added a new rule about discriminatory speech, they encouraged members to ask questions if anyone needed clarification: "This should be fairly self explanatory but if

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[421] chipmusic.org/forums/topic/21/forum-rules/

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anyone wants clarification please ask."[422] A member responded asking if moderators considered it insensitive to use "gays as an euphemism for lame,"[423] which led to members and moderators engaging in dialogue about the question. In some instances, moderators altered or reversed their original decisions based on discussions with members.[424] Throughout discussions like these, it is clear moderators had the power to create and enforce rules within the space; however, it is also clear that members discussed or questioned these rules.

In addition to questioning rules, members could provide feedback and propose community features within the "Bugs and requests" subforum (293 topic with 3,197 posts). For example, the aforementioned request for a function that allowed members to ignore selected members,[425] or proposing the ability to rate or rank music posted on chipmusic.org.[426] Although moderators considered each feature request, they also had to account for other factors such as the cost to host files.[427] Both the ability to question and challenge rules that were enforced by members and moderators of the community, and the ability to propose expanding or limiting modes of participation within the discussion forum, are forms of collective efficacy. In addition, these subforums suggest chipmusic.org was continually developing and adapting in response to the people who participated within the space.

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[422] chipmusic.org/forums/topic/9480/new-rule-regarding-discriminatory-speech/

[423] chipmusic.org/forums/topic/9480/new-rule-regarding-discriminatory-speech/

[424] See topics such as "CUSTOMIZED GEAR THREAD."

[425] See topics such as "USER IGNORE FUNCTION."

[426] See topics such as "POPULARITY CONTEST."

[427] See topics such as "POSSIBLE NEW RULE: MUSIC SECTION- NUMBER OF SONGS LIMITATION."

Summary of Community Practices

The discussion forum members of chipmusic.org frequently engaged in practices I describe as "community practices." Members of chipmusic.org engaged in collective learning to work together to answer questions and solve problems related to each of the aforementioned themes. This practice was a key practice utilized throughout discussion forum discourse within chipmusic.org. Other community practices included providing feedback through constructive criticism or collaborating with other members of chipmusic.org. Although not as frequent as some of the other community practices, some members created and engaged in competitive events for a variety of the aforementioned themes. Lastly, the moderators and members of chipmusic.org engaged in collective efficacy that shaped the discussion forum as a whole.

Chapter Summary

I began this chapter with an overview of the discussion forum within chipmusic.org. Although the subforum was divided into 24 subforums within one of four categories, members discussed chiptune-related practices across and within each subforum. I grouped a multitude of interconnected practices within seven themes and provided example topics or excerpts of discussion forum posts for each theme (see Table 5 at the conclusion of this chapter).

Of the chiptune-related practices presented in this chapter, members discussed composition practices most frequently. Composition discourse tended to revolve around discussing using trackers and DAWs to create compositions and chiptune appropriations, engaging in sound synthesis and reverse engineering, and discussing composition concepts and tools. In addition to composing, members of chipmusic.org discussed live, streamed, or recorded performance practices that often used video game and computer hardware to perform live chiptunes. In order to improve video game and computer hardware audio quality for recording and performing, members engaged in

practices I describe as "maker practices" to modify, manufacture, or build chiptune-related hardware with improved audio quality or effects capabilities; however, some members engaged in maker practices for aesthetic or experimental purposes. The coding practices theme introduced how members discussed modifying or developing chiptune-related software for existing or newly manufactured chiptune-related devices. Throughout each of the aforementioned themes, members often engaged in practices I describe as "entrepreneurial practices," where members promoted and marketed chiptune-related media, events, services, or merchandise. The visual art practices theme introduced how members discussed incorporating pixel art, video mixing, and databending in chiptune-related practices. I describe the final them as "community practices," which presented discourses with peer-to-peer assistance, feedback, collaboration, or competitive events, as well as collective efficacy that may have influenced how and what people discussed within the discussion forum. Although each of the themes were interconnected in varying degrees, community practices occurred throughout all of the aforementioned themes.

Table 5

An outline of the seven themes with corresponding subthemes

Theme	Subthemes

Composition practices	Chiptune appropriations
	    Sample-based producing, covering and arranging, remixing, mash-ups, and commenting and discussing
	Sound synthesis
	    Reverse engineering
	Composition concepts and tools
	    Western staff notation and music theory
	Fakebit

Performance practices	Using a Game Boy as a performing instrument Live performing Recording performances for streaming Performing with acoustic and electronic instruments Discourse on performance practices

Maker practices	Hard mods
	    Aesthetic mods
	    Functionality mods
	        Electrical engineering practices
	            Circuit-bending and soldering
	    Perspectives on modding
	    Learning how to mod
	Manufacturing or building new devices

Coding practices	Soft mods Source code Software development Learning how to code
Entrepreneurial practices	Promoting Selling, buying, and trading
Visual art practices	Pixel art Video mixing Databending
Community practices	Collective learning Constructive criticism Collaborating Competitive events Collective efficacy

CHAPTER 5

MULTIDISCIPLINARITY ACROSS REVEALED PRACTICES

The seven broad themes presented in Chapter Four provide examples of members of chipmusic.org discussing music-centered making. While the organizational structure in Chapter Four presents each theme and subtheme within a compartmentalized discussion, each of the aforementioned practices were interconnected. For example, many members created pixelated album artwork (visual arts practices) for chiptunes (composition or performance practices) created by using modded DMGs (maker practices), which members often promoted and marketed in the "Releases" subforum (entrepreneurial practices). In this chapter I discuss the interconnected nature of these practices by answering research question two: What do chipmusic.org discussion forum posts reveal about the multidisciplinary aspects of chiptunes?

Multidisciplinarity and Music-centered Making

The themes outlined within Chapter Four broadly demonstrate engagement across several academic disciplines or fields of study. For example, (a) the composition and performance practices are music practices; (b) maker and coding practices broadly draw from the fields of computer science and STEM (Science, Technology, Engineering, and Math), and related scholarship on maker culture and mod culture; (c) entrepreneurial practices incorporate business and marketing practices; (d) visual art practices appropriate graphic and media arts practices; and (e) community practices relate to scholarship on informal learning within communities of practices and affinity spaces. Members often appeared to merge or blur disciplinary boundaries when discussing chiptune engagement within and across forum topics. Such engagement resemble scholarship on maker culture, which often investigate informal spaces with practices that merge or blur disciplinary boundaries.

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Sheridan et al. (2014) posit makerspaces and maker culture "support making in disciplines that are traditionally separate" (p. 526). Maker culture scholars often describe maker practices as "multidisciplinary," where makers "mess around at the crossroads and fringes of disciplines such as science, technology, engineering, art, and math" (Brahms & Werner, 2013, p. 1). Although I do not classify chipmusic.org as a makerspace, the discourse on multidisciplinary practices within maker culture serves as a framework for exploring music-centered making evident within the discussion forum of chipmusic.org. In Chapter One I defined *multidisciplinary practice*s as the practices and ways of knowing that blur disciplinary boundaries and referred to the ways people engage in multidisciplinary practices for music-related purposes as *music-centered making*. The remainder of this chapter describes the potential for multidisciplinarity to occur across the music-centered making discussed within chipmusic.org and questions the role of music within such practices.

Multidisciplinarity Evident within A Single Topic and Replies

Individual discussion forum topics and their replies can demonstrate multidisciplinarity. For example, in Chapter Four I described a discussion forum topic[428] about a piece of software known as "lightwall" that was collaboratively developed by members of chipmusic.org. Within this topic, members discussed engagement with varied practices involving the development and use of the software. When a member initially proposed the topic, members who replied engaged in collaborative practices (community practices) to discuss, write, and debug code (coding practices). When the software was released, members posted pictures of themselves performing with the software, which demonstrates the interconnected nature of this software with both performance practices and visual arts practices. In addition, members engaged in a form

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[428] chipmusic.org/forums/topic/1714/Project ideas-concept-for-vj-oriented-nes-rom/

of collective efficacy (community practice) when they discussed whether it was considered appropriate to create swastikas with the software.[429] This single discussion forum topic and subsequent replies included discussions on practices from several themes: (a) performance practices, (b) coding practices, (c) visual art practices, and (d) community practices. In addition, based on other discourses throughout the discussion forum, members also likely performed with modded DMGs (maker practices) or triggered precomposed works during a live performance (composition practices). However, such practices were not overtly discussed in this example topic.

Multidisciplinarity Evident within a Single Post

In addition to demonstrating multidisciplinarity across and within discussion forum topics, individual discussion forum posts can also demonstrate multidisciplinarity. For example, in Chapter Four I described how one of the members released their project files with their album to share "information, tricks, and ideas."[430] This single post demonstrated (a) entrepreneurial practices when the member promoted and sold their album, (b) composition practices when the member mentioned using LSDJ to compose original music and cover Beethoven's "Moonlight Sonata," (c) performance practices when the member played electric guitar for some of the tracks, (d) visual art practices because the album's cover was a pixelated tree with roots,[431] and (e) community practices as the member released the album's project files so other members could learn from them.

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[429] chipmusic.org/forums/topic/1714/lightwall-concept-for-vj-oriented-nes-rom/page/16/

[430] chipmusic.org/forums/topic/5552/ubi031-danimal-cannon-roots/

[431] See the following link for a video of the artist creating the album cover: youtu.be/i2UlLOHGtVE

The aforementioned example demonstrates five themes within a single post. However, what's not stated is the post also likely relates to maker and coding practices. For example, the member may have used a modified DMG (maker practices) to compose and record the music, as an unmodified DMG's audio signal is too low for quality recordings. In addition, the member mentions using LSDJ to compose music, which is software created by another chipmusician in the chipscene (coding practices). Although these two themes were not overtly stated in the post, these practices likely influenced the creation of the album. Regardless, this single topic demonstrates several themes.

Multidisciplinarity Evident within a Single Image

In addition to demonstrating multidisciplinarity through text, members shared imagery that also demonstrates multidisciplinary practices. For example, Figure 44 demonstrates practices across multiple themes within a single image. The discussion forum member who modded this DMG added prosound, backlight, and case mods (maker practices). The case mod is also an example of pixel art, which demonstrates a visual art practice. In addition, the screen appears to display a tracker interface, which suggests composition practices, or performance practices if using a live performance mode. As with the previously discussed example, the use of trackers also broadly demonstrates the influence of coding practices, as trackers were developed by members of the chipscene; however, it is unknown whether the member who posted this picture engaged in coding practices to modify or create their own tracker interface. Although the member who posted this picture discussed these and other practices separately within related discussion forum topics (e.g., topics on installing a backlight,[432] adding a

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[432] chipmusic.org/forums/topic/10968/backlights/

prosound mod,[433] seeking constructive criticism on compositions,[434] and releasing an EP under a "pay what you want" model[435]), this image demonstrates the potential for multidisciplinarity across music-centered making.

Figure 44. An image of a DMG that demonstrates multiple practices from different themes. Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/42/

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[433] chipmusic.org/forums/topic/11069/a-few-questions-about-jacks-for-use-with-prosund-mod/

[434] chipmusic.org/forums/topic/12370/feedback-on-various-things-please/

[435] chipmusic.org/forums/topic/19185/myexplosion-rampant-ep/

Questioning the Role of Music in Multidisciplinary Practices

When engaging in hard mod practices (i.e., hardware modification practices), members of chipmusic.org might primarily engage in electrical engineering practices for the purpose of achieving a music-related outcome (e.g., increasing the quality of sound on a DMG with a prosound mod). Hard mod practices such as these may disproportionately center around electrical engineering practices (e.g., using soldering practices to modify a device) rather than practices typically found in music education contexts (e.g., composing and performing). Although some members of chipmusic.org indicated these practices were part of the music making experience, some educators might question where these practices might occur within an educational context. For example, the collaboratively developed "lightwall" software demonstrated how members discussed coding practices more than typical music practices such as composing and performing. However, the topic also demonstrates such practices were for music-related purposes (i.e., adding visuals to enhance live performances). Music-centered making such as these practices could occur within either a music education or computer science context; however, members were able to oscillate between practices at will rather than being siloed into engagement within a particular time, space, or curricular focus.

Rather than focusing on which academic discipline or field of study a chiptune-related practice might occur, maker culture scholars might suggest embracing music-related practices that "mess around at the crossroads and fringes of disciplines" (Brahms & Werner, 2013), and that multidisciplinarity encourages engagement and innovation (Sheridan et al., 2014). It is because (a) each theme described within this study revolves around discussing music practices (i.e., chiptune-related practices) or culture (i.e., the chipscene), and through (b) the aforementioned scholarship about maker culture and the mod scene (see Chapter Two), that I framed the chiptune-related practices within chipmusic.org as "music-centered making." Although the practices discussed within this

study drew from different disciplines, each practice centered around chiptunes and chiptune culture. In other words, regardless of which academic discipline or field of study such practices typically occur, the practices evident within chipmusic.org were in some way connected to music making. The multidisciplinary nature of such practices raises questions about how and where such practices might occur within formalized educational contexts, as well as who might facilitate such practices. In Chapter Six, I address these questions by discussing whether such practices might occur within music or computer science classes, an interdiscipline, or a transdisciplinary context.

Chapter Summary

This chapter addressed research question two ("What do chipmusic.org discussion forum posts reveal about the multidisciplinary aspects of chiptunes?") by providing selected examples of the interconnected nature between each theme discussed in Chapter Four. While individual discussion forum topics tend to focus on a limited number of practices pertaining to a particular practice or question, members of chipmusic.org can demonstrate multidisciplinarity across and within discussion forum topics, posts, and media. In the following chapter I discuss the implications of these findings for music educators who are interested in music-centered making that merges or blurs academic disciplines or fields of study.

CHAPTER 6

IMPLICATIONS

Introduction

My interests in this study were born out of an unyielding desire to explore and question the boundaries of music making and learning. These interests have led me to simultaneous careers in music education and computer science education, where I continue to explore the blurred boundaries between the arts and computer science. With this study, I explored both personal and professional interests in music making and learning that merges or blurs practices from multiple academic disciplines or fields of study. I identified chiptunes as a music genre and medium with potential for such multidisciplinary practices. Findings in this study exceeded my expectations and challenged my own understandings of music education practices.

This chapter explores the implications of this study's findings by addressing the third research question: What import might music-centered making evident within chipmusic.org discussion forum posts hold for music education? I begin with a discussion on the difficulty I had with searching for a framework that might assist with making sense of music-centered making and follow with discussions on implications for the field of music education. Throughout this chapter, I refer to teachers, facilitators, instructors, or leaders of a music education context as "music educators" and refer to students, musicians, members, or participants of a music education context as "learners."[436]

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[436] I do not intend for this distinction to suggest "an inequality between those who have learned and now know, can, or are, and those who still need to learn in order to know, be able, or be" (Biesta, 2010, p. 541). This distinction implies the broader roles within a music education context rather than an assumption there needs to be an intervention for learning to occur.

Searching for a Framework

Generally speaking, K-12 music education practices and curricular offerings in the United States have not developed in parallel with music making and learning practices found outside of typical K-12 contexts (Clements, 2016; Kratus, 2007; D. A. Williams, 2011). Although some music educators encourage developing music curricula or practices in tandem with music making and learning outside of K-12 contexts (Allsup, 2011; Bledsoe, 2014; Bolden, 2014; Clements, 2016; Kratus, 2007; Tobias, 2013; D. A. Williams, 2011), many of the practices described in chiptune-related scholarship (e.g., circuit-bending), and found within this study (e.g., maker, coding, and entrepreneurial practices), are atypical for music education discourse. The following paragraphs describe some of the scholarship that informed my thinking about chiptune-related practices and music-centered making.

While preparing the proposal for this study I spent several years struggling with finding a framework and vocabulary for describing the diverse practices discussed across chiptune-related scholarship. My initial framing of the potential practices cited scholarship about curricula, with a focus on interdisciplinary music curricula, perspectives, and frameworks. For example, scholarship with general discussions and critiques of interdisciplinary curricula and learning (e.g., J. Barrett, 2016; Bresler, 2002; Burton, 2001; Campbell, 1995; Ellis & Fouts, 2001; Friman, 2010; Gardner & Boix-Mansilla, 1994; Snyder, 2001; J. Wiggins & R. Wiggins, 1997; R. Wiggins, 2001) assisted with understanding various stakeholders' perceived affordances and constraints of such experiences. These perspectives informed how I discuss the implications of music-centered making later in this chapter.

Some music education scholars suggest engaging in interdisciplinary connections that inform and enhance multiple academic disciplines by using a facets model that encourages exploration of musical works from varied perspectives (facets) through

inquiry-based engagement (J. Barrett, 2001; J. Barrett, McCoy, & Veblen, 1997; J. Barrett & Veblen, 2012). Such a framing of musical works informed my own understanding of chiptunes, as I analyzed the practices discussed within chipmusic.org from multiple perspectives. For example, I used scholarship from the mod scene and maker culture to make sense of music-related practices discussed within chipmusic.org.

In addition to thinking through the potential facets of music-related practices, scholarship that investigated interdisciplinary collaborations between educators with expertise in different academic disciplines also informed my understanding of practices discussed within chipmusic.org. Examples of such connections and collaborations between academic disciplines include scholarship on liberal arts and engineering (Connor, Karmokar, & Whittington, 2015), music and biology (Carrier, Wiebe, Gray, & Teachout, 2011), music and visual art (Kite, 1994), music and the digital arts (Savage, 2005), music and engineering (Culbertson et al., 2009; Kim et al., 2011), the arts and computer science (Martin et al., 2009), dance and computational thinking (Leonard et al., 2015), and music and computational thinking (J. Bell & T. Bell, 2018; Greher & Heines, 2014; Heines, Greher, & Kuhn, 2008, 2009; Heines, Greher, Ruthmann, & Reilly, 2011; Heines, Jeffers, & Kuhn, 2008; Ruthmann, Heines, Greher, Laidler, & Saulters II, 2010). While most of the aforementioned examples demonstrate a connection between two academic disciplines, Burrack and McKenzie (2005) describe connections between multiple disciplines such as music, art, poetry, literature, and history. In addition to interdisciplinary engagement within a single class or project, J. Jenkins (2008) demonstrates interdisciplinary connections and collaborations can occur across an entire school, and Madden et al. (2013) describe an interdisciplinary undergraduate degree.

Each example of interdisciplinary curricula demonstrates potential connections between two or more academic disciplines and helped me better understand potential

connections between music and other academic disciplines. However, these reflections, perspectives, and frameworks investigate or describe interdisciplinary experiences within formalized education contexts rather than practices within an informal space and without formalized curricula or standards. In addition, the aforementioned scholarship tends to develop interdisciplinary practices and connections for academic purposes rather than observing interdisciplinary practices created and used by (sub)cultures outside of formalized educational contexts. Because the aforementioned scholarship did not describe practices developed by people within informal spaces like chipmusic.org, but instead created interdisciplinary practices for academic purposes, I found it inappropriate to use scholarship on interdisciplinary curricula as a lens for analyzing chiptune-related practices that existed outside of formalized educational contexts.

During the process of thinking through and writing the proposal for this study, I also read scholarship about informal learning spaces and online music spaces to try and find scholarship that investigated practices evident within informal, online spaces. However, the scholarship about informal learning spaces and online music spaces I reviewed and discussed in Chapter Two did not investigate or address the potential for blurred boundaries within music making and learning practices. Rather, such scholarship tended to investigate who participated in online spaces and how they worked together as an online community. Neither scholarship about interdisciplinary curricula or scholarship about online music spaces appeared to provide a sufficient framework or vocabulary I could use to address the research questions of this study.

As I continued to search for relevant literature, I sought scholarship on music subcultures that might include some of the practices discussed in chiptune-related scholarship. For example, scholarship about music technology (e.g., A. King & Himonides, 2016) and digital musicianship (e.g., Hugill, 2008) appeared to provide vocabulary for understanding composing and performing with DAWs. Although music

technology and digital musicianship practices can resemble chiptune practices, scholarship on such practices did not explore the potential for blurred boundaries between music and other academic disciplines outside of music technology. In other words, scholarship on music technology and digital musicianship were useful for understanding some of the composition and performance practices discussed within chipmusic.org, but not as useful for describing many of the maker, coding, entrepreneurial, visual art, and community practices discussed within Chapter Four.

O'Leary and Tobias (2016) describe how some people participate in music and sound cultures within, through, and around video games. To discuss such participation, O'Leary and Tobias initially drew upon scholarship about different kinds of participatory cultures. For example, scholarship on media studies (Ito et al., 2010; H. Jenkins et al., 2009), live music participation (Turino, 2008), relationships between people and engagement within participatory cultures (Schäfer, 2011), and the "intersections among gameplay musical experience, and theatrical performance" (K. Miller, 2012, p. 5). Although these frameworks were useful for discussing some of the ways people engage with video game music, O'Leary and Tobias (2016) indicate these frameworks were inadequate for describing the variegated ways people engage with music and video games, including some of the chiptune practices discussed within this study. My experiences with writing that chapter demonstrated that although no single framework could account for all of the ways people engage with video game music, a combination of several frameworks was useful for describing such engagement.

Of the research that informed the proposal for this study, research on the mod scene and maker culture (see Chapter Two) provided the closest match for the potential breadth of informal practices discussed within chipmusic.org. Makers and modders often discuss practices within informal and online spaces, and the practices themselves appear to resemble many of the practices discussed within Chapters Four and Five.

However, neither scholarship about the mod scene or maker culture account for the interconnected music practices evident within this study. Maker culture scholars, however, frequently discuss blurred disciplinary boundaries (i.e., multidisciplinary practices) that resemble the interconnected practices discussed within Chapters Four and Five. Because maker culture scholars describe many of the kinds of practices evident within chiptune literature as well as the potential for blurred disciplinary boundaries within informal spaces, I primarily draw from scholarship about maker culture to describe chiptune practices as "multidisciplinary" rather than drawing from curriculum scholarship (see J. Barrett, 2016; Burton, 2001; Friman, 2010; Gardner & Boix-Mansilla, 1994) to describe the practices as "interdisciplinary," "transdisciplinary," or as an "interdiscipline."

Although useful for my own thinking and learning, the aforementioned scholarship did not appear to provide a way for thinking through or analyzing both the practices discussed within informal, online spaces such as chipmusic.org, as well as the practices evident within scholarship on the chipscene. Considering the chipscene exists outside of formalized educational structures and practices, it makes sense that scholarship on formalized education might not relate to practices evident within chipmusic.org. In addition, because the notion of disciplinary boundaries largely exists within academic discourse and practice, it also makes sense that scholarship on music subcultures and engagement within informal spaces do not investigate the potential interconnected nature between music practices and practices typically associated with other academic disciplines. Rather than drawing upon a single framework or set of scholarship to make sense of this study's findings, I use a combination of scholarship to not only make sense of the findings discussed in Chapters Four and Five, but to discuss implications within the following sections.

Music-centered Making

Spaces such as chipmusic.org might provide examples of diverse music practices that can occur when people appear to make music without consideration of disciplinary boundaries. For example, Chapters Four and Five describe music-centered making that drew from several academic disciplines or fields of study (e.g., music, electrical engineering, computer science, entrepreneurship, and art). In the following sections, I discuss implications of music-centered making.

Null Curricula and Music-centered Making

Eisner (2002) suggests curricular discourse can define not only the kinds of experiences a learner engages in within formalized learning contexts, but how a learner thinks about such experiences and topics:

> When policymakers and educational theorists define a curriculum for a school or a classroom, they are also defining the forms of thinking that are likely to be promoted in the school. They are, in effect, laying out an agenda for the development of mind. (p. 148)

The musical concepts, practices, and understandings promoted within a music curriculum or program can shape not only how a learner thinks about music, but the ways a learner engages with music in such contexts. Although it is impossible to include all music-related concepts, practices, and understandings within any given music curriculum or program, what is left out of a curriculum can also impact how learner's engage with music within formalized educational contexts. Eisner (2002) and Schubert (2008) refer to the concepts, practices, or understandings absent from curricula as the "null curriculum."

In addition to the potential for curricular discourse to impact the forms of thinking within schools, discourse from district, state, and national standards can impact the development and implementation of curricula within formalized learning contexts.

For example, many districts and states align curricula with the National Core Arts Standards,[437] which forwards a particular set of musical concepts, practices, and understandings. An alignment between the national standards and music curricula can influence the kinds of music engagement (un)available to learners.

Consider the implications of null curricula within the following example: the National Core Arts Standards categorizes eleven anchor standards within one of four artistic processes (see Table 6). Where might the music-centered making practices discussed throughout this study fit within these artistic processes and their related anchor standards? For example, if a person modifies a DMG by bypassing the internal amplifier to obtain an audio signal with less noise (unwanted audio signals or interference), are these practices considered an act of "creating" because a person is "refining" (e.g., anchor standard three) a DMG? Or, would it become an artistic process when a person composes (e.g., anchor standard one) or performs (e.g., anchor standard six) with the modded DMG? When might we consider each of these processes (i.e., modding, composing, and performing) as forms of creating? The specifically worded music technology performance standard MU:Cr1.1.T.IIIa indicates the refining practices in music technology involve "develop[ing] and implement[ing] varied strategies and apply[ing] appropriate criteria to improve and refine the technical and expressive aspects of *draft compositions and improvisations* [emphasis added]";[438] in other words, no, the question above about modding a DMG is not considered an act of creating through refinement because the practices do not involve modification of a draft composition or improvisation.

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[437] www.nationalartsstandards.org/

[438]
www.nationalartsstandards.org/sites/default/files/Music%20Tech%20Strand%20at%20a%20Glance%204-20-15.pdf

Table 6

National Core Arts Standards artistic processes and anchor standards

Creating

#1 - Generate and conceptualize artistic ideas and work.
#2 - Organize and develop artistic ideas and work.
#3 - Refine and complete artistic work.

Performing/Presenting/Producing

#4 - Select, analyze and interpret artistic work for presentation.
#5 - Develop and refine artistic techniques and work for presentation.
#6 - Convey meaning through the presentation of artistic work.

Responding

#7 - Perceive and analyze artistic work.
#8 - Interpret intent and meaning in artistic work.
#9 - Apply criteria to evaluate artistic work.

Connecting

#10 - Synthesize and relate knowledge and personal experiences to make art.
#11 - Relate artistic ideas and works with societal, cultural and historical
        context to deepen understanding.

To further problematize the relationship between music-centered making and the

National Core Arts Standards, consider how each of the above artistic processes and

anchor strands divide into the following categories: (a) dance; (b) media arts; (c) music;

(d) music: harmonizing instruments; (e) music: composition and theory; (f) music:

traditional and emerging ensembles; (g) music: technology; (h) theatre; and (i) visual

arts. Based on the discourse within chipmusic.org, would chiptune compositions fall into

the category of "music: technology" because members used trackers and DAWs to create

music or "music: composition and theory" because members composed music and

applied music theory concepts? Are chiptune performances an example of "music:

harmonizing instruments" because some members accompanied their chiptune

compositions with instruments such as electric guitars or are such performances

considered "music: traditional and emerging ensembles" because members sometimes

created small "bands" to perform live shows? If a chiptune band engaged in video mixing

practices during a live performance, is this an example of "media arts," "visual arts,"

"music: technology," "music: traditional and emerging ensembles," or a combination of several categories? Such questions about the standards demonstrate music-centered making is not easily categorized within the national standards.

I posit many of the practices discussed within this study are either not evident or not easily categorized within the artistic processes or anchor standards in the National Core Arts Standards. However, some of the members of chipmusic.org indicated such practices were "part of the enjoyment of making music on Game Boys."[439] This contrast between practices that some members of chipmusic.org considered a part of the music making experience and the discourse within the National Core Arts Standards demonstrates null curricula. In other words, many of the forms of music-centered making discussed in Chapter Four demonstrate null curricula through their absence within the musical concepts, practices, and understandings forwarded by the national standards.

Curriculum and standards developers interested in designing more comprehensive or inclusive curricula might consider using language that is broad enough to incorporate the interconnected practices discussed in Chapters Four and Five. For example, changing the words "draft compositions and improvisations" to "musical artifacts" in the previously stated music technology performance standard could broaden the standard to account for the refinement of musical practices outside of composing and improvising: "develop and implement varied strategies and apply appropriate criteria to improve and refine the technical and expressive aspects of [musical artifacts]."[440] Or, instead of using the narrowly defined performance standards, curriculum developers

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[439] chipmusic.org/forums/topic/10193/pay-for-a-dmg-mod-or-do-it-yourself/page/2/

[440] www.nationalartsstandards.org/sites/default/files/Music%20Tech%20Strand%20at%20a%20Glance%204-20-15.pdf

might align with the anchor standards (e.g., "Refine and complete artistic work"),

enduring understandings (e.g., "Musicians' creative choices are influenced by their

expertise, context, and expressive intent"), and essential questions (e.g., "How do

musicians improve the quality of their creative work?") listed above each performance

standard.[441] Although the current framing of the national standards might not include or

enable some of the music-centered making discussed within chipmusic.org, such

practices could occur within formalized educational contexts that combine concepts,

practices, and understandings from multiple academic disciplines.

Chiptunes as Interdiscipline

In Chapter Five I discussed how some educators might question how and where

interconnected forms of music-centered making might occur within formalized

educational contexts, as well as who might facilitate them. Although I suggest music-

centered making could occur within music education contexts and curricula with

language broad enough to incorporate such practices, some curriculum scholars might

describe chiptunes as a potential "interdiscipline." Friman (2010) describes an

interdiscipline as a synthesis of disciplinary perspectives and practices. In other words,

an interdiscipline is the result of merging two or more disciplines to create a new

discipline. However, an interdiscipline's boundaries differ from typical disciplinary

boundaries "in that it is open to boundary crossing and alternative framings of specific

issues" (Friman, 2010, p. 15).

The variegated practices evident within chipmusic.org and across the chipscene

could demonstrate the potential for chiptunes as an interdiscipline that synthesizes

practices from several academic disciplines or fields of study. In particular, this study

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[441]
www.nationalartsstandards.org/sites/default/files/Music%20Tech%20Strand%20at%2
0a%20Glance%204-20-15.pdf

demonstrates discussions on chiptune engagement synthesize music, electrical engineering, computer science, entrepreneurship, and visual art practices. Rather than questioning which academic disciplines chiptune engagement might occur in, chiptune practices could become an interdiscipline that combines concepts, practices, and understandings from multiple academic disciplines. To illustrate this point, the following paragraphs highlight the potential for chiptunes as an interdiscipline of music and computer science.

In [Chapter Four](#), one member indicated they could create chiptune trackers but were not good enough to compose music, which might suggest the practices and understandings used to create a tracker do not demonstrate an interdiscipline between computer science and music. However, I assert this person would need to understand both music and computer science concepts to create trackers for composing music and that such practices might demonstrate an interdiscipline. Consider a simplified example of what a person would need to know to enable user-controlled volume within a tracker. From a music education perspective, a person would need to understand that sounds and music can change volume, and they might label that concept "dynamics," "volume," or even "amplitude." From a computer science perspective, a person would also need to understand that a symbolic label can keep track of a value that changes through user interaction, and they might label that concept a "variable." Without understanding that volume can change (music education concept) and that a variable that represents the numeric value of the volume can change through user interaction (computer science concept), a person would be unable to create this simple interface. This simplified example demonstrates a person would apply concepts from both disciplines to enable user-controlled volume within a tracker.

My assertion that a person would need to understand concepts from both academic disciplines is based on my own experiences in computer science education and

music education, Peppler and Kafai's (2005) finding that media arts coding platforms "establish a greater connection to the arts in general" (p. 5), as well as Shaked's (2013) finding that an integration of music and computer science led to better understanding of music and coding; "study participants have acknowledged that their concurrent engagement has occasionally informed their thinking and learning paradigms at work" (p. 321). Further investigation of the apparent nexus between computer science and music may provide another example of what Rich, Leathman, and G. Wright (2013) refer to as convergent cognition: "the synergistic effect that occurs when a learner studies two complementary subjects" (p. 431). The following paragraphs provide an example of the complementary nature between music and computer science within one of the topics discussed within chipmusic.org

The K-12 Computer Science Framework[442] outlines seven core practices of computer science: (a) fostering an inclusive computing culture, (b) collaborating around computing, (c) recognizing and defining computational problems, (d) developing and using abstractions, (e) creating computational artifacts, (f) testing and refining computation artifacts, and (g) communicating about computing. Within the collaboratively developed "lightwall" software discussed within Chapter's Four and Five, members collaborated in discussions (i.e., collaborating around computing, and communicating about computing) on how to develop a piece of software suggested by a member of chipmusic.org. At the beginning of this topic, members discussed what they were going to create and the potential problems for creating such software (i.e., recognizing and defining computational problems, and communicating about computing). When members began the development process of the software (i.e., developing and using abstractions, and creating computational artifacts), they released

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[442] k12cs.org/

in-development versions of the software to the community so other members could find bugs and offer suggestions to improve the software (i.e., testing and refining computational artifacts, collaborating around computing, and communicating about computing). This collaborative effort resulted in software that members used in live chiptune performances and to create visual art.

Although the "lightwall" example demonstrates engagement with six of the seven core computer science practices, they are situated within music-related purposes. This distinction is a key point to understand why I suggest chiptunes as a potential interdiscipline with relevance to academic disciplines and fields of study beyond music education alone. However, to be clear, this study is not representative of all practices within the chipscene, but the practices frequently discussed within a single chiptune discussion forum, therefore more connections with other academic disciplines or fields of study may exist within the broader chipscene.

People interested in the intersections of the practices described in this study might jump at the idea of creating chiptunes as a class or as an interdiscipline; however, I want to caution that such an approach might recreate some of the problems with null curricula addressed earlier. For example, although people could create curricula or classes based on the findings of this study, such an approach might inadvertently create new boundaries or silos that limit the ways people engage with music and music-centered making. As much as I enjoy the thought of chiptunes as a new curricular strand in music education or as an interdiscipline, the following section suggests the practices discussed within chipmusic.org might serve as an exemplar of transdisciplinary engagement, which is a curricular approach that moves beyond disciplinary boundaries.

Chiptunes as an Exemplar of Transdisciplinary Engagement

> Mishra, Koehler, and Henriksen (2011) argue that
>
> standard disciplinary structures, around which school-curricula have been
>
> constructed, may not be as useful as they once were . . . [and that]
>
> recommendations for the future of learning emphasize the importance of being
>
> able to creatively move across multiple disciplines, to cross-pollinate ideas
>
> between domains. (p. 24)

Rather than trying to incorporate music-centered making within existing academic

disciplines such as music education, or creating a new interdiscipline that combines

concepts, practices, and understandings from multiple academic disciplines, chiptune

practices might demonstrate an exemplar of transdisciplinary engagement. Burton

(2001) describes transdisciplinary learning as moving beyond disciplinary boundaries by

solving problems through whatever knowledge or practices are needed, regardless of

academic discipline or field of study. If chiptune practices were introduced into

formalized educational contexts, curricular theorists might describe such practices as

transdisciplinary engagement where learners bring together a multitude of disciplinary

practices to solve the problem of making music through computer and video game

hardware and software.

Positioning chiptunes or music-centered making as forms of transdisciplinarity

reaches beyond the boundaries of academic disciplines or an interdiscipline. In the

previous section on chiptunes as interdiscipline, I provided an example of the potential

connections between chiptune practices and core practices within computer science;

however, several other areas of scholarship already explore the intersections of music

and computer science. For example, scholarship on the nexus of computer science

education and music education explore disciplinary intersections such as performing

music through live coding practices (Aaron, Blackwell, & Burnard, 2010; N. Collins,

2011, 2016; Magnusson, 2014a, 2014b; Manaris, B. Stevens, & Brown, 2016; McLean, 2014; Ogborn, 2016; Ruthmann, Heines, Greher, Laidler, & Saulters, 2010; Wang & Cook, 2004), designing and building electronic music instruments (Brunvand & McCurdy, 2017; N. Collins, 2009; Flood, 2016; Jo, Parkinson, & Tanaka, 2013; Rosenbaum, 2016), and the nexus of computational thinking and music making (J. Bell & T. Bell, 2018; Greher & Heines, 2014; Heines, Greher, Ruthmann, & Reilly, 2011; Magerko et al., 2013; Ruthmann & Heines, 2009). A key distinction between the notion of transdisciplinary learning and the above scholarship is that much of the aforementioned scholarship explores connections between disciplines for the purpose of learning concepts, practices, and understandings within a particular discipline (i.e., *inter*disciplinary), rather than moving beyond disciplinary boundaries (i.e., *trans*disciplinary). For example, Brunvand and McCurdy (2017) created an undergraduate course that explored "sound-art, experimental and electronic music, noise-making circuits, hardware hacking, and circuit bending" (p. 87). Although learners in this course had the opportunity to engage in composition, performance, maker, and coding practices that resemble practices discussed within chipmusic.org, the goal of the course was "to introduce computer engineering and computational principles to non-CS [non-computer science] students" (p. 87). Such an interdisciplinary approach to learning differs from the notion of transdisciplinary learning, which focuses on solving problems through whatever concepts, practices, or understandings are needed, regardless of academic discipline or field of study (Burton, 2001).

Educators from different subject areas could collaborate to create an interdiscipline or transdisciplinary offerings within a formalized educational context; however, Bresler (2002) cautions that "collaboration should not be imposed with prescribed outcomes, but as an open-ended process, generated by growth and meaningful relationship" (p. 17). Carrier, Wiebe, Gray, and Teachout (2011) suggest that

collaborations between different subject area educators enables better understanding of not only the content taught in different subject areas, but expands an educator's views on their own subject area. Music educators interested in chiptunes as interdiscipline might find other educators with complimentary expertise and interest in synthesizing concepts, practices, and understandings from multiple academic disciplines relevant to chiptune practices. For example, the practices revealed in this study demonstrate the potential for music educators to collaborate with engineering, computer science, entrepreneurship, and visual art educators. In addition, music educators interested in transdisciplinary learning might begin with a problem and then collaborate with other educators who share an interest in working on the same problem; which may not require engagement with any of the practices discussed within this study. Although such collaborations provide interesting opportunities across subject areas, the forms of engagement discussed within this study also have implications for music educators working in formalized music education contexts, which I discuss in the following sections.

Multifaceted Music Making

A recurring pattern within discussion forum posts and topics demonstrates many of the members of chipmusic.org discussed variegated practices for creating or engaging with chiptunes. Borrowing from the facets model previously discussed within this chapter, I refer to such practices as multifaceted music making, as members of chipmusic.org approach music making from a multitude of engagement. The topic titled "POST YOUR GIG/HOME SETUP!"[443] demonstrates the potential for multifaceted music making through hundreds of pictures of the various instruments and hardware people used to create music. Within topics such as these, members discussed using not only a range of practices for creating chiptunes, but also a range of performing instruments,

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[443] chipmusic.org/forums/topic/166/post-your-gighome-setup/

hardware, and software. Such a multifaceted approach to music making relates to Partti's (2014) discussion on how digital musicians enrolled in a London-based music college valued learning a multitude of music-related practices: "Rather than aiming to deepen and master one or two musical practices 'authentically', the participants' musicianship is based on the values of flexibility and versatility" (p. 13). Although similar in practice, the multifaceted music making discussed within chipmusic.org differs from Partti's (2014) case study because members of chipmusic.org also demonstrated engagement with music-related practices from several academic disciplines or fields of study rather than music practices alone.

Members of chipmusic.org were able to engage in multifaceted musicianship by freely moving between a multitude of music practices, instruments, software, or hardware. For example, the discussion on multidisciplinary practices in Chapter Five demonstrated how members of chipmusic.org shifted between varying chipmusician roles (e.g., producer, composer, performer, video mixer) or processes (e.g., modding, coding, composing, performing), across and within discussion forum topics. The oscillation between varied roles and processes is a common practice among digital musicians (Partti, 2014), and the ability to shift between roles creates a place or space with multiple entry points, which is a common trait among makerspaces (Sheridan et al., 2014) and affinity spaces (O'Leary, in press). Such an approach to music making contrasts with music education contexts where each class, ensemble, or community tends to focus on a topic or set of closely related music practices (e.g., performing, music theory, audio production, etc.) (Shuler, 2011), which are often specific to particular instruments (e.g., string instruments), software (e.g., Western staff notation software), or hardware (e.g., audio mixers). The following section discusses the potential for multifaceted musicianship to occur through hyphenated musicianship within hybrid spaces.

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Hyphenated Musicianship and Hybrid Spaces

In addition to creating curricula or spaces that explore potential connections between concepts, practices, and understandings from multiple academic disciplines, music educators might also consider designing or facilitating music spaces with continually shifting, multifaceted roles, practices, and processes. For example, if members were engaging in these multifaceted music practices within a formalized educational context rather than discussing practices within an online discussion forum, I might describe the ability to move between traditionally separated roles and processes as hyphenated musicianship (Tobias, 2012). Tobias (2016) applies the concept of hyphenated musicianship within "hybrid" educational spaces where "learners are involved in varied projects and musical inquiry that involve multiple ways of being musical" (p. 114). This "hybrid" approach to music education "embraces overlaps, combinations, connections, and blurred lines among music and ways of being musical. It fosters classrooms that mix aspects of general music and ensembles; mobile devices and acoustic instruments; or music from multiple genres, eras, and cultures" (p. 113). A hybrid approach provides an example of what an educational context might look like if designed to encourage multifaceted music making.

Although hyphenated musicianship and a hybrid approach could provide ways for encouraging multifaceted music making, many of the practices discussed in Chapter Four do not include active music making (e.g., maker, coding, entrepreneurial, visual art, and community practices), nor are they typically associated with music making and learning. For example, the previous discussion on the coding practices in the "lightwall" topic included practices that might occur within a computer science class rather than a music class; however, members of chipmusic.org discussed engagement with such practices in order to enhance or afford music making through computer and video game hardware and software. Rather than describing the chiptune-related practices as

"hyphenated musicianship," I borrowed from discourse on maker culture and chose to describe the practices as "music-centered making." However, music educators do not need to engage in music-centered making to encourage multifaceted music making and learning.

Music educators interested in creating hybrid spaces with multifaceted or hyphenated musicianship might consider how and when formalized educational experiences that enable a narrow set of music-related roles, practices, or processes unintentionally create null curricula. In addition, rather than creating more classes, ensembles, or communities that focus on specific facets or strands of music, music educators might consider creating hybrid spaces that encourage variegated music-related roles, practices, and processes. However, because such an approach might differ from typical formalized music education, music teacher educators and professional development facilitators might consider providing opportunities for modelling different approaches for working with learners who engage in a multitude of music-related practices, instruments, software, or hardware within a shared place or space.

Expanding Discourse on Music-related Appropriations

In the discussion forum of chipmusic.org, members frequently discussed appropriating (i.e., modifying) existing media, hardware, and software. For example, members discussed and shared project files for remixing chiptunes, circuit diagrams for changing hardware, and source code for modding software. Such appropriations relate to scholarship about participatory cultures, maker culture, and the mod scene. For example, in [Chapter Four](#) I demonstrated how many of the composition practices discussed by members of chipmusic.org related to Tobias's (2013) discussion on participatory engagement people employ with popular music and culture. Much of the maker practices discussed in [Chapter Four](#) involved modifications to computer and video game hardware that resemble practices discussed within scholarship on both maker

culture and the mod scene cited in Chapter Three, as well as described in scholarship on

DIY[444] music instrument making that suggests music instruments are not fixed, but are

continually evolving (Richards, 2013). In addition, the coding practices discussed in

Chapter Four used software modification practices discussed within mod scene

scholarship cited in Chapter Three. Although scholars in each of these fields of study use

similar terminology to discuss practices in relation to media, hardware, or software, I use

the term "appropriations" to broadly encompass modification practices within each of

these categories.

The findings within this study suggest chiptune-related appropriations appear to

be a part of many of the chiptune practices evident within chipmusic.org and resemble

other chiptune scholarship, which often describes chiptunes as an appropriation

(Carlsson, 2008; Tomczak, 2009; Yabsley, 2007) or re-appropriation (Carlsson, 2010) of

video game technology. In particular, members of chipmusic.org appeared to enjoy

active creating and appropriating rather than using ready-made hardware and software

without modifications. Such perspectives on appropriation practices are congruent with

Partti (2012) and Hugill's (2008) discussions about digital musicians, who often

indicated preference for creating or producing media rather than strictly consuming. In

addition, scholarship on mod culture suggest modders enjoy appropriating software

rather than creating them from scratch (El-Nasr & Smith, 2006).

Within chiptune appropriation practices, it appears experimentation was a key

component or potential motivator. For example, some members indicated enjoying the

semi-experimental nature of databending an image file to create art or circuit-bending a

toy to create unique sounds. The apparent experimental nature of some chiptune

practices relates to scholarship on DIY music instrument making, which suggests a DIY

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[444] DIY is an acronym for "Do-It-Yourself."

approach "encourages working with sound objects and instruments from a naïve stance since the object is always offering a mode of exploration and discovery" (Richards, 2013, p. 277).

H. Jenkins and Bertozzi's (2008) suggest that appropriations can be thought of as a kind of apprenticeship through which an artist learns from those who came before them. This assertion relates to similar processes and perspectives discussed in multiple themes within Chapter Four. For example, in Chapter Four I describe a post where a member released their project files with their album to encourage others to "learn, remix, be curious. There's no reason to have trade secrets in chiptune composing."[445] Music educators interested in appropriation practices as a form of music apprenticeship might consider how learners can modify music-related media, hardware, and software. For example, learners might appropriate an audio file, performing instrument, or music software in a music education context to learn more about the musical artifact. However, when engaging in appropriation practices as broadly conceived (i.e., media, hardware, and software appropriation practices), music educators should consider the tools (e.g., a DAW, soldering iron, or software development platform) and understandings needed for such appropriations, as well as where a learner might engage in such practices (e.g., a computer lab, woodshop, or makerspace).

Expanding Opportunities for Performing and Composing

Findings from this study demonstrate potential opportunities for expanding performance and composition practices within formalized music education contexts. In the following paragraphs I begin with implications for performance practices to occur in soloist or small ensemble contexts and follow with a discussion on composition practices. Although I present them in a compartmentalized manner, members of

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[445] chipmusic.org/forums/topic/5552/ubi031-danimal-cannon-roots/

chipmusic.org discussed engagement with both practices throughout much of the discussion forum. In addition, I suggest that music educators could incorporate both practices within a formalized music education context.

Chapter Four indicated that members frequently discussed performance practices within chipmusic.org. In discussion forum topics where members of chipmusic.org shared their music experiences outside of chiptunes[446] or formalized music learning experience,[447] some members indicated having performed in large ensembles in formalized educational contexts; however, one of the findings in this study was the lack of discussions on large chiptune ensembles. Baker (2006) describes this kind of finding as a "negative keyword," which is a word or topic that is either missing entirely or occurs infrequently in a corpus. Negative keywords "help to show topics or words of style which are not favoured in a corpus, which in itself can be illuminating" (Baker, 2006, p. 140). For example, while members frequently discussed performing in small ensembles with an eclectic blend of acoustic and electronic instruments, the majority of shared and discussed performances involved individual chipmusicians performing as solo artists. The lack of discussions on large chiptune ensembles is interesting because it demonstrates that, while some members have experience in large ensemble settings, their chiptune experiences appear to focus on performing as a solo artist or within small ensembles (often referred to by members of chipmusic.org as "bands"). The lack of large chiptune ensembles could be a result of geographic barriers preventing a large number of members from forming larger groups. However, it might also demonstrate members of chipmusic.org prefer making music as solo artists or

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[446] See topics such as "WHAT'S YOUR NON-CHIP MUSICAL BACKGROUND?" "MUSICAL EXPERIENCE?" and "MUSICAL EXPERIENCE?."

[447] See topics such as "I'D LIKE TO ASK YOU A FEW QUESTIONS A RESEARCH PAPER ON CHIPTUNES."

within small ensembles, something Savage (2005) also found with a study participant who engaged in digital music making practices.

Although it appears members preferred making music as solo artists or within small ensembles, in Anglo-North America, most secondary school music education course offerings tend to focus on large performing ensembles and performance-centered classes on a particular instrument group or music genre (Abril & Gault, 2008; Bolden, 2014). For example, Elpus and Abril (2011) found "21% of American high school seniors participated in band, choir, and/or orchestra in 2004" (p. 134). However, D. B. Williams (2012) suggests a significant number of students engage with music outside of typical school-based music offerings (i.e., outside of large, performance-centered ensembles). The contrast between this study's findings and typical curricular offerings reaffirms the concern of some music educators who question the current curricular dominance of large ensembles in relation to lifelong music making and learning (Mantie, 2009; Regelski, 2013), learner oppression (Allsup & Benedict, 2008), anachronism (Kratus, 2007; D. A. Williams, 2011), or relevance in relation to music practices outside of K-12 contexts (Clements, 2016). Music educators interested in providing music opportunities for learners who do not participate in large ensemble offerings might consider incorporating performance opportunities as soloists or within small ensembles.

In addition to considering alternative performance opportunities within K-12 offerings, this study also demonstrates the potential for composition practices to occur alongside performance practices. For example, members appeared to discuss and engage in composing chiptunes more frequently than performing chiptunes. This assertion is evident by a comparison of the corpus analysis results discussed in Chapter Four, and may indicate that members preferred composing chiptunes over performing, that chiptune hardware and software was more conducive to composition practice than

performance practices, or that members of chipmusic.org had fewer questions about performing chiptunes than they did about composing chiptunes.

Music educators interested in expanding opportunities for performing and composing might consider creating a place or space where musicianship can occur in independent or group contexts of varying sizes and experiences (e.g., opportunities to compose in addition to perform). Such a suggestion need not incorporate multidisciplinary practices or music-centered making. For example, music educators might provide opportunities for hyphenated musicianship within hybrid spaces to enable music making through both performing and composing rather than performing only. Rather than performing the works of others, this combination of practices could encourage learners to engage in a cyclical process of composing music that a learner then performs. For clarification, I do not intend to suggest removing large ensembles or performance-centered offerings from K-12 education, but expanding offerings to include additional ways of being musical.

Incorporating Collective Learning Practices

The word "learn" and its lemmas (e.g., learned, learning, learner, and learnt) accounted for 4,032 word tokens with an overall dispersion rate of 0.876 across the discussion forum. Upon closer examination, many of the discourses that used the word "learn" and its lemmas indicated members discussed a desire to learn chiptune practices or shared what they learned through engagement in such practices. For example, some of the top word clusters associated with the word "learn" and its lemmas include "to learn" ($n = 1{,}033$), "learn how to" ($n = 284$), "I learned" ($n = 255$), "you learn" ($n = 134$), "learning how to" ($n = 98$), "I've learned" ($n = 91$), "want to learn" ($n = 90$), "need to learn" ($n = 85$), "learn more about" ($n = 53$), and "have to learn" ($n = 43$). To be clear, these data indicate members discussed learning in the discussion forum but do not indicate learning occurred within chipmusic.org. Although this study did not investigate

what people learned by engaging in music-centered making through chiptunes, a recurring pattern across discussion forum posts and the aforementioned themes indicated members of chipmusic.org engaged in forms of community-based learning that I describe as "collective learning" in Chapter Four.

Collective learning is the practice of large groups of individuals engaging in activities that revolve around "sustained, enjoyed participation within [a] community over time" (Kafai & Peppler, 2011, p. 19). Throughout many of the themes introduced in Chapter Four I discussed how members of chipmusic.org engaged in collective learning practices when they created and shared resources to answer questions from other members. The sharing of resources and collective learning resembles findings in other literature on learning within affinity spaces (Gee, 2004, 2008; Gee & Hayes, 2010; Lammers, Curwood, & Magnifico, 2012) or through online resources and communities (Durga, 2012; R. Halverson, Kallio, Hackett, & E. Halverson, 2016; Kafai & Peppler, 2011; Partti & Karlsen, 2010; Smith, 2011; Miller, 2012; Steinkuehler & Duncan, 2008). For example, Steinkuehler and Duncan (2008) found 86% of discussion forum posts within an online video game discussion forum engaged in problem solving, knowledge sharing, and debate with other members. Each of these examples of collective learning are evident within the discussion forum posts of chipmusic.org and may provide an example of collective learning practices that could occur within a music education context.

Music education scholars wrestle with the implications of translating music making and learning evident within informal contexts into formalized music education contexts. For example, Bledsoe (2014) raises questions about "three adult music makers, whose pathways did not include school music experiences past their elementary years" (p. 18). Bledsoe (2014) suggests music educators "need to learn more about students and their musical cultures, place [themselves] in the roles of learners or colearners with

[students], and develop different pathways to music experiences" (p. 21). Other scholars discuss implications of informal practices found within recording and production studios (A. King, 2016; Slater, 2016), popular music cultures (Davis, 2013; R. Wright, 2016), adult music making in an Irish pub (Waldron & Veblen, 2009), and online music spaces (O'Leary, in press; Partti & Karlsen, 2010; Partti & Westerlund, 2012; Waldron, 2009, 2011, 2013; Waldron & Veblen, 2009). However, Folkestad (2006) suggests music educators interested in informal music making cannot simply embed informal content into a formalized context, but should strive to embed the culture and informal learning practices that occur within that culture.

If the collective learning practices evident within chipmusic.org were to occur within a classroom setting, H. Jenkins, Ito, and Boyd (2016) might describe such a space as a participatory classroom "where students help to shape the curriculum, define the norms of what constitutes appropriate conduct, and feel free to share what they know with others in their own community" (Kindle Locations 1852-1854). The ability to create, share, and link to resources allows for collective learning practices, even when people are separated by time and space (Kafai & Peppler, 2011). For example, members who posted a question within the discussion forum often received replies with links to outside resources or previous posts that might have assisted with answering a particular question or to elaborate on a particular topic. Because these topics and posts were archived within the discussion forum, members could continue to read through and use the resources shared within a particular topic, which resembles how people use wikis (Mittell, 2013). This form of community-based learning provides an example of how members were able to not only learn from each other by asking questions, but learn from previously asked questions.

Music educators interested in incorporating collective learning practices within a formalized music education context might consider using digital platforms for archiving

resources, topics, and questions (e.g., a shared digital folder, class website, or discussion forum) for future learners. For example, a music educator might create a resource repository that allows learners to create and share tutorials on a music-related concept, practice, or understanding. If such a repository were available online, learners might access or share resources outside of formalized educational contexts (e.g., accessing resources created by another class, from home, or after graduating). Music educators might also consider whether such a repository should include the opportunity for learners outside of a music education context (e.g., community members, alumni, or learners in another music program) to contribute their own perspectives and resources. Such an approach might enable opportunities for collective learning practices within a music education context.

Summary of Implications

This chapter explored the implications of this study's findings by addressing the third research question: What import might music-centered making evident within chipmusic.org discussion forum posts hold for music education? I began this chapter with a discussion on the difficulty I had with finding a framework and vocabulary for describing the diverse practices discussed across chiptune-related scholarship. I followed this discussion by suggesting that music-centered making demonstrates a null curriculum within the National Core Arts Standards, and provide suggestions to address this null curriculum: (a) use language in curricula and standards that is broad enough to incorporate music-centered making, (b) create an interdiscipline by combining two or more disciplines, and (c) create transdisciplinary opportunities that move beyond disciplinary boundaries. In addition to implications of music-centered making, I discuss implications for music educators interested in incorporating multifaceted music making, expanding discourse on music-related appropriations, expanding opportunities for both

composition and performance practices, and the potential for collective learning practices to occur within music education contexts.

A Word of Caution

Partti and Karlsen (2010) suggest music educators should not only understand affinity spaces (e.g., chipmusic.org), but be able to provide tools to assist with further learning through such spaces. Such tools or skills may assist learners with navigating musical practices, styles, or genres evident within various music communities, places, or spaces (Partti & Westerlund, 2012). Although I recommend music educators spend time learning from and engaging with members of chipmusic.org, I have mixed feelings about whether I would recommend a learner under the age of 18 visit the discussion forum, due to topics and language considered "inappropriate" in many formalized education contexts. The discussion forum's rules explicitly state "this is an all-ages forum, so please keep it clean! As a rule of thumb, if you wouldn't send it to your grandma we'd rather you not post it here."[448] However, variations of the word "shit" (e.g., "shitty," "apeshit," "bullshit," "shitting," "shitstorm," etc.) accounted for 11,983 word tokens with an overall dispersion rate of 0.780, and variations of the word "fuck" (e.g., "fucking," "fucked," "fuckn," "fucks," "motherfucker," etc.) accounted for 9,512 word tokens with an overall dispersion rate of 0.782. Although curse words were dispersed throughout the discussion forum, many of these tokens originated from isolated posts with excessive curse words. For example, in a single post, a member of chipmusic.org wrote "OH SHIT" over 1,000 times (see Figure 45). Posts like these are why I suggest caution with encouraging young learners to engage in spaces with content that some schools or communities might consider inappropriate.

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[448]chipmusic.org/forums/topic/21/forum-rules/

Figure 45. An example post of a member using excessive profanity. This post contained the words "OH SHIT" over 1,000 times. Source: chipmusic.org/forums/topic/2173/bris-aus-september-11-pocket-music-ctrix-10k-derriskharlan/page/2/

Suggestions for Future Research

In this study, I describe practices discussed within the discussion forum of chipmusic.org; however, discourses within chipmusic.org do not represent all chiptune-related practices. Other discussion forums focus more on demoscene or modding practices, which might include practices not as prevalent within chipmusic.org discourse. In addition, the practices and themes discussed within this study may not include practices a chipmusician might engage in frequently, but seldom discussed within the space. Because the data for this study consist of archived discussion forum posts, I am unable to verify findings with members of the space; however, my approach to this study allowed me to investigate discourse from tens of thousands of members across several years. Working with data from tens of thousands of members across several years allowed me to investigate practices discussed by more people around the world than if I interviewed individual members or attempted to survey chipmusicians across the chipscene. However, this study is not representative of all practices within the chipscene, but the practices frequently discussed within a single chiptune discussion forum. Future research might investigate other chiptune discussion forums or chipmusician perspectives on the findings of this study.

Members of chipmusic.org discussed a diverse range of musical experiences and perspectives. These discussions often involved asking other members about music experiences outside of chiptunes,[449] formalized music learning experience,[450] how they

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[449] See topics such as "WHAT'S YOUR NON-CHIP MUSICAL BACKGROUND?" "MUSICAL EXPERIENCE?" and "MUSICAL EXPERIENCE?."

[450] See topics such as "I'D LIKE TO ASK YOU A FEW QUESTIONS A RESEARCH PAPER ON CHIPTUNES."

became interested in chiptunes,[451] life outside of chiptunes,[452] how people learned how to make music,[453] or posting topics such as "IS MUSIC EDUCATION NECESSARY TO WRITE GOOD MUSIC?"[454] In addition, members discussed how other people reacted to chiptunes,[455] their artist identity,[456] and what made a musician a musician.[457] Although generally unrelated to the purpose of this study, topics like these provide context for better understanding the musical backgrounds and perspectives of members who respond to these topics. Future research might investigate musical experiences, understandings, or perspectives of chipmusicians to better understand how their perspectives on chiptunes and related practices, as well as their perspectives on such practices occurring within formalized educational contexts.

Although infrequent, some members questioned which pronouns to use with another member: "i just referred to a member here as 'he' by automatic assumption…forgive me if i was wrong are there many female chip producers? i get the impression it's (yet another) male dominated music genre."[458] Another member created

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[451] See topics such as "HOW'D YOU GET HERE?"

[452] See topics such as "WHAT'S YOUR DAY JOB/MAJOR?" and "WHAT'S YOUR LIFE OUTSIDE OF MAKING CHIPTUNE?"

[453] See topics such as "HOW DID YOU LEARN MUSIC?"

[454] chipmusic.org/forums/topic/16210/is-music-education-necessary-to-write-good-music/

[455] See topics such as "YOUR FAMILY'S THOUGHT ON CHIP?" and "WHAT IS YOUR MUSIC DOING FOR YOU?"

[456] See topics such as "YOUR ARTIST IDENTITY" and "POST-CHIPTUNE ARTIST IDENTITY. YOUR THOUGHTS?"

[457] See topics such as "WHAT MAKES A MUSICIAN A MUSICIAN."

[458] chipmusic.org/forums/topic/15785/chip-tune-sexes/

a topic asking "WHO ARE SOME FEMALE CHIPMUSIC ARTISTS?"[459] Corpus analysis

techniques reveal the word "female" and its lemmas (e.g., she, girl, her, woman, etc.)

accounted for 4,465 word tokens with an overall dispersion rate of 0.729. The word

"female" accounted for 258 word tokens and tend to reference a female port (input) for

hardware. Many of the posts were on significant others or talking about women in

general, and not necessarily about female chipmusicians or members of chipmusic.org.

The word "male" and its lemmas (e.g., dude, guy, he, him, his, man, men, etc.) accounted

for 49,210 word tokens with an overall dispersion rate of 0.879. The word "male"

accounted for 182 tokens and had some false positives with male ports (output) for

hardware. By frequency alone, male pronoun tokens accounted for more than ten times

the female pronoun tokens, possibly indicating a higher percentage of persons who

identify as male participating within the discussion forum. Such a discrepancy reflects

scholarship on women in technology fields and cultures that demonstrate women held

less than 25% of STEM jobs (Sheffield, Koul, Blackley, & Maynard, 2017), account for

20% of maker culture demographics (Whelan, 2018), and audio technology, which found

"women and girls are underrepresented in every aspect of audio technology including

academic communities, professional music production, students enrolled in music

technology degrees, composers utilising music technology and semi-professional or

professional developers of audio technology outside academia" (Stewart, Skach, & Bin,

2018, p. 164). Future research might investigate discrepancies in the percentage of

chipmusicians who might identify as male, female, or non-binary to better understand

why such discrepancies exist and how educators might address such discrepancies. In

addition, future research might consider "how tools and materials [used within chiptune

practices] bear traces of their histories of cultural use and access, communicating

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[459] chipmusic.org/forums/topic/9558/who-are-some-female-chipmusic-artists/

gendered scripts that invite participants to read and perform masculinities and femininities in socially recognized ways" (Peppler & Wohlwend, 2017, p. 91). For example, scholars might investigate whether the names of devices such as Nintendo's "Game Boy" or the "Arduinoboy" denote gendered scripts that promote engagement by people who identify as male and not by people who identify as female or non-binary.

The word "happy" and related words (e.g., "enjoy," "fun," "love," "joy," etc.) accounted for 22,444 word tokens with an overall dispersion rate of 0.836 across the discussion forum, indicating frequent use throughout the discussion forum. It appears members enjoyed discussing and engaging in chiptune practices as many members shared hundreds or thousands of posts within the discussion forum; however, few topics discussed member perspectives on why they made chiptunes[460] or what members liked about chiptunes.[461] Future research might inquire into these perspectives on why chipmusicians choose to engage in the medium and genre of chiptunes, which may inform how educators design curricular experiences or educational spaces that merge or blur disciplinary practices.

Some chipmusicians inquired about studying chipmusic in higher education settings.[462] These inquiries might demonstrate examples of members who desired to continue making and studying chiptune practices as a potential career or leisure pursuit. In addition, these inquiries may indicate an opportunity for music programs to collaborate with other departments to create an interdiscipline or provide transdisciplinary offerings that meet the needs of learners interested in music-centered

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[460] See topics such as "WHY DO YOU COMPOSE/LISTEN TO CHIP?" "WHY CHIPTUNE?," "RE: LIMITATION," and "WHAT IS YOUR MUSIC DOING FOR YOU?"

[461] See topics such as "WHAT DO YOU LIKE ABOUT CHIP MUSIC?"

[462] See topics such as "COLLEGE, CHIPMUSIC, AND YOU" and "CHIPTUNE UNIVERSITY?"

making. For example, Madden et al. (2013) developed an undergraduate degree program "that integrates scientific training with creativity development to promote innovative cognitive skills in undergraduate science students" (p. 541). In this program, undergraduate learners can design up to 48% of their major by combining at least two different fields of study. If degree programs such as the previous example do not exist in a university or college, learners might need to take classes outside of a degree program. For example, Shaked (2013) found computer scientists with a serious music-making avocation often engaged in both disciplines simultaneously by obtaining multiple degrees (i.e., one in computer science and one in music), or by combining interests as "musical computer-scientists" (p. 14), and suggests "academic institutions should offer programs designed especially for such combinations, in the same way they began offering other combinations like law and business" (p. 330).

Considering Future Directions

It is my hope that this study not only increases awareness of the breadth of musical practices chipmusicians engage in, but encourages music educators to question the potential for music-centered making within music education contexts. In addition, I hope this study challenges the notion of siloed academic disciplines or fields of study, and encourages educators and scholars to find ways to merge or blur concepts, practices, and understandings to create something new and enjoyable. Perhaps by questioning or transcending disciplinary boundaries through collaborative efforts across academic disciplines and fields of study, we might reveal or develop new ways of engaging with music.

REFERENCES

Aaron, A. S., Blackwell, A. F., & Burnard, P. (2010). The development of Sonic Pi and its use in educational partnerships: Co-creating pedagogies for learning computer programming. *Journal of Music, Technology & Education*, 9(1), 75–94.

Abrams, S. S. (2018). The arts: Arts education and makerspaces—Opportunities for democratizing practices and supporting socially responsible learning. In B. Johnson & Y. Pratt-Johnson (Eds.), *Inequalities in the Early Years* (pp. 95–108). Routledge.

Abril, C. R., & Gault, B. M. (2008). The state of music in the secondary school: The principal's perspective. *Journal of Research in Music Education* 56 (1): 68–81.

Allsup, R. E. (2011). Popular music and classical musicians: Strategies and perspectives. *Music Educators Journal*, 97(3), 30–34.

Allsup, R. E., & Benedict, C. (2008). The problems of band: An inquiry into the future of instrumental music education. *Philosophy of Music Education Review*, 16(2), 156–173.

Androutsopoulos, J. (2007). Style online: Doing hip-hop on the German-speaking web. In P. Auer (Ed.), *Style and Social Identities: Alternative Approaches to Linguistic Heterogeneity*, 279–317. Berlin: Mouton de Gruyter.

Androutsopoulos, J. (2008). Potentials and limitations of discourse-centered online ethnography. *Language@Internet*, *5*.

Baker, P. (2006). *Using corpora in discourse analysis*. London: Continuum.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W. H. Freeman and Company.

Barness, J. (2015). Social disruptions: WYSi-WE, what you see is what emerged. *Visual Communication*, 14(1), 41–48.

Barrett, J. R. (2001). Interdisciplinary work and musical integrity. *Music Educators Journal*, 87(5), 27.

Barrett, J. R. (2016). Adopting an interdisciplinary approach to general music. In C. R. Abril & B. M. Gault (Eds.), *Teaching General Music: Approaches, Issues, and Viewpoints* (pp. 168–182). Oxford: Oxford University Press.

Barrett, J. R., McCoy, C. W., & Veblen, K. K. (1997). *Sound ways of knowing: Music in the interdisciplinary curriculum*. New York: Schirmer Books.

Barrett, J. R., & Veblen, K. K. (2012). Meaningful connections in a comprehensive approach to the music curriculum. In G. E. McPherson & G. F. Welch (Eds.), *The Oxford Handbook of Music Education* (1st ed., pp. 361–380). New York: Oxford University Press.

Barrett, M. (1996). Children's aesthetic decision-making: An analysis of children's musical discourse as composers. *International Journal of Music Education*, *28*(1), 37–62.

Bell, J., & Bell, T. (2018). Integrating computational thinking with a music education context. *Informatics in Education*, 17(2), 151–166.

Benedict, C. & O'Leary, J. (2018). *Reclaiming making: Music technology in the age of neoliberalism*. Manuscript submitted for publication.

Bernard, C. F., Weiss, L., & Abeles, H. (2018). Space to share: Interactions among music teachers in an online community of practice. *Bulletin of the Council for Research in Music Education*, Winter(215), 75–94.

Biber, D. (2012). Register and discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 191–208). New York: Routledge.

Biesta, G. (2010). Learner, student, speaker: Why it matters how we call those we teach. *Educational Philosophy and Theory*, 42(5–6), 540–552.

Blackwell, A., & Collins, N. (2005). The programming language as a musical instrument. 17th Workshop of the *Psychology of Programming Interest Group*, 1–11.

Bledsoe, R. N. (2014). Music education for all? *General Music Today*, 28(2), 18–22.

Boellstorff, T., Nardi, B., Pearce, C., & Taylor, T. L. (2012). *Ethnography and virtual worlds: A handbook of method*. Princeton: Princeton University Press.

Bolden, B. (2014). The dearth of creativity in music education: Time to shift. *Canadian Music Educator*, 55(3), 2–3.

Brahms, L., & Crowley, K. (2016). Making sense of making: Defining learning practices in MAKE magazine. In K. Peppler, E. R. Halverson, & Y. B. Kafai (Eds.), *Makeology: Makers as Learners* (Vol. 2, pp. 13–28). New York: Routledge.

Brahms, L., & Werner, J. (2013). Designing makerspaces for family learning in museums and science centers. In *Design, Make, Play: Growing the Next Generation of STEM Innovators* (pp. 71–94). New York: Routledge.

Bresler, L. (2002). Out of the trenches: The joys (and risks) of cross-disciplinary collaborations. *Bulletin of the Council for Research in Music Education*, *Spring*(152), 17–39.

Brunvand, E., & McCurdy, N. (2017). Making noise: Using sound-art to explore technological fluency. In *Proceedings of the* 48th *ACM Technical Symposium on Computer Science Education*, 87–92.

Burrack, F., & McKenzie, T. (2005). Enhanced student learning through cross-disciplinary projects. *Music Educators Journal*, 91(5), 45.

Burton, L. H. (2001). Interdisciplinary curriculum: Retrospect and prospect. *Music Educators Journal*, 87(5), 17–21+66.

Campbell, M. R. (1995). Interdisciplinary projects in music. *Music Educators Journal*, 82(2), 37–44.

Carlsson, A. (2008). Chip music: Low-tech data music sharing. In K. Collins (Ed.), *From Pac-Man to Pop Music: Interactive Audio in Games and New Media* (pp. 153-162). Burlington: Ashgate.

Carlsson, A. (2009). The forgotten pioneers of creative hacking and social networking–Introducing the demoscene. In *Proceedings of the* 2009 *Re: live Media Art Histories*, 16-20.

Carlsson, A. (2010). *Power users and retro puppets: A critical study of the methods and motivations in chipmusic*. Unpublished manuscript, Department of Media and Communication Studies, Lund University, Lund, Sweden.

Carrier, S., Wiebe, E. N., Gray, P., & Teachout, D. (2011). BioMusic in the classroom: Interdisciplinary elementary science and music curriculum development. *School Science and Mathematics*, 111(8), 425–434.

Clayman, S. E., & Gill, V. T. (2012). Conversation analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 120–134). New York: Routledge.

Clements, A. (2016). Teaching general music in the digital age. In C. R. Abril & B. M. Gault (Eds.), *Teaching General Music: Approaches, Issues, and Viewpoints* (pp. 327–346). Oxford: Oxford University Press.

Collins, K. (2005a). Fine tuning the terrible twos: The musical aesthetic of the Atari VCS. Retrieved from http://www.tagg.org/xpdfs/kcflat2.pdf

Collins, K. (2005b). From bits to hits: Video games music changes its tune. *Film International*, *12*, 4–19.

Collins, K. (2006). "Loops and bloops" Music of the Commodore 64 games. *Soundscapes*, *8*.

Collins, K. (2008). *Game sounds: An introduction to the history, theory, and practice of video game music and sound design*. Cambridge: The MIT Press.

Collins, K. (2013). *Playing with sound: A theory of interacting with sound and music in video games*. Cambridge: The MIT Press.

Collins, N. (2009). *Handmade electronic music: The art of hardware hacking* (2nd ed.). New York: Routledge.

Collins, N. (2011). Live coding of consequence. *Leonardo*, 44(3), 207–211.

Collins, N. (2016). Live coding and teaching SuperCollider. *Journal of Music, Technology & Education*, 9(1), 5–16.

Connor, A. M., Karmokar, S., & Whittington, C. (2015). From STEM to STEAM: Strategies for enhancing engineering & technology education. *International Journal of Engineering Pedagogy*, 5(2), 37–47.

Culbertson, R., Oehrtman, M., Thompson, J. M., Gardner, J., Mehrens, C., Baker, D., & Krause, S. (2009). Engineering design of musical instruments as a context for math, physics and technical writing in a freshman learning community course. *American Society for Engineering Education*.

D'Errico, M. (2012). How to reformat the planet: Technostalgia and the "live" performance of chipmusic. *Journal on the Art of Record Production*, *June*(06).

Davis, S. G. (2013). Informal learning processes in an elementary music classroom. *Bulletin of the Council for Research in Music Education*, 198(198), 23–50.

DeVane, B. (2012). Whither membership? Identity and social learning in affinity spaces. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 162–185). New York: Peter Lang Publishing, Inc.

Dobbs, T. L. (2005). *Discourse in the band room: How talk shapes teaching, learning, and community in a middle school instrumental music classroom* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3177710).

Dobbs, T. L. (2010). Talking to myself: Re-framing music classroom discourse. *Bulletin of the Council for Research in Music Education*, (183), 7–24.

Dobbs, T. T. L. (2012). A critical analysis of disabilities discourse in the journal of research in music education, 1990–2011. *Bulletin of the Council for Research in Music Education*, (194), 7–30.

Duncan, S. C. (2010). Gamers as designers: A framework for investigating design in gaming affinity spaces. *E-Learning*, *7*(1), 21–34.

Duncan, S. C. (2012a). Kongregating online: Developing design literacies in a play-based affinity space. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 51–83). New York: Peter Lang Publishing, Inc.

Duncan, S. C. (2012b). World of Warcraft and "the World of Science": Ludic play in an online affinity space. *Social Exclusion, Power, and Video Game Play: New Research in Digital Media and Technology*, 177–198.

Durga, S. (2012). Learning to mod in an affinity-based modding community. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 84–102). New York: Peter Lang Publishing, Inc.

Eisner, E. W. (2002). *The Arts and the Creation of Mind*. New Haven: Yale University Press.

El-Nasr, M. S., & Smith, B. K. (2006). Learning through game modding. *ACM Computers in Entertainment*, *4*(1), 1–20.

Ellcessor, E., & Duncan, S. C. (2012). Forming the Guild: Star power and rethinking projective identity in affinity spaces. In P. Felicia (Ed.), *Developments in Current Game-Based Learning Design and Deployment* (pp. 188–202). Hershey: Information Science Reference.

Ellis, A. K., & Fouts, J. T. (2001). Interdisciplinary curriculum: The research base. *Music Educators Journal*, 87(5), 22–26.

Elpus, K., & Abril, C. R. (2011). High school music ensemble students in the United States: A demographic profile. *Journal of Research in Music Education*, 59(2), 128–145.

Fairclough, N. (2006). *Language and globalization*. New York: Routledge.

Fairclough, N. (2012). Critical discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 9–20). New York: Routledge.

Farmer, D. M. (2015). *Urban music education: A critical discourse analysis* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3700184).

Flood, L. (2016). *Building and becoming: DIY music technology in New York and Berlin* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 10011005).

Flowerdew, L. (2012). Corpus-based discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 174–188). New York: Routledge.

Folkestad, G. (2006). Formal and informal learning situations or practices vs formal and informal ways of learning. *British Journal of Music Education*, 23(2), 135–145.

Franklin, S. (2009). On game art, circuit bending and speedrunning as counter-practice: "Hard" and "soft" nonexistence. *CTheory*.

Friman, M. (2010). Understanding boundary work through discourse theory: Inter/disciplines and interdisciplinarity. *Science Studies*, 23(2), 5–19.

Gan, Y. C., & Zhu, Z. T. (2007). A learning framework for knowledge building and collective wisdom advancement in virtual learning communities. *Educational Technology and Society*, 10(1), 206–226.

Gardner, H., & Boix-Mansilla, V. (1994). Teaching for understanding–Within and across the disciplines. *Educational Leadership*, 51(5), 14–18.

Gee, J. P. (2000). Identity as an analytic lens for research in education. In *Review of Research in Education* (Vol. 25, pp. 99–125). Washington: American Educational Research Publication.

Gee, J. P. (2004). *Situated language and learning: A critique of traditional schooling*. New York: Routledge.

Gee, J. P. (2008). *Good video games + good learning: Collected essays on video games, learning and literacy*. New York: Peter Lang Publishing, Inc.

Gee, J. P. (2013). *The social mind: Language, ideology, and social practice* (2nd ed.). Champaign: Common Ground Publishing LLC.

Gee, J. P. (2014a). *An introduction to discourse analysis: Theory and method* (4th ed.). London: Routledge.

Gee, J. P. (2014b). *How to do discourse analysis: A toolkit* (2nd ed.). New York: Routledge.

Gee, J. P. (2014c). *Unified discourse analysis: Language reality, virtual worlds, and video games* (Kindle). New York: Routledge.

Gee, J. P. (2015). *Social linguistics and literacies* (5th ed.). London: Routledge.

Gee, J. P., & Hayes, E. R. (2010). Passionate affinity groups: A new form of community that works to make people smarter. In *Women and Gaming: The Sims and 21st Century Learning* (pp. 105–123). New York: Palgrave Macmillan.

Geere, D. (2010). Glitch art created by data-bending. *Wired*. Retrieved October 9, 2018, from www.wired.co.uk/news/archive/2010-08/17/glitch-art-databending

Ghazala, Q. R. (2004). The folk music of chance electronics: Circuit-bending the modern coconut. *Leonardo Music Journal*, *14*, 97–104.

Greher, G. R., & Heines, J. M. (2014). *Computational thinking in sound: Teaching the art and science of music and technology*. Oxford: Oxford University Press.

Gutwill, J. P., Hido, N., & Sindorf, L. (2015). Research to practice: Observing learning in tinkering activities. *Curator*, *58*(2), 151–168.

Halverson, E. R., & Sheridan, K. M. (2014). The maker movement in education. *Harvard Educational Review*, *84*(4), 495–504.

Halverson, R., Kallio, J., Hackett, S., & Halverson, E. (2016). Participatory culture as a model for how new media technologies can change public schools. *WCER Working Paper*. Retrieved from https://wcer.wisc.edu/docs/working-papers/Working_Paper_No_2016_7.pdf

Hayes, E. R., & Lee, Y. N. (2012). Specialist language acquisition and 3D modding in a Sims fan site. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 186–211). New York: Peter Lang Publishing, Inc.

Hebdige, D. (1979). *Subculture: The meaning of style*. London: Taylor & Francis Group.

Heines, J. M., Greher, G. R., & Kuhn, S. (2009). Music performamatics: Interdisciplinary interaction. In *SIGCSE Technical Symposium on Computer Science Education* (pp. 478–482).

Heines, J. M., Greher, G. R., Ruthmann, S. A., & Reilly, B. L. (2011). Two approaches to interdisciplinary computing + music courses. *IEEE Computer*, 44(12), 25–32.

Heines, J. M., Jeffers, J., & Kuhn, S. (2008). Performamatics: Experiences with connecting a computer science course to a design arts course. *The International Journal of Learning*, 15(2), 9–16.

Hira, A., & Hynes, M. M. (2018). People, means, and activities: A conceptual framework for realizing the educational potential of makerspaces. Manuscript submitted for publication. *Education Research International*, 2018.

Holden, C. L. (2012). The not-so-secret life of Dance Dance Revolution. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 129–161). New York: Peter Lang Publishing, Inc.

Hong, R., & Chen, V. H.-H. (2014). Becoming an ideal co-creator: Web materiality and intensive laboring practices in game modding. *New Media & Society*, *16*(2), 290–305.

Hopkins, C. J. (2015). *Chiptune music: An exploration of compositional techniques as found in Sunsoft Games for the Nintendo Entertainment System and Famicom from 1988-1992* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3712434).

Hugill, A. (2008). *The digital musician*. New York: Routledge.

Ito, M., Baumer, S., Bittanti, M., Boyd, D., Cody, R., Herr-Stephenson, B., . . . Tripp, L. (2010). *Hanging out, messing around and geeking around*. Cambridge: The MIT Press.

Jansz, J., & Theodorsen, J. (2009). Modifying video games on web 2.0: Exploration of motives for publishing creative game content. In *59th Conference of the International Communication Association*.

Jaspers, J. (2012). Interactional sociolinguistics and discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 135–146). New York: Routledge.

Jenkins, H., & Bertozzi, V. (2008). Artistic expression in the age of participatory culture: How and why young people create. In S. J. Tepper & B. Ivey (Eds.), *Engaging Art: The Next Great Transformation of America's Cultural Life*. New York: Routledge.

Jenkins, H., Clinton, K., Purushotma, R., Robison, A. J., & Weigel, M. (2009). Confronting the challenges of participatory culture: Media education for the 21st century. John D. and Catherine T. MacArthur Foundation. Chicago.

Jenkins, H., Ito, M., & Boyd, D. (2016). *Participatory culture in a networked era.* Cambridge: Polity Press.

Jenkins, J. N. (2008). A kaleidoscopic view of the Harlem Renaissance. *Music Educators Journal*, 94(5), 42-49.

Jeppesen, L. B. (2004). Profiting from innovative user communities: How firms organize the production of user modifications in the computer games industry. *Techreport*, 1–21.

Jo, K., Parkinson, A., & Tanaka, A. (2013). Workshopping participation in music. *Organised Sound*, 18(3), 282–291.

Kafai, Y. B., & Peppler, K. A. (2011). Beyond small groups: New opportunities for research in computer-supported collective learning. In *Proceedings of the 2011 Computer-Supported Collaborative Learning Conference (CSCL)*, I, 17–24.

Kim, Y. E., Batula, A. M., Migneco, R., Richardson, P., Dolhansky, B., Grunberg, D., . . . Scott, J. (2011). Teaching STEM concepts through music technology and DSP. *Digital Signal Processing Workshop and IEEE Signal Processing Education Workshop* (DSP/SPE), 220–225.

King, A. (2016). Studio pedagogy: Perspectives from record producers. In A. King & E. Himonides (Eds.), *Music, Technology, and Education: Critical Perspectives* (pp. 45–66). Abingdon: Routledge.

King, A., & Himonides, E. (Eds.). (2016). *Music, technology, and education: Critical perspectives*. Abingdon: Routledge.

King, E. M. (2012). The productive side of playing in the great indoors. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 103–128). New York: Peter Lang Publishing, Inc.

Kite, T. S., Smucker, T., Steiner, S., & Bayne, M. (1994). Using program music for interdisciplinary study. *Music Educators Journal*, 80(5), 33–36+53.

Kopkas, J. M. (2011). *Soundings: Musical aesthetics in music education discourse from 1907 to 1958* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3480301).

Kow, Y. M., & Nardi, B. (2010a). Culture and creativity: World of Warcraft modding in China and the US. In W. S. Bainbridge (Ed.), *Online Worlds: Convergence of the Real and the Virtual* (pp. 21–41). London: Springer.

Kow, Y. M., & Nardi, B. (2010b). Who owns the mods? *First Monday*, *15*(5).

Kratus, J. (2007). Music education at the tipping point. *Music Educators Journal*, 94(2), 42–48.

Kress, G. (2012). Multimodal discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 35–50). New York: Routledge.

Lammers, J. C. (2012). "Is the hangout…The Hangout?" Exploring tensions in an online gaming-related fan site. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 23–50). New York: Peter Lang Publishing, Inc.

Lammers, J. C. (2013). Fangirls as teachers: Examining pedagogic discourse in an online fan site. *Learning, Media and Technology*, 38(4).

Lammers, J. C., Curwood, J. S., & Magnifico, A. M. (2012). Toward an affinity space methodology: Considerations for literacy research. *English Teaching: Practice and Critique*, 11(2), 44–58.

Laukkanen, T. (2005). *Modding scenes: Introduction to user-created content in computer gaming*. University of Tampere Hypermedia Laboratory. Retrieved from: https://tampub.uta.fi/handle/10024/65431

Lee, Y. N. (2012). *Learning and literacy in an online gaming community: Examples of participatory practices in a Sims affinity space* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3505612).

Lemke, J. L. (2012). Multimedia and discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 79–89). New York: Routledge.

Leonard, A. E., Dsouza, N., Babu, S. V., Daily, S. B., Jörg, S., Waddell, C., . . . Boggs, K. (2015). Embodying and programming a "constellation" of multimodal literacy practices: Computational thinking, creative movement, biology, & virtual environment interactions. *Journal of Language and Literacy Education*, 11(2), 64–93.

Levy, P. (2000). *Collective intelligence: Man's emerging world in cyberspace*. New York: Perseus Books.

Lysloff, R. T. A. (2003). Musical life in Softcity: An internet ethnography. In R. T. A. Lysloff & L. C. Gay Jr (Eds.), *Music and Technoculture* (pp. 23–63). Middletown: Wesleyan University Press.

Madden, M. E., Baxter, M., Beauchamp, H., Bouchard, K., Habermas, D., Huff, M., . . . Plague, G. (2013). Rethinking STEM education: An interdisciplinary STEAM curriculum. *Procedia Computer Science*, 20, 541–546.

Magerko, B., Freeman, J., McKlin, T., McCoid, S., Jenkins, T., & Livingston, E. (2013). Tackling engagement in computing with computational music remixing. *Proceeding of the 44th ACM Technical Symposium on Computer Science Education - SIGCSE '13*, 657.

Magnifico, A. M. (2012). The game of Neopian writing. In E. R. Hayes & S. C. Duncan (Eds.), *Learning in Video Game Affinity Spaces* (pp. 212–234). New York: Peter Lang Publishing, Inc.

Magnusson, T. (2014a). Herding cats: Observing live coding in the wild. *Computer Music Journal*, 38(1), 8–16.

Magnusson, T. (2014b). Scoring with code: Composing with algorithmic notation. *Organised Sound*, 19(03), 268–275.

Maloney, J., Peppler, K., Kafai, Y. B., Resnick, M., & Rusk, N. (2008). Programming by choice: Urban youth learning programming with Scratch. In *Proceedings of the 39th SIGCSE Technical Symposium on Computer Science Education*, 367–371.

Manaris, B., Stevens, B., & Brown, A. R. (2016). JythonMusic: An environment for teaching algorithmic music composition, dynamic coding and musical performativity. *Journal of Music, Technology & Education*, 9(1), 33–56.

Mann, C., & Stewart, F. (2000). *Internet communication and qualitative research: A handbook for researching online*. London: SAGE Publications Ltd.

Mantie, R. (2009). *Stylizing lives: Selected discourses in instrumental music education* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. NR61025).

Mantie, R. (2012). Music education and avocational music making: Examining discourse using techniques from corpus linguistics. In L. K. Thompson & M. R. Campbell (Eds.), *Situating Inquiry: Expanded Venues for Music Education Research* (pp. 119–146). Information Age Publishing.

Mantie, R. (2013). A comparison of "popular music pedagogy" discourses. *Journal of Research in Music Education*, 61(3), 334–352.

Marshall, J. A., & Harron, J. R. (2018). Making learners: A framework for evaluating making in STEM education. *Interdisciplinary Journal of Problem-Based Learning*, 12(2).

Martin, F., Greher, G., Heines, J., Jeffers, J., Kim, H. J., Kuhn, S., . . . Yanco, H. (2009). Joining computer and the arts at a mid-size university. In *Consortium for Computing Sciences in Colleges - Northeastern Region*.

Mason, S. (2012). Glitched lit: Possibilities for databending literature. In *Proceedings of the 2nd Workshop of Narrative and Hypertext, 23rd ACM Special Interest Group on Hypertext, Hypermedia, and Web*. Milwaukee.

McAlpine, K. B. (2017). The Sound of 1-bit: Technical constraint and musical creativity on the 48k Sinclair ZX Spectrum. *G|A|M|E The Italian Journal of Game Studies*, 1–15. Retrieved from https://www.gamejournal.it/the-sound-of-1-bit-technical-constraint-as-a-driver-for-musical-creativity-on-the-48k-sinclair-zx-spectrum/

McLean, A. (2014). Making programming languages to dance to: Live coding with Tidal. In *Proceedings of the 2014 ACM SIGPLAN International Workshop on Functional Art, Music, Modelling and Design*.

Miller, K. (2012). *Playing along: Digital games, YouTube, and virtual performance*. New York: Oxford University Press.

Miller, V. (2011). *Understanding digital culture*. London: SAGE Publications Ltd.

Mishra, P., Koehler, M. J., & Henriksen, D. (2011). The seven trans-disciplinary habits of mind: Extending the TPACK framework towards 21st century learning. *Educational Technology*, 51(2), 22–28.

Mitchell, G., & Clarke, A. (2007). Videogame music: Chiptunes byte back? *Situated Play, Proceedings of DiGRA 2007 Conference*, 393–399.

Mittell, J. (2013). Wikis and participatory fandom. In A. Delwiche & J. J. Henderson (Eds.), *The Participatory Cultures Handbook* (pp. 35–42). New York: Routledge.

Montano, E. (2010). 'How do you know he's not playing Pac-Man while he's supposed to be DJing?': Technology, formats and the digital future of DJ culture. *Popular Music*, 29(3), 397–416.

Moshirnia, A. (2006). An analysis of knowledge sharing structures within modification culture. In *Proceedings of the Fourth IASTED International Conference on Knowledge sharing and collaborative engineering*, 122–127.

Moshirnia, A. (2007). The educational potential of modified video games. *Issues in Informing Science and Information Technology*, *4*, 511–521.

Nardi, B. a. (2010). Theorycraft and mods. In *My Life as a Night Elf Priest: An Anthropological Account of World of Warcraft* (pp. 137–151). Ann Arbor: The University of Michigan Press.

Nerland, M. (2007). One-to-one teaching as cultural practice: Two case studies from an academy of music. *Music Education Research*, *9*(3), 399–416.

Nieborg, D. (2004). Who put the mod in commodification ? – A descriptive analysis of the first person shooter mod culture. *Unpublished Manuscript*, (April).

Nieborg, D. (2005). Am I mod or not? - An analysis of first person shooter modification culture. *Creative Gamers Seminar Exploring Participatory Culture in Gaming*.

Nieborg, D. B., & van der Graaf, S. (2008). The mod industries? The industrial logic of non-market game production. *European Journal of Cultural Studies*, 11(2), 177–195.

O'Donnell, C. (2013). Mixed messages: The ambiguity of the MOD chip and pirate cultural production for the Nintendo DS. *New Media & Society*, 737–752.

O'Leary, J. (in press). Affinity spaces and music education. In J. Waldron, S. Horsley, & K. Veblen (Eds), *Oxford Handbook of Social Media and Music Learning*. Oxford: Oxford University Press.

O'Leary, J., & Tobias, E. S. (2016). Sonic participatory cultures within, through, and around video games. In R. A. Mantie & G. D. Smith (Eds), *The Oxford Handbook of Music Making and Leisure*(pp. 543-566). Oxford: Oxford University Press.

Ogborn, D. (2016). Live coding together: Three potentials of collective live coding. *Journal of Music, Technology & Education*, 9(1), 17–32.

Palmquist, J. E., & Barnes, G. V. (2015). Participation in the School Orchestra and String Teachers Facebook v2 group: An online community of practice. *International Journal of Community Music*, 8(1), 93–103.

Partti, H. (2012). *Learning from cosmopolitan digital musicians: Identity, musicianship, and changing values in(in)formal music communities* (Doctoral dissertation). Retrieved from http://urn.fi/URN:ISBN:978-952-5959-33-8

Partti, H. (2014). Cosmopolitan musicianship under construction: Digital musicians illuminating emerging values in music education. *International Journal of Music Education*, 32(1), 3–18.

Partti, H., & Karlsen, S. (2010). Reconceptualising musical learning: New media, identity, and community in music education. *Music Education Research*, *12*(4), 369–383.

Partti, H., & Westerlund, H. (2012). Democratic musical learning: How the participatory revolution in new media challenges the culture of music education. In *Sound Musicianship: Understanding the Crafts of Music* (pp. 300–312). Newcastle upon Tyne: Cambridge Scholars Publishing.

Partti, H., & Westerlund, H. (2013). Envisioning collaborative composing in music education: Learning and negotiation of meaning in operabyyou.com. *British Journal of Music Education*, *30*(2), 207–222.

Pasdzierny, M. (2013). Geeks on stage? Investigations in the world of (live) chipmusic. In P. Moormann (Ed.), *Music and Game: Perspectives on a Popular Alliance* (Kindle). Berlin: Springer VS.

Paul, L. J. (2014). For the love of chiptune. In K. Collins, B. Kapralos, & H. Tessler (Eds.), *The Oxford Handbook of Interactive Audio* (pp. 507–530). Oxford: Oxford University Press.

Peppler, K., & Kafai, Y. (2005). Creative coding: Programming for personal expression. Retrieved from https://download.scratch.mit.edu/CreativeCoding.pdf

Peppler, K. A., & Kafai, Y. B. (2007a). Collaboration, computation, and creativity: Media arts practices in urban youth culture. *Computer-Supported Collaborative Learning Conference, CSCL*, 8(PART 2), 586–588.

Peppler, K. a, & Kafai, Y. B. (2007b). What videogame making can teach us about literacy and learning: Alternative pathways into participatory culture. *Situated Play, Proceedings of DiGRA 2007*, 369–376.

Peppler, K., & Wohlwend, K. (2018). Theorizing the nexus of STEAM practice. *Arts Education Policy Review*.

Polymeropoulou, M. (2014). Chipmusic, fakebit and the discourse of authenticity in the chipscene. *WideScreen*. Retrieved from http://widerscreen.fi/numerot/2014-1-2/chipmusic-fakebit-discourse-authenticity-chipscene/

Postigo, H. (2007). Of mods and modders: Chasing down the value of fan-based digital game modifications. *Games and Culture*, *2*(4), 300–313.

Postigo, H. (2010). Modding to the big leagues: Exploring the space between modders and the game industry. *First Monday*, *15*(5).

Potter, J. (2012). Discursive psychology and discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 104–119). New York: Routledge.

Ratliff, B. (2007). *Why did freely shared, tracked music in the 1990's computer demoscene survive the arrival of the MP3 age?* Unpublished manuscript, International Centre for Music Studies, University of Newcastle Upon Tyne, Newcastle upon Tyne, England.

Regelski, T. A. (2013). Another perspective: A response to "toward convergence." *Music Educators Journal*, 99(4), 37–42.

Rich, P. J., Leatham, K. R., & Wright, G. A. (2013). Convergent cognition. *Instructional Science*, 41(2), 431–453.

Richards, J. (2013). Beyond DIY in electronic music. *Organised Sound*, 18(Special Issue 03), 274–281.

Richland, J. B. (2012). Discourse analysis and linguistic anthropology. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 160–173). New York: Routledge.

Rickels, D. A., & Brewer, W. D. (2014). A content analysis of social media interactions in the Facebook Band Directors Group. *Bulletin of the Council for Research in Music Education*, *201*(201), 7–22.

Rosenbaum, E. (2016). *Explorations in musical tinkering* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. AAI0830897).

Rovito, M. (2014). For the love of the game. *Electronic Musician*, *30*(9), 30–35.

Ruthmann, S. A., & Heines, J. M. (2009). Designing music composing software with and for middle school students: A collaborative project among senior computer science and music education majors. *Association for Technology in Music Instruction Conference*, 1–3.

Ruthmann, A., Heines, J. M., Greher, G. R., Laidler, P., & Saulters II, C. (2010). Teaching computational thinking through musical live coding in scratch. In *Proceedings of the 41st ACM Technical Symposium on Computer Science Education*, 351–355.

Salavuo, M. (2006). Open and informal online communities as forums of collaborative musical activities and learning. *British Journal of Music Education*, *23*(3), 253.

Salazar, S. (2017). Searching for gesture and embodiment in live coding. In *Proceedings of the International Conference in Live Coding*.

Salazar, S., & Armitage, J. (2018). Re-engaging the body and gesture in musical live coding, (June). Retrieved from https://www.researchgate.net/publication/324783054

Savage, J. (2005). Information communication technologies as a tool for re-imagining music education in the 21st century. *International Journal of Education & the Arts*, 6(2), 1–13.

Scacchi, W. (2010). Computer game mods, modders, modding, and the mod scene. *First Monday*, *15*(5).

Scacchi, W. (2011). Modding as an open source approach to extending computer game systems. *International Journal of Open Source Software & Processes*, *3*(3), 36–47.

Schäfer, M. T. (2011). *Bastard culture! How user participation transforms cultural production*. Amsterdam: Amsterdam University Press.

Schleppegrell, M. J. (2012). Systemic functional linguistics. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 21–34). New York: Routledge.

Schmidt, C. M. (1999). *Multiculturalism and the representation of culture in the 1995 elementary music series textbooks: A discourse analysis* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 9927359).

Schubert, W. H. (2008). Curriculum inquiry. In F. M. Connely, M. F. He, & J. Phillion (Eds.), *The Sage Handbook of Curriculum and Instruction* (pp. 399–419). Thou: Sage.

Scollon, S. W., & de Saint-Georges, I. (2012). Mediated discourse analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 66–78). New York: Routledge.

Shaked, V. (2013). *The meaning of music-making for computer scientists with a serious music-making avocation: A phenomenological case study* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3554739).

Sharf, B. F. (1999). Beyond netiquette: The ethics of doing naturalistic discourse research on the internet. In S. Jones (Ed.), *Doing Internet Research. Critical Issues and Methods for Examining the Net* (pp. 243–257). Thousand Oaks: SAGE Publications, Inc.

Sheffield, R., Koul, R., Blackley, S., & Maynard, N. (2017). Makerspace in STEM for girls: A physical space to develop twenty-first-century skills. *Educational Media International*, 54(2), 148–164.

Sheridan, K., Halverson, E. R., Litts, B., Brahms, L., Jacobs-Priebe, L., & Owens, T. (2014). Comparative case study of three makerspaces. *Harvard Educational Review*, *84*(4), 505–532.

Shuler, S. C. (2011). Music education for life: Building inclusive, effective twenty-first-century music programs. *Music Educators Journal*, 98(1), 8–13.

Shultz, P. (2008). Music theory in music games. In K. Collins (Ed.), *From Pac-Man to Pop Music: Interactive Audio in Games and New Media* (pp. 177–188). Burlington: Ashgate.

Sihvonen, T. (2011). *Players unleashed! Modding the Sims and the culture of gaming*. Amsterdam: Amsterdam University Press.

Simon, B. (2007). Geek chic: Machine aesthetics, digital gaming, and the cultural politics of the case mod. *Games and Culture*, *2*(3), 175–193.

Slater, M. (2016). Processes of learning in the project studio. In A. King & E. Himonides (Eds.), *Music, Technology, and Education: Critical Perspectives* (pp. 9–26). Abingdon: Routledge.

Smith, H. M. (2011). Global connections via YouTube: Internet video as a teaching and learning tool. In N. Biamonte (Ed.), *Pop-Culture Pedagogy in the Music Classroom: Teaching Tools from American Idol to YouTube* (pp. 29–43). Plymouth: Scarecrow Press, Inc.

Snoman, R. (2014). *Dance music manual: Tools, toys, and techniques* (3rd ed.). Abingdon: Focal Press.

Snyder, S. (2001). Connection, correlation, and integration. *Music Educators Journal*, 87(5), 32–39+70.

Sotamaa, O. (2007). On modder labour, commodification of play, and mod competitions. *First Monday*, *12*(9), 1–13.

Sotamaa, O. (2010a). Play, create, share? Console gaming, player production and agency. *The Fibreculture Journal*, (2000), 1–13.

Sotamaa, O. (2010b). When the game is not enough: Motivations and practices among computer game modding culture. *Games and Culture*, *5*(3), 239–255.

Steinkuehler, C., & Duncan, S. (2008). Scientific habits of mind in virtual worlds. *Journal of Science Education and Technology*, *17*(6), 530–543.

Steinkuehler, C., & Johnson, B. Z. (2009). Computational literacy in online games: The social life of mods. *International Journal of Gaming and Computer-Mediated Simulations*, *1*(1), 53–65.

Stevens, E. Y. (2016). Teacher discourses and identities: Understanding your teaching self. In K. A. Munger (Ed.), *Steps to Success: Crossing the Bridge Between Literacy Research and Practice*. Open SUNY Textbooks.

Stewart, R., Skach, S., & Bin, A. (2018). Making grooves with needles: Using e-textiles to encourage gender diversity in embedded audio systems design. In *Proceedings of the 2018 Designing Interactive Systems Conference*, 163–172. Hong Kong: Association for Computing Machinery.

Strawhacker, A., Sullivan, A., & Portsmore, M. (2016). Billund builds music: An engineering education initiative in Danish kindergartens. In *Proceedings of the 6th IEEE Integrated STEM Education Conference*, 257–261.

Sveningsson Elm, M., Buchanan, E. A., & Stern, S. R. (2009). QUESTION THREE: How do various notions of privacy influence decisions in qualitative internet research? In A. N. Marhkham & N. K. Baym (Eds.), *Internet Inquiry: Conversations About Method* (pp. 69–98). Thousand Oaks: SAGE Publications, Inc.

Swalwell, M. (2012). The early micro user: Games writing, hardware hacking, and the will to mod. *DiGRA Nordic 2012 Conference*.

Sweeny, R. W. (2017). Making and breaking in an art education makerspace. *Journal of Innovation and Entrepreneurship*, 6(1), 9.

Talbot, B. C. (2010a). Critical discourse analysis for transformative music teaching and learning: Method, critique, and globalization. *Bulletin of the Council for Research in Music Education*, *186*, 81–93.

Talbot, B. C. (2010b). *Finding a way: Discourse analysis of music transmission in Eka Sruti Illini and implications for music education* (Doctoral dissertation). Retrieved from ProQuest Dissertations & Theses Global. (Order No. 3445844).

Talbot, B. C. (2013). Discourse analysis as potential for re-visioning music education. *Action, Criticism & Theory for Music Education*, *12*(1), 47–63.

Talbot, B. C., & Millman, M. B. (2011). Discourses surrounding marginalized groups, LGBTQ issues, and music learning and teaching practices in season 1 of Glee. *Bulletin of the Council for Research in Music Education*, 1–18.

Taylor, T. L. (2006). Does WoW change everything? How a PvP server, multinational player base, and surveillance mod scene caused me pause. *Games and Culture*, *1*(4), 1–20.

Thompson, K. (2002). A critical discourse analysis of world music as the "other" in education. *Research Studies in Music Education*, 14–21.

Thornborrow, J. (2012). Narrative analysis. In J. P. Gee & M. Handford (Eds.), *The Routledge Handbook of Discourse Analysis* (pp. 51–66). New York: Routledge.

Tobias, E. S. (2012). Hybrid spaces and hyphenated musicians: Secondary students' musical engagement in a songwriting and technology course. *Music Education Research*, 14(August), 329-346.

Tobias, E. S. (2013). Toward convergence: Adapting music education to contemporary society and participatory culture. *Music Educators Journal*, 99(4), 29–36.

Tobias, E. S. (2014). Inter/Trans/Multi/Cross/New media(ting): Navigating an emerging landscape of digital media for music education. In C. Randles (Ed.), *Music Education: Navigating the Future* (pp. 91–121). New York: Routledge.

Tobias, E. S. (2016). Learning with digital media and technology in hybrid music classrooms. In C. R. Abril & B. M. Gault (Eds.), *Teaching General Music: Approaches, Issues, and Viewpoints* (pp. 112–140). Oxford: Oxford University Press.

Tobias, E. S., & O'Leary, J. (2016). Video games. In A. King, E. Himonides, & A. Ruthmann (Eds.), *The Routledge Companion to Music, Technology & Education.* New York: Routledge.

Tomczak, S. (2009). Authenticity and emulation: Chiptune in the early twenty-first century. *International Computer Music Conference.*

Tonelli, C. (2014). The chiptuning of the world: Game Boys, imagined travel, and musical meaning. In S. Gopinath & J. Stanyek (Eds.), *The Oxford Handbook of Mobile Music Studies, Volume 2* (pp. 402–426). New York: Oxford University Press.

Turino, T. (2008). *Music as social life: The politics of participation*. Chicago: The University of Chicago Press.

van Dijk, T. A. (2008). *Discourse & power*. New York: Palgrave Macmillan.

Vossoughi, S., Hooper, P. K., & Escudé, M. (2016). Making through the lens of culture and power: Toward transformative visions for educational equity. *Harvard Educational Review*, 86(2), 206–232.

Waldron, J. (2009). Exploring a virtual music 'community of practice': Informal music learning on the Internet. *Journal of Music, Technology & Education*, *2*(2-3), 97–112.

Waldron, J. (2011). Locating narratives in postmodern spaces: A cyber ethnographic field study of informal music learning in online community. *Action, Criticism & Theory for Music Education*, *10*(2), 32–60.

Waldron, J. (2012). YouTube, fanvids, forums, vlogs and blogs: Informal music learning in a convergent on- and offline music community. *International Journal of Music Education*, *31*(1), 91–105.

Waldron, J. (2013). User-generated content, YouTube and participatory culture on the Web: Music learning and teaching in two contrasting online communities. *Music Education Research*, *15*(3), 257–274.

Waldron, J., & Veblen, K. (2009). Learning in a Celtic community: An exploration of informal music learning and adult amateur musicians. *Bulletin of the Council for Research in Music Education*, 180(180), 59–74.

Wang, G., & Cook, P. R. (2004). On-the-fly programming: Using code as an expressive musical instrument. *2004 International Conference on New Interfaces for Musical Expression (NIME)*.

Webber, S. (2008). *DJ skills: The essential guide to mixing & scratching* (Kindle). Oxford: Focal Press.

Whelan, T. (2018). We are not all makers: The paradox of plurality in the maker movement. In *Proceedings of the 2018 ACM Conference Companion Publication on Designing Interactive Systems*, 75–80.

Wiggins, J., & Wiggins, R. (1997). Integrating through conceptual connections. *Music Educators Journal*, 83(4), 38–41.

Wiggins, R. A. (2001). Interdisciplinary curriculum: Music educator concerns. *Music Educators Journal*, 87(5), 40–44.

Williams, D. A. (2011). The elephant in the room. *Music Educators Journal*, 98(1), 51–57.

Williams, D. B. (2012). The non-traditional music student in secondary schools of the United States: Engaging non-participant students in creative music activities through technology. *Journal of Music, Technology, and Education*, 4(2 & 3), 131–147.

Wilson, J., & Gobeil, M. (2017). Guitars and makerspace: Examining the experience of First Nations students. *Canadian Journal of Learning and Technology*, 43(2), 1–16.

Wright, R. (2016). Informal learning in general music education. In C. R. Abril & B. M. Gault (Eds.), *Teaching General Music: Approaches, Issues, and Viewpoints* (pp. 209–240). Oxford: Oxford University Press.

Yabsley, A. (2007). *The sound of playing: A study into the music and culture of chiptunes*. Unpublished manuscript, Department of Music Technology, Griffith University, Queensland, Australia.

Zagorski-Thomas, S. (2016). How is theoretical research meeting the challenges of pedagogy in the field of record production? In A. King & E. Himonides (Eds.), *Music, Technology, and Education: Critical Perspectives* (pp. 67–84). Abingdon: Routledge.

APPENDIX A

WEB SCRAPER CODE

The following sitemap code was used to extract data from each subforum. The asterisks and text between the asterisks were replaced with the URL and title for each subforum.

{"startUrl":"**INSERT SUBFORUM URL**","selectors":[

{"parentSelectors":["_root","subforum_page"],"type":"SelectorLink","multiple":true,"id":"post_title","selector":"h3.hn a","delay":""},

{"parentSelectors":["_root","subforum_page"],"type":"SelectorLink","multiple":true,"id":"subforum_page","selector":"div#brd-pagepost-end.main-pagepost p.paging a","delay":""},

{"parentSelectors":["post_title","post_pagination"],"type":"SelectorElement","multiple":true,"id":"text_box","selector":"div.entry-content","delay":""},

{"parentSelectors":["text_box"],"type":"SelectorText","multiple":false,"id":"post_text","selector":"_parent_","regex":"","delay":""},

{"parentSelectors":["post_title","post_pagination"],"type":"SelectorLink","multiple":true,"id":"post_pagination","selector":"div#brd-pagepost-end.main-pagepost p.paging a","delay":""}

],"_id":"**INSERT NAME OF SUBFORUM**"}

APPENDIX B

INSTITUTIONAL REVIEW BOARD EXEMPTION

ASU Knowledge Enterprise
Development

EXEMPTION GRANTED

Roger Mantie
Music, School of
480/965-3170
Roger.Mantie@asu.edu

Dear Roger Mantie:

On 11/16/2017 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Multidisciplinary practices evident within publicly archived discussion forum posts within chipmusic.org
Investigator:	Roger Mantie
IRB ID:	STUDY00007371
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• OLeary_DissertationIRB.pdf, Category: IRB Protocol;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (4) Data, documents, or specimens on 11/16/2017.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Sincerely,

IRB Administrator

cc: Jared O'Leary
        Jared O'Leary
        Evan Tobias

APPENDIX C

GLOSSARY OF FREQUENTLY USED TERMS

ADSR (Attack, Decay, Sustain, and Release): ADSR shapes the sonic characteristics of a sound by controlling the amount of time it takes to get to the initial peak of a given parameter (attack), the amount of time from the initial peak to a sustained amplitude (decay), how long the sustained amplitude is held for (sustain), and the amount of time it takes to decay from the sustained level to zero or nil value of a parameter (release). For example, a person might adjust the ADSR of an instrument's amplitude to create a sound with a short and loud attack with a quick decay, sustain, and release to create a percussive instrument or sound (e.g., a snare drum, hand clap, or finger snap). Some synthesizers allow for even more controls for shaping the sonic characteristics of a sound than ADSR alone.

Arduino: An open source microcontroller that allows people to build and code digital devices, which are often used by members of chipmusic.org to create chiptunes. Find out more information by visiting: arduino.cc/

Chipmusician: Musicians who create chiptunes.

Chipscene: The larger social world encompassing chiptune practices.

Chiptunes: Electronic music compositions or performances either emulating the sounds of or created through computer and video game sound chips typically from the 1970s and 1980s. *Synonyms:* 8-bit music, chipmusic, or micromusic with subgenres or alternative names such as bitpop, Gameboy music, nerdcore, chip-hop, bitcore, fakebit, or Konami-style (Carlsson, 2008; Paul, 2014; Polymeropoulou, 2014; Rovito, 2014)

Circuit Diagram: A circuit diagram is a graphical representation of an electronic circuit. To learn more about circuits, visit en.wikipedia.org/wiki/Circuit_diagram

Clocking: Clocking is a modding process involving changing the processing (clock) speed of a device. This type of mod is also known as a "pitch mod" because a device's clock speed affects the pitch

Collective Learning: I use the etic term "collective learning" to describe discourse on community-based learning practices evident within chipmusic.org. Kafai and Peppler (2011) describe collective learning as learning practices where large groups of individuals engage in activities that revolve around "sustained, enjoyed participation within [a] community over time" (p. 19).

Collocation: Similar to concordances, collocation analysis creates a window of words to the left or right of a search term, however, collocation analysis differs from concordances by counting the number of occurrences another word appears within the window to illuminate associations and meanings of words; see Figure 14 for an example collocation of the word "circuit."

Concordance: Concordances list "all of the occurrences of a particular search term in a corpus, presented within the context that they occur; usually a few words to the left and right of the search term" (Baker, 2006, p. 71).

Demoscene: The demoscene emerged in conjunction with personal computers and video game consoles in the 1980s and "revolved around the production, dissemination, and competition of realtime generated audiovisual works (demos), demonstrating how to maximize specific hardware through unorthodox programming" (Carlsson, 2009, p. 16). Within the demoscene, crackers removed copy protection from games and added their own real-time generated audiovisual works in the form of graffiti-like signatures known as "demos" (Carlsson, 2008, 2010; Sihvonen, 2011).

Demoscener: A demoscener is a person who identifies as a participant within the demoscene.

Digital Audio Workstation (DAW): Software with a range of features designed for recording, editing, and producing music or sound. Popular examples of modern DAWs include Ableton Live, Renoise, FL Studio, Logic Pro, Pro Tools, and GarageBand.

Dispersion: The level of distribution a word appears across text, which provides an approach for better understanding context surrounding a word's usage (Baker, 2006). Dispersion plots can indicate if a word is evenly distributed across a text, indicating common usage, or used within a limited number of instances, indicating less common usage.

Emulator: Software that enable devices to run software originally designed for other hardware; for example, running a Game Boy game on a mobile phone.

Frequency Analysis: Like word lists, this technique displays a word count; however, lexical frequency analysis filters out words unrelated to determining what a corpus is about (e.g., articles such as "the," "an," or "a").

Game Boy (DMG): Nintendo's Game Boy is a handheld gaming console released in the late 1980s. DMG is an acronym for "Dot Matrix Game," Nintendo's original codename for the Game Boy. The DMG is the most pervasive hardware discussed within chipmusic.org

Keyness: A corpus analysis technique for comparing word frequencies between two sub-corpora while accounting for the relative size of two sub-corpora (Baker, 2006). Keyness techniques used within this study include keyword lists and key clusters.

Lemma: Words belonging to the same major word class or stem, with differences in spelling or inflection (Baker, 2006). An example set of lemmas within chipmusic.org is for the word "chipmusic," which includes the lemmas "chiptune," "chiptunes," "micromusic," "fakebit," "nerdcore," "bitpop," "bitcore," "nintendocore," "chip-hop," and "konami-style."

LittleGPTracker (LGPT): A music tracker with a user interface modeled after LSDJ. Unlike LSDJ, LGPT runs on a multiple portable game consoles (e.g., Game Park's GP2X, Caanoo, PSP, and Dingoo), operating systems (e.g., Windows, Max OSX, and Linux), and their respective emulators. To learn more about LittleGPTracker, visit littlegptracker.com. *Synonyms:* "piggy" or "the piggy."

Little Sound DJ (LSDJ): A tracker designed for the Nintendo Game Boy and Game Boy Color (handheld game consoles), which includes a sequencer, sound synthesis, samples, and synchronization capabilities for linking multiple Game Boys for more complicated compositions or performances. To learn more about LSDJ, visit littlesounddj.com or read D'Errico (2012).

Multidisciplinary Practices: The practices and ways of knowing that blur disciplinary boundaries. *Note: This definition is drawn from maker culture scholarship rather than scholarship on curricula.*

Music-centered Making: Maker practices that merge or blur practices from a multitude of disciplines for music-related purposes. For example, maker culture scholars might describe practices such as designing, manufacturing, and building electronic devices as *making*; however, for the purpose of this study, I describe such practices as *music-centered making* when people engage in these practices for music-related purposes (e.g., designing, manufacturing, and building an electronic musical instrument).

Open Source Software: Open source software is software with freely available source code that can be redistributed or modified. To learn more about open source software, visit opensource.org/faq

Schematic: A schematic uses common symbols to represent various components and connections within an electronic circuit. To learn more about schematics and circuit diagrams, visit en.wikipedia.org/wiki/Circuit_diagram

Soldering: Soldering is a process of joining two or more conductive items (usually a wire and a point on a circuit) by melting a conductive material with a low melting point (usually flux). In chipmusic.org, members often discussed soldering when engaging in circuit-bending practices (to create semi-permanent bends) or desoldering (the removal of solder, typically to break a connection point) when discussing repairs or alterations.

Source Code: The modifiable files (or lines of code) written in a programming language used to create software. When developers and companies release software, they often release a compiled version of the software in an easily executable format. By running source code through a compiler, this translates the source code (readable by a human) into a language easily read by a computer, which also limits or attempts to prevent the ability to modify the software. When a developer or company releases the source code in addition to the compiled code, this allows people to easily engage in the soft mod practices pervasive of the mod scene, as described in Chapter Two.

Tracker: Trackers are software that combine capabilities of music sequencers with synthesizers, often through a text-based interface, that allow a user to compose or perform live music.

Type/Token Ratio (TTR): The percentage of unique words within a text. A TTR is determined by dividing the total number of unique words (type) by the total number of words (token) to determine what percentage of words within a text are unique.

Word Cluster: Word combinations found within a concordance analysis. For instance, a cluster around the use of the word "practice" within the discussion forum in chipmusic.org could reveal different uses of the word; e.g., "*practice* chiptunes," "*practice* guitar," "this is a *practice* run," or "soccer *practice*." See Figure 8 for an example cluster within the "Audio production" subforum.

Word Lists: Word lists are computer-generated lists of words within a corpus displaying frequencies and percentage of contribution in relation to a corpus (Baker, 2006); see Figure 4.

APPENDIX D

EXAMPLE PHOTOGRAPHS FROM LIVE PERFORMANCES

Figure 46. A photo from BRKfest 2013 in Lexington, Kentucky. Source:

chipmusic.org/forums/topic/11811/brkfest-happenings-thread/page/2/

Figure 47. A photo from BRKfest 2013 in Lexington, Kentucky. Source:

chipmusic.org/forums/topic/11811/brkfest-happenings-thread/page/3/

Figure 48. A photo from BRKfest 2013 in Lexington, Kentucky. Source:

chipmusic.org/forums/topic/11811/brkfest-happenings-thread/page/3/

Figure 49. A photo from the 2014 lWlVl Festival in Brooklyn, New York. Source:

chipmusic.org/forums/topic/14368/us-ny-82223-lwlvl-festival/page/4/

Figure 50. A photo from the 2014 lWlVl Festival in Brooklyn, New York. Source:

chipmusic.org/forums/topic/14368/us-ny-82223-lwlvl-festival/page/4/
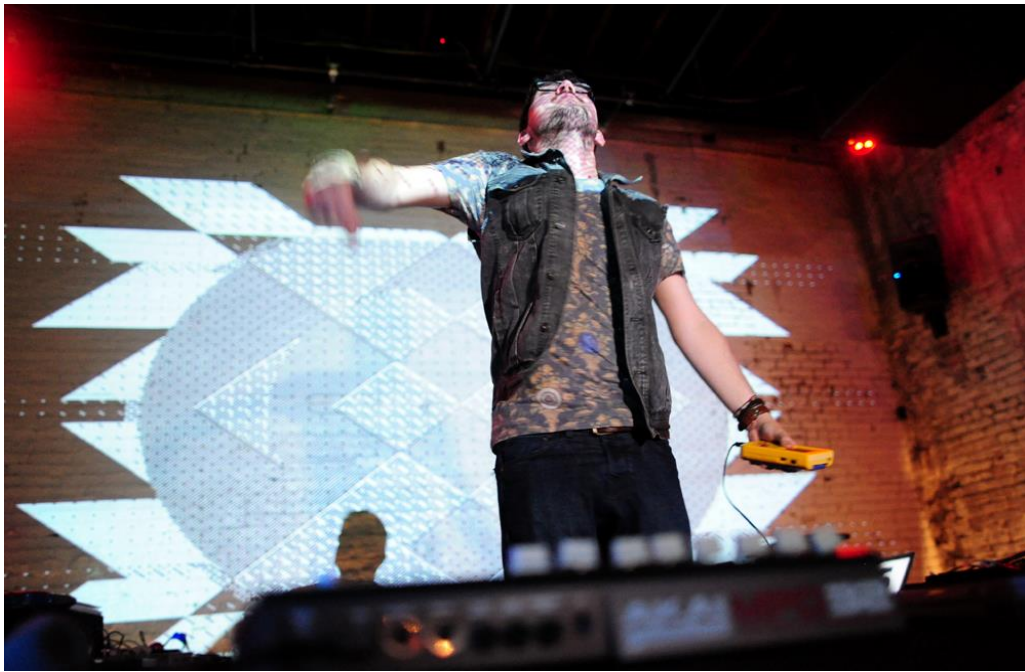
Figure 51. A photo from the 2014 lWlVl Festival in Brooklyn, New York. Source:

chipmusic.org/forums/topic/14368/us-ny-82223-lwlvl-festival/page/4/

Figure 52. A photo from the 2014 lWlVl Festival in Brooklyn, New York. Source:

chipmusic.org/forums/topic/14368/us-ny-82223-lwlvl-festival/page/4/

Figure 53. A photo of ui (the performer wearing a mask) performing with a DMG at the

2012 gamexpo in Venezuela. Source: chipmusic.org/forums/topic/9274/ui-at-gamexpo-

venezuela/page/2/

Figure 54. A photo from a 2013 Kick.Snare event in Brooklyn, New York. Source:

chipmusic.org/forums/topic/12864/us-ny-1220-kicksnare-spunky-brewster-corset-lore-

binarpilot/page/2/

Figure 55. A promotional image of Void Vision performing a show. Source:

chipmusic.org/forums/topic/1774/8static-710-phl-neil-vossvoid-visionpeter-swimmda-

pantzvblank/

Figure 56. A promotional picture of Decktonic performing with chiptune-related

hardware. Source: chipmusic.org/forums/topic/3271/8static-219-phl-crashfaster-

minusbaby-decktonic-notendo/

APPENDIX E

EXAMPLE IMAGES OF HARD MODS WITHIN CHIPMUSIC.ORG

Aesthetic Mod Example Pictures

Painting and Dying

Figure 57. A DMG with customized buttons and casing, and a yellow backlight. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/30/

Figure 58. Two painted DMGs with prosound and backlight mods. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/10/
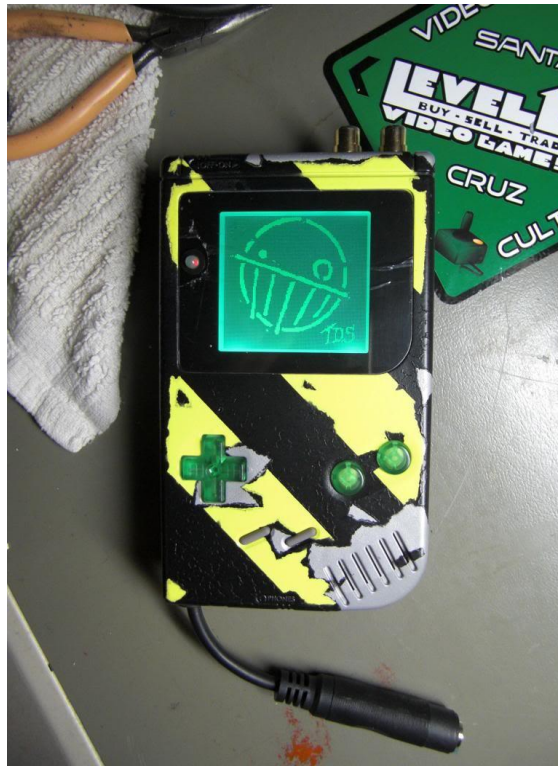
Figure 59. A DMG with customized buttons and casing, a backlight mod, and two audio

mods. Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/27/

Figure 60. An example of customizing a DMG case as well as two different backlight

mods. Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/61/

Figure 61. A DMG with modified buttons, artwork, and an inverted yellow backlight.

Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/61/

Figure 62. An example of a custom case with backlight. This "Circuit Boy" also has LEDs

in the battery case (not pictured here). Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/26/

Figure 63. A DMG case with an octopus design. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/18/

Figure 64. Two images demonstrating some members create a large number of DMG

aesthetic mods. Source: chipmusic.org/forums/topic/155/new-lots-of-new-dmgs-pg2/

Figure 65. A modified Nintendo Entertainment System (NES). Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/32/

Laser Engraving

Figure 66. Laser engraving a DMG case. Source:

chipmusic.org/forums/topic/12223/laser-engraving-take-two/page/4/

Figure 67. Laser engraving a tree on a DMG case. Source:

chipmusic.org/forums/topic/12023/laser-engraving-on-a-gbc/
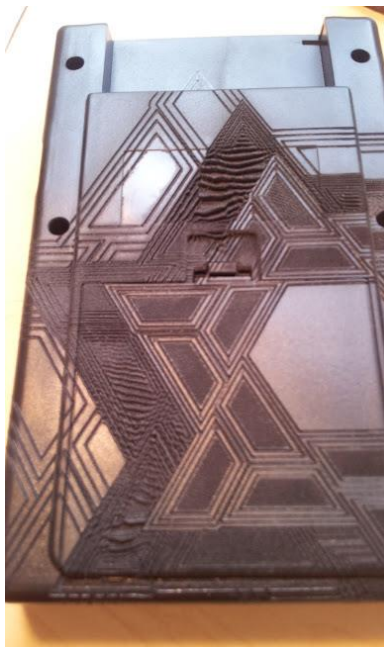
Figure 68. Laser engraving a star design on DMG case. Source:

chipmusic.org/forums/topic/12223/laser-engraving-take-two/page/2/

Figure 69. Laser engraving a DMG case. Source:

chipmusic.org/forums/topic/12223/laser-engraving-take-two/page/2/

LEDs

Figure 70. An example of a multicolored LED and a backlight mod. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/70/

Figure 71. An example of an LED mod inside a clear DMG. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/16/
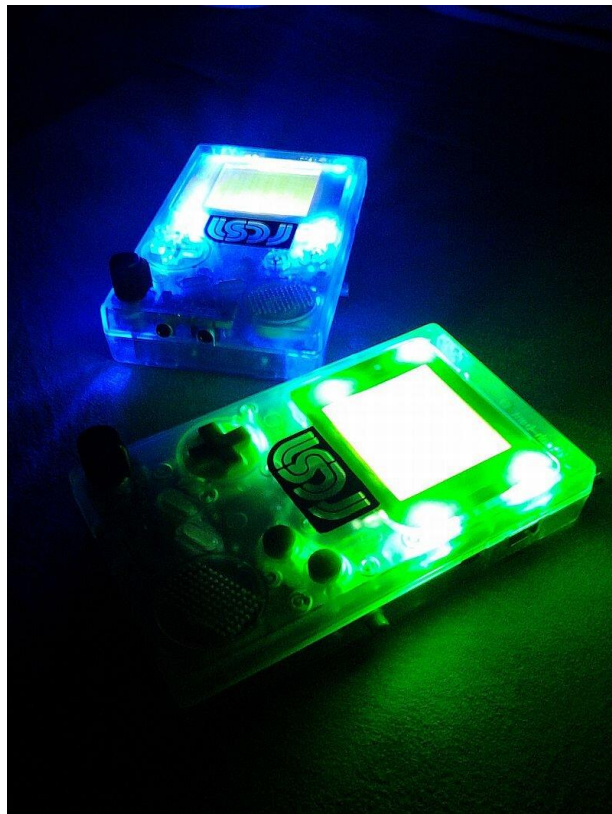
Figure 72. Two DMGs with LED mods, a clocking mod and prosound mod. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/25/

Figure 73. An example of using an LED behind the D-pad (plus sign buttons on the left),

as well as customized case, buttons, and a backlight mod. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/14/

Accessories

Figure 74. A "steampunk DMG" with gear accessory and paint. Source:

chipmusic.org/forums/topic/155/new-lots-of-new-dmgs-pg2/page/2/

Figure 75. Adding a piercing to a DMG. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/3/
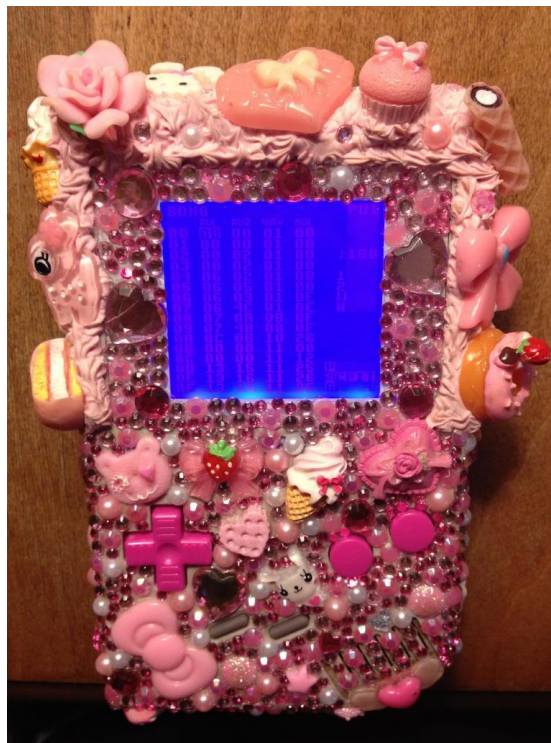
Figure 76. A DMG with attached objects and a backlight mod. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/21/

Other Physical Alterations

Figure 77. Modifying a DMG's case, buttons, and backlight to resemble a character from

a television show. Source: chipmusic.org/forums/topic/7345/customized-gear-

thread/page/72/

Figure 78. Replacing DMG buttons with buttons from a Playstation controller, custom

backlight mod, and custom case design. Source:

chipmusic.org/forums/topic/10130/d3th-st4r-wild-builds-nonsense/page/9/

Figure 79. Modifying a DMG by removing pieces to expose the electronics. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/12/

Figure 80. Modified a DMG case to make it appear broken. Source:

chipmusic.org/forums/topic/10130/d3th-st4r-wild-builds-nonsense/page/15/

Functionality Mod Example Pictures

Prosound and Audio Mods

Figure 81. Adding two ¼" audio outputs for the left and right channels. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/5/

Figure 82. Adding two audio outputs and a switch/potentiometer for clocking. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/73/

Figure 83. Adding one video and three audio outputs to the Nintendo Entertainment

System (NES). Source: chipmusic.org/forums/topic/7345/customized-gear-

thread/page/17/

Backlighting

Figure 84. Two DMGs with backlight mods. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/70/

Figure 85. An example of an inverted pink backlight installed in a DMG. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/8/

Figure 86. An example of an inverted red backlight installed in a DMG. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/2/

Figure 87. An example of a backlight mod with backlit buttons. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/14/

Clocking

Figure 88. A DMG with a switch and potentiometer to adjust the clock speed. This mod

is also known as a "pitch mod" because the clock speed affects the pitch. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/5/

Figure 89. A DMG with artwork, LEDs behind the start and select buttons, prosound audio mod, and a clock mod with switch and potentiometer (also known as a "pitch mod"). Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/59/

Figure 90. A DMG with a clocking switch and potentiometer, as well as two additional audio outputs. Source: chipmusic.org/forums/topic/7345/customized-gear-thread/page/5/

Circuit-bending

Figure 91. Adding switches to a "Speak & Music" toy. Source:

chipmusic.org/forums/topic/4136/bent-circuits-by-greightbit/

Figure 92. Adding switches and potentiometers (knobs) to a Casio Synthesizer. Source:

chipmusic.org/forums/topic/4136/bent-circuits-by-greightbit/

Figure 93. Adding potentiometers (knobs) and a button to a Simon Cowell talking bobble

head. Source: chipmusic.org/forums/topic/15247/circuit-bent-slimeon-cowell-talking-

figure/

Figure 94. Adding a potentiometer (knob) to control the pitch, toggle switches to pitch

down or loop, and a ¼" audio jack to a toy gun. Source:

chipmusic.org/forums/topic/14499/circuit-bent-stylophone-beatbox-circuit-bent-toy-

gun/

Figure 95. Adding several buttons and switches for both audio and video bends on a Sega

Mega Drive. Source: chipmusic.org/forums/topic/14965/circuit-bent-megadrive-lotus-

ii-rewire/

Figure 96. Circuit-bending the Nintendo Entertainment System (NES). Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/8/

Other Functionality Mods

Figure 97. Repurposing a Commodore 64 keyboard (pictured left) as a MIDI keyboard with several external devices (pictured right). Left image source: pixabay.com/p-2154499/?no_redirect Right image source: chipmusic.org/forums/topic/15249/c64c-mods/page/3/

Figure 98. Adding controller buttons to the Nintendo Entertainment System's (NES) case. Source: chipmusic.org/forums/topic/4601/modified-nesmidines-with-midi-in-socket-front-panel-control/

Figure 99. Adding a screen to a Nintendo Entertainment System (NES). Source:

chipmusic.org/forums/topic/10130/d3th-st4r-wild-builds-nonsense/page/21/

Figure 100. Repurposing a Wii remote as a vaporizer. Source:

chipmusic.org/forums/topic/7345/customized-gear-thread/page/50/