“KNOWING IS SEEING”: THE DIGITAL AUDIO WORKSTATION AND THE VISUALIZATION OF SOUND

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Abstract

The computer's visual representation of sound has revolutionized the creation of music through the interface of the Digital Audio Workstation software (DAW). With the rise of DAW-based composition in popular music styles, many artists' sole experience of musical creation is through the computer screen. I assert that the particular sonic visualizations of the DAW propagate certain assumptions about music, influencing aesthetics and adding new visually-based parameters to the creative process. I believe many of these new parameters are greatly indebted to the visual structures, interactional dictates and standardizations (such as the office metaphor depicted by operating systems such as Apple's OS and Microsoft's Windows) of the Graphical User Interface (GUI). Whether manipulating text, video or audio, a user's interaction with the GUI is usually structured in the same manner—clicking on windows, icons and menus with a mouse-driven cursor. Focussing on the dialogs from the Reddit communities of *Making hip-hop* and *EDM production*, DAW user manuals, as well as interface design guidebooks, this dissertation will address the ways these visualizations and methods of working affect the workflow, composition style and musical conceptions of DAW-based producers.

Dedication

To Ba, Dadas and Mary, for all your love and support.

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Chapter One: Introduction

> The Knowing Is Seeing metaphor is so firmly rooted in the role of vision in human knowing and is so central to our conception of knowledge that we are seldom aware of the way it works powerfully to structure our sense of what it is to know something. (Lakoff and Johnson 1999, 394)

> Our own lives now revolve around a more prosaic text: the computer desktop. Understanding the implications of that metaphor—its genius and its limitations—is the key to understanding the contemporary interface. (Johnson 1997, 45)

> Everybody now works with screens if they work in digital technology. It used to be that one person worked with a pencil and another person worked with a violin—totally different forms of technology—but now there is a convergence on the screen. There is something I call screen ceremony, where work is created on the screen. —David Toop (Eshun 2000, 70)

In their seminal work *Philosophy in the Flesh*, George Lakoff and Mark Johnson assert, that for the majority of us, what we see holds sway over how we understand the world; knowing is equated with seeing. Acknowledging the influence of this visual bias is doubly important in our current software-based culture, in which a large part of our acquired knowledge is mediated, structured and visualized on the computer screen. An interesting arena for the examination of this brand of visualization is the music composition and recording software called the Digital Audio Workstation (DAW), as it provides a unique example of these visual structures encroaching on a sonic art form. With the rise of DAW-based composition in popular music styles such as electronic dance music (EDM[1]) and hip-hop, many artists' (who I hereafter will be

[1] I am aware that as a moniker for the vast collection of genres that make up dance music, EDM is a problematic term. Nonetheless, as many of my online informants utilize the term, throughout this dissertation, I shall also use it to represent popular styles of music created for the purposes of dancing.

calling producers) sole experience of musical creation is through the computer screen. I assert that, the particular sonic visualizations of the DAW propagate certain assumptions about music, changing aesthetics and adding new parameters that need to be accounted for in a musical analysis. Many of these new parameters are greatly indebted to the visual structures, interactional dictates and standardizations (such as the office metaphor depicted by operating systems such as Apple's OS and Microsoft's Windows) of the Graphical User Interface (GUI). Whether manipulating text, video or audio, a user's interaction with the GUI is usually structured in the same manner—clicking on windows, icons and menus with a mouse driven cursor. In this dissertation, I will address the ways these visualizations and methods of working impact the workflow, composition style and musical conceptions of DAW-based producers. *Encyclopedia Britannica* states,

> the GUI has replaced the arcane and difficult textual interfaces of earlier computing with a relatively intuitive system that has made computer operation not only easier to learn but more pleasant and natural. (*Britannica* online)

I wish to unpack the biases and influences of this pleasant and natural system, examining the effects this intuitive and visual way of interaction has on the process of DAW-based popular music producers.

For the purposes of this dissertation, I am defining a Digital Audio Workstation as a software package that utilizes graphic representations and direct manipulation (the manipulation of on-screen graphics to affect a visual—and sonic—result) to control, record as well as manipulate audio and MIDI information. With a DAW this interaction is structured as an emulation of the recording studio mixer board—where recordings can be separated onto multiple tracks that can be controlled with tape recorder style controls, as well as graphic representations

of faders and knobs—and sequentially order their sonic representations along a timeline—where "every musical idea that exists in the piece the composer is working on must be placed in an absolute time location" (Duignan et.al. 2005, 3). There are audio editors (such as *Audacity* and the earlier programs *Sound Forge* or *Sound Designer*) and loop designers (such as *ReCycle*) that provide graphic representations of audio (and occasionally MIDI) along a timeline; however, these packages usually allow the manipulation of one audio file at a time, versus the manipulation of numerous audio files and MIDI information, separated into tracks, allowed by DAW packages (Audacity 2017; Madison Media Software 2005; Ludvig et.al. 2002). These audio editors excel in the editing of individual sound recordings, versus the DAW which allows recording, manipulation and composition of entire compositions with a multitude of tracks. Moreover, many of these sound editors lack the plethora of effects emulators and MIDI instrumentation that are packaged with the DAW, as well as the visual rhythmic grid that stratifies musical time.

With this in mind, I will investigate user manuals, instructional guides, YouTube videos, producer DAW files, advertisements, magazine reviews and online commentaries to unpack numerous visual methods for creating popular music in our computer-based age. Yet, it must be understood that the methods for creating music that I portray in this dissertation are a subset of the ways to interact with the DAW. There are many software-based producers who utilize all sorts of unexpectedly idiosyncratic approaches to music creation; for the most part, this dissertation will not focus on these users. I am interested in the common and widespread methods of musical creation and interaction, specifically ones that are frequently shared online, as I believe many reveal the biases and visual influences that owe a great debt to the GUI. As the

DAW becomes increasingly popular for music creation, understanding the visual impact of its graphics is an essential undertaking.

A large portion of my online sources have been obtained from content submitted by members of the online bulletin board system Reddit. Founded by Steve Huffman and Alex Ohanian in 2005, and currently owned by Condé Nast, it was estimated (as of 2012) that Reddit had 112 million unique visitors from over 195 countries (Singer et al. 2012). The Reddit website is partitioned in different areas of interest (called "subreddits") to which users can subscribe. Within each subreddit, users can "upvote" and "downvote" posts, giving karma points. The posts with high karmic scores are featured prominently in a subreddit's listings (where they are viewed more often), whereas lowest scoring posts are relegated to the bottom of the listings. I have taken a large portion of my examples from two subreddits, *Making hip-hop* and *EDM production.*[2] These subreddits are communities where producers can ask questions, discuss their craft, share their compositions (usually through links to *SoundCloud*) and find other artists for collaboration. Of particular interest is the *Making hip-hop* "Daily Feedback thread," which allows users to post their compositions for critique by other subscribers, the *EDM production* thread "How do I make this sound?," as well as various competition threads, such as the *Making hip-hop*'s "Flip This Challenge," where users have to sample and transform a chosen song into a hip-hop track and the participants vote on the winner. As of March 2017, *Making hip-hop* had 37,821 subscribers and *EDM production* had 86,607 (Reddit 2017; 2017a). While not every subscriber posts regularly, these subreddits are highly trafficked. For example, the *Making hip hop* daily feedback thread

[2] For my research, I examined two weeks of posts from the *Making hip-hop* and *EDM Production* subreddits, compiling a list of relevant search terms and topics. I then utilized those terms to search the rest of the contents of each subreddit. All Redditors post under pseudonyms and their posts are part of the public domain, searchable from Google or Reddit without the need of a Reddit account for access. I have made no attempts to contact or discern the identities of these posters.

regularly has over three hundred posts (Reddit 2017b). These subreddits also have excellent moderators who delete spam, organize the main page and ban users who do not follow the rules or are overly abusive.

I wish to frame this dissertation as a form of social media ethnography that highlights specific online discussions from two Reddit communities to reveal various influences of the visual and interactional design of the DAW (as well as the GUI) on the processes of these particular users. Although this dissertation is not a direct elucidation of the structure and social relations of these producer communities, I am providing an examination of these producers' processes, portraying specific ways they understand and discuss music, the DAWs they use, as well as displaying the pervasive nature of my chosen examples through supplementary Reddit citations in the glossary.[3] The specific software packages and ways of operating I explore during this dissertation represent the processes of many of my Reddit informants. There are plenty of other ways of creating music using software but (for the most part) those are not representative of the Reddit community of amateur producers I have chosen to study. In this instance, I have, for the most part, focused on language and concepts that can be found throughout these subreddits; yet, these ways of operating can also be found in many other online producer message boards and communities.[4]

During the early days of my dissertation I had an amateur rapper friend who recommended the *Making hip-hop* subreddit as an excellent resource for DAW related information. After lurking on various subreddits, I began entering the *Making hip-hop* weekly producer "Flip this challenge" competitions. At the time, I felt this process of weekly beat

[3] These supplementary examples are included in the appendices starting on page 231.
[4] Other producer communities I have examined during my research are (Dogs on Acid 2017; Future Producers 2017; IDM 2017; illmuzik 2017; KVR Audio 2017; Stones Throw Records 2017; Trance Addict 2017).

creation would spark ideas for writing topics as well as give me a better understanding of the process of sample-based creation in the DAW.[5] In fact, it was participating in these competitions that made me realize what an excellent resource Reddit could be for a researcher interested in creative processes. In their study of online ethnography methods, Garcia et al. contend "ethnographers will get a more authentic experience of an online setting if they jump straight into participation. In short, the ethnographer should attempt to experience the online site the same way that actual participants routinely experience it" (Garcia et. al. 2009, 59). Mary K. Walstrom utilizes the term "participant-experiencer" to describe this type of online ethnographer who gets involved within the community (Walstrom 2004, 175). I feel participating in the Reddit producer community by making beats has been invaluable in teasing out various roles the visuals play in musical creation with the DAW.

Other than the sheer size of its user base, I chose Reddit as the focus of my ethnography for several reasons. The Reddit community allows the user to subscribe to as many subreddits as they want; as a result, there is often a larger cross-pollination of ideas and methods between different producer subreddits than specific communities that are focused on one DAW or on one particular style of music. Most DAWs have their own message boards for questions and community discussions; nevertheless, largely consisting of desperate producers with software problems these sites usually lack the wide array of tips on musical processes and discussions of producer-created compositions (Ableton 2017b; Apple 2017a; Avid Technology 2017a; Image line 2017a; Steinberg 2017a). Also, in comparison to other online producer forums Reddit has a cleaner interface, lacking the clutter of advertisements, animated gifs and non-white backgrounds

[5] Throughout the research of this dissertation, I participated in 31 "Flip This Challenge" competitions (winning two in the process, Reddit 2013; Reddit 2014). At no time did I identify myself as a researcher or solicit questions from other Redditors.

that make text a challenge to read and search[6] (Dogs on Acid 2017; Future Producers 2017; IDM 2017; illmuzik 2017; KVR Audio 2017; Stones Throw Records 2017; Trance Addict 2017). Furthermore, I have not found a producer forum that has as robust a community as Reddit for sharing and discussing compositions in progress.

As a scholar interested in the creative processes of DAW-based artists, these subreddits offer a treasure trove of information. There are countless producers detailing their favourite methods for creation, arrangement and remixing, as well as offering advice on topics such as choosing the best DAW, defeating writers block and promoting music online. Speaking of World Wrestling Entertainment fan community message boards, Crystle Martin observes that

> connected learning environments grow from the social support of peer and friendship networks centered on shared purpose, projects, and interests. When young people are engaged with peers in these shared contexts, they learn fluidly from each other by giving and receiving feedback and sharing knowledge in timely and task-specific ways. Seeking recognition and validation by peers also provides social motivation for acquiring skills and expertise. (Martin 2014, 11)

This type of online learning environment offers a large collection of popular DAW techniques and processes that would be impossible for an ordinary researcher to access through personal interviews or surveys. Most studies of the process of DAW-users involve a small number of producers (in the articles I have examined, anywhere from 3-17) and cannot hope to encompass the breath of information detailed online (Brooker and Sharrock 2016; Duignan 2008; Eaglestone et al. 2008; Marrington 2010; Mycroft et al. 2015; Phillips 2010; Tubb and Dixon 2014; Wilkie et al. 2010; Williams 2012). While I maintain that one-on-one interviews, video

[6]This might be more of a problem for this researcher than the amateur producers I am studying, as many of these cluttered online forums give me a headache after prolonged use. Nonetheless, I believe the visual clutter can have a deleterious effect on forum users. See chapter 4 for a discussion of visual clutter and user attention. Moreover, the Reddit system of Karma points automatically puts the most popular posts at the top of the page, a boon to a researcher looking for ubiquitous methods of musical creation.

recordings of producers at work, as well as surveys are highly important—as they collect specific and detailed information of the workflow of individual producers and allow scholars to question their informants for elaboration on specific details—for an overview of processual trends, online resources cannot be beat. I believe that many of the findings in this dissertation could also point researchers to new areas of exploration in their personal interviews and surveys.

This dissertation has been largely inspired by my own musical experiences. I received a copy of the DAW *Fruity Loops* in Junior High, a few years after I started drumming in bands. Since then, I have always combined the two styles of music making in various ways—creating dance remixes of recordings made in my parents' basement, for instance. However, I always considered my work with the DAW to be more akin to my experiments creating band posters and photo montages with *Adobe Photoshop*. While the final results of my software-based creativity encompassed two vastly distinct disciplines of art, the processes of manipulation and experimentation were the same: scrolling through menus, using the cursor to navigate the screen, as well as selecting, highlighting, copying, cutting and pasting graphic objects. As the Canadian producer Deadmau5 declares in an online interview,

> ive been making music since … i was 13? perhaps? just toyed away on a piano my [grandmother] left me, until i took an interest in computers and graphic design ... and found a way to combine both! (Deadmau5 2015)

Through visual standardization, the GUI enforces the same methods of interaction across all artistic disciplines and this standardization exerts a large influence over how music is created and conceptualized in the DAW.

Encompassing four chapters, this dissertation examines various areas in which the DAW exerts a visual influence. Chapter two examines looping and the DAW. As a formative

compositional element in many a producer's musical style, I claim that there are many features and visual structures within the DAW dedicated to the creation of the loop. With this in mind, I will discuss the DAW's layout and unpack various functions and representations, as well as examining the affordances of specific DAW packages and comparing their looping credentials. I will then provide a history of the loop and recording technology, investigating perceptual and conceptual features of looped recordings, portraying various musicians and genres, as well as explicating how the technologically transgressive act of looping became concretized in many of the DAW's methods for manipulating music.

In Chapter three, I will examine the interactive visuals of the DAW. Through the GUI concept of direct manipulation, I will investigate the DAW's visual response to interactions, focusing on the topics of play, agency and manipulation. To many users, the complexity and structure of the DAW's visual feedback seems to impart greater feelings of control, pleasure and mastery than representations that offer less visual detail. Often, this optically influenced sense of enjoyment and agency encourages increased compositional manipulation, as well as a creative process that foregrounds free play and experimentation. Moreover, online, these manipulatory affordances of the DAW seem to partially drive an aesthetic that pushes manipulation as an important element in a successful composition.

Chapter four will address the DAW's spatial representation of music, examining the arrange window—the space where a composition is mapped out along a timeline. Focusing on the arrange window's interactively unique features, I will show how the DAW's particular visualization of a composition as a compound graphical object, temporally delineated and stretched across a timeline, highlights a modular form of arrangement that centers a spatial analysis of music in the producer's process. Assessing ways producers utilize this spatial analysis

to evaluate and label other compositions, as well as their own, I will also demonstrate ways this spatial representation intensifies the powerful feeling of transcending musical time by transposing the common GUI trait of navigating digital environments into the world of music. This type of navigation also creates a new form of multimodal composition and performance where producers can spatially remix their compositions in real time. Finally, examining certain theories on the effects of computer usage on human learning and the crossmodal integration of the senses, I will evaluate the downside of the DAW, discussing producers who believe the computer screen can serve as a distraction and hindrance to musical composition.

Lastly, in Chapter five I will continue with my examination of the DAW's spatialization of music by focussing on the manipulation of notes in the creation of drum grooves (rhythms that encourage dancing), revealing ways spatial representations are inculcated into a traditionally performed phenomenon. Portraying two sides of percussive notes, the attacks and decays, I will provide analyses of music created in the DAW, highlighting several methods by which producers introduce microrhythmic deviations into their compositions. I will also utilize transcriptions and waveform graphics to inspect EDM four-on-the-floor rhythms, samples from commercial libraries and trap hip-hop hi-hats in the search of the DAW's spatial influence on groove. I will also speculate as to some of the effects of these grooves, showcasing the manipulation of note decays as a form of rhythmic anticipation and citing writings that emphasize the bodily connection to musical rhythm.

Literature Review

In my examination of ways that the visuals on the screen influence the creation of music, one discipline of great interest is software studies. Matthew Fuller states,

> … Software Studies proposes that software can be seen as an object of study and an area of practice for kinds of thinking and areas of work that have not historically "owned" software, or indeed often had much of use to say about it. Such areas include those that are currently concerned with culture and media from the perspectives of politics, society, and systems of thought and aesthetics…What we can achieve though, is to show the stuff of software in some of the many ways that it exists, in which it is experienced and thought through, and to show, by the interplay of concrete examples and multiple kinds of accounts, the conditions of possibility that software establishes. (Fuller, 2008)

While Fuller contends that through software studies it should be possible to examine "every level of the software…from installation to…class libraries of already written code," I am less ambitious, focusing on the structures that can be seen on the screen (Fuller 2003, 143-144). In this instance, other authors provided many fascinating insights into the effects of interacting with the computer screen. Wendy Chun's discussions of the paradoxical nature of the visual interface, as well as her analysis of direct manipulation proved influential in many of my assertions (Chun 2011). Moreover, Rob Kitchin and Martin Dodge's monograph, examining the connection of software to spaces in everyday life alongside various articles and collections focussing on operations, technologies and interactions in the realm of software were also very useful (Kitchin and Dodge 2011; Strate 2008; Bodker 2007; Matteas and Stern 2007; Parikka 2008; Tedre and Eglash 2008). Furthermore, authors who addressed cultural issues surrounding the software interface, examining how software changes how we tell stories, how we view the world and how we think, were invaluable in providing ideas and frameworks to apply to software-based musical creation (Murray 1997; Friedberg 2006; Norman 1991; Johnson 1997). Finally, Lev Manovich's thorough examination of media software was particularly significant (Manovich 2013).

As an interactive product that can be utilized in a multitude of ways[7], the DAW is a tricky subject for examination. To assist me in this endeavour, I utilized two frameworks for analysis that take into account the multi-layered nature of software, affordances and the space of possibility. Coined by psychologist James J Gibson, the concept of affordances has been adapted by many scholars analyzing the process of computer interaction (Gibson 1979; Butler 2014, 71-72; Gall; Breeze, 2005, 417; Mollen et al. 2016, 366; Norman 2002, 9; Patrick-Bell 2015; Ware 2012, 20). They maintain that certain software interfaces afford a particular way of working. This is by no means the only way of working with an interface, just that, the ways the visuals and interactions are structured can foreground a particular way of operating.

Katie Salen and Eric Zimmerman's "Space of Possibility" is another framework that captures the multifaceted nature of DAW interaction (Salen and Zimmerman 2004). In their monograph, *Rules of Play: Game Design Fundamentals*, they provide a primer for the field of video game design, offering concepts and methodologies for understanding interactive games. Salen and Zimmerman maintain the game designer cannot entirely dictate the actions of their players; they can only indirectly influence their choices in the game space through various techniques of interactive design. This account of video gaming, emphasizing the manifold nature of interactive software, stresses that a game can be played in a multitude of ways, some that are completely unexpected by the designer. As a framework that "bridges the distance between the designed structure and the player experience," the concept of a space of possibility has many

[7] Alongside the creation of compositions from scratch, manipulating sound entirely within the software environment (which is usually the process of my online informants), The DAW can afford tasks such as live music and voice-over recording and synchronizing of sound to video.

benefits for the analysis of the influence of the DAW on the producer's process (Salen and Zimmerman 2004).

This concept is particularly useful when examining the on-screen visual response to producer interactions—what Salen and Zimmerman call "discernability" (Salen and Zimmerman 2004). Like video games, the discernable visual response that the DAW presents to producers has an affect on the possible actions that are taken when creating a composition. This discernable response connects directly with the GUI concept of direct manipulation—the act of pointing at a graphic object on the screen and affecting a visible result. Several scholarly examinations on direct manipulation were utilized to connect this interactive act to the processes of producers creating music with the DAW (Hutchins et al. 1985; Löwgren 2007; Shneiderman 1983; Thomas and Calder 2005; Wang 2014). In addition, Malcolm McCullough's assertion that direct manipulation encourages a new style of craft in software-based graphic design helped solidify my ideas concerning the manipulation of sound in the DAW (McCullough 1996).

Other articles in the field of video game studies proved useful in analyzing producers' propensity for playfully manipulating sonic events (Korhonen et al. 2009; Rusch 2008; Salen and Zimmerman 2004). Also, Brian Sutton-Smith's classic monograph, unpacking the concept of play and J. P. Guilford's concept of divergent creativity shaped my examination of many producers' playful engagements with the DAW (Sutton-Smith 2009; Guilford 1967).

For a better understanding of the ways humans process what they hear and see, I read numerous scientific papers on crossmodal studies—the ways various modalities combine and influence one another in human perception. These papers imparted background information for my thoughts regarding the ways the DAW's visualizations could affect the perception of musical

events (Boltz et al. 2009; Driver and Spence 1998; Falk et al. 2014; McGurk and McDonald 1976; Soto-Faraco and Alsius 2009; Spence 2011). Rob Hamilton and Ronald Rensink also furnished interesting analyses of the crossmodal effects available to music software designers, as well as the ways interfaces can visually overwhelm the user (Hamilton 2015; Rensink 2011).

Continuing in the scientific realm, Edward Tufte and P.R. Graves-Morris' classic monograph, *The Visual Display of Quantitative Information*, assesses various concepts for the design of data visualizations, giving me the inspiration for my reconceptualization of the DAW as a site for analysis (Tufte and Graves-Morris 1982). Similarly, Donna Cox's examination of data visualizations for interactive software was useful in applying an scientific and analytical bent to my review of the DAW's on-screen representations (Cox 2006).

In the realm of interface design, several instructional manuals detailing methods for designing interactive interfaces were vital in linking many of the visual structures of the DAW to design guidelines of the GUI (Cooper et al. 2007; Johnson 2014; Mullet and Sano 1994). Particularly useful was Chris Crawford's inclusion of the techniques, characteristics and history of computer interaction and Ware's discourse on visual thinking and its connection to interface design (Crawford 2003; Ware 2010; 2012).

While still an emerging field, there are quite a few articles written on various aspects of the DAW. Adam Patrick-Bell et al. investigate the influence of analog and digital hardware in the representations of the DAW (Patrick-Bell et al. 2015). Examining the processual differences between hardware and software, as well as the constraints and benefits afforded to the musician, they also speculate on the future of the DAW, believing that through the influence of the gaming industry, on-screen music creation will eventually evolve beyond the metaphor of older

recording technologies. Tellef Kvifte discusses several of the DAW's unique features and their implications for the practice of music composition and performance (Kvifte 2010). By detailing the DAW's relationship to gesture and performance, as well as the qualities of its executable graphic notation in comparison to standard musical notation, he highlights the blurring of the line between performance and composition endemic to this type of music software. Patrick-Bell highlights the preponderance of white male participants in the recording field as a disputation of the claim that the DAW democratizes recording technology (Patrick-Bell 2015).

Nick Prior explores the laptop as a mobile device that liberates the creation, recording and distribution of music from the traditional spaces of the recording studio and the record store (Prior 2008). He maintains that the laptop and music software "both afford and intensify music's non-materiality and hypermobility, lubricating its diffusion into myriad spaces (virtual and face-to-face) and practices (collective and individual)" (ibid., 928). To emphasize this radical departure from the traditional methods of record production, Prior provides a cultural analysis of *Ableton Live*, stressing its unparalleled differences from other software emulations of the hardware recording studio (ibid., 912). In contrast, Sergi Jorda provides a fascinating history of computers as interactive live musical instruments. Citing "idiosyncratic programs" such as *Music Mouse, M, Jam Factory* and "interactive sequencers developed by the company DR. T," he stresses *Ableton Live*'s membership in a lineage that began in the 1990s (Jorda 2007, 92).

Ian Reyes argues that in the digital realm, techniques for analyzing and manipulating sound are being supplanted by non-auditory modalities. He argues that through diverse technologies, such as the visuals of the DAW, reference speakers, room correction systems, open mixes, pre-sets, social networking sites and automatic music information retrieval systems, there is a trend in digital audio "toward producing more information about sound while reducing the

amount of critical listening needed to produce and understand that information" (Reyes 2010, 336).

Mark J. Butler provides a fascinating survey of performance, composition and improvisation in electronic dance music, detailing various technologies (including the DAW), interviewing artists and reconceptualising the concept of musical performance for the software and DJ era (Butler 2014). Moreover, his earlier monograph offers a framework for analysis that includes transcription, detailed rhythmic analysis, as well as concepts from Western Art Music in order to depict and transmit important elements of electronic dance music (Butler 2006).

Many authors' utilization of the DAW as a tool for visualizing and analysing various rhythmic and timbral elements assisted in structuring my own sonic visualizations of producer-created rhythms (Brøvig-Hanssen 2010; Clarke 2010; Danielsen 2010; 2012; Lacasse 2010).

Numerous examinations of the processes of DAW-based producers provided background to my writing. For instance, through video recordings of classes in session, as well as interviews with students and teachers, Marina Gall and Nick Breeze examine the "multimodal affordances" presented by music composition software in the hopes of discovering new "opportunities for students to engage in composition work in the classroom" (Gall; Breeze 2005, 415). Conversely, in an effort to improve the design of music software, Katie Wilkie et al., extracted the conceptual metaphors utilized by three musicians when discussing a piece of music and compared them to the visual metaphors utilized in the DAW (Wilkie et al. 2010). By finding the gaps between how a musician conceives of the sonic domain, versus how it is represented on the computer screen, Wilkie et al. believe they can pinpoint the locations where DAW "designs could be improved to better support musicians' understanding and tasks" (ibid., 2).

Philip Brooker and Wes Sharrock assessed video and sound recordings of two amateurs collaboratively composing with the DAW (Brooker and Sharrock 2016). Utilizing ethnomethodology and conversation analysis to attend to the "visible and audible interactions occurring between people—talk, body orientation, pointing, gazes, and so on—and how those interactions organize the activity" of sonic creation, they consider the ways the features of the DAW influences the structure of their informants' collaborations (ibid., 464; 476). Presenting his findings from a two-year stint of supervising six university students working with the DAW and the music composition software *Sibelius*, Mark Marrington attempts to address the difficulties of teaching music composition in the digital age (Marrington 2010). Through this study, he provides examples of the multifaceted ways music composition software can influence musical creation, a process he claims is "entirely dependent upon the specific nature of the literacy that the student brings to it" (ibid.). Briefly highlighting elements such as the effects of visuals on the composition process, as well as the ways the digital realm can transcend non-digital methods of composition, Marrington's goal was to understand the "extent to which the students *themselves* understood the nature of the medium they were employing and the impact it has upon their approach to writing music" (Marrington 2010).

Through ethnographic observation, Alan Williams examines the influence of the computer monitor in the recording process (Williams 2012). Stressing the DAW's democratizing potentials, its visual distractions as well as its conceptualization of music as a graphic sound object, Williams seeks to demonstrate ways that "the visual representation of recording practice…has truly transformed the recording industry" (Williams 2012). Utilizing a web-based survey, Barry Eaglestone et al. tested musicians' cognitive styles when composing, placing these informants into four possible dimensions, "global/analytic, imager/verbaliser, intuitive/sensing,

active/reflector" (Eaglestone et al. 2008, 467). The informants' cognitive styles were then correlated to the users' satisfaction with their music software, assessing whether their cognitive needs were met or ignored by various interfaces.

By means of personal interviews with a mixture of professional, semi-professional, hobbyist producers, musicians and recording engineers, William Phillips provides an excellent dissertation that assesses how the democratizing nature of the DAW has transformed the production and creation of music (Phillips 2010). Alongside the examination of the changing culture of the recording studio, Phillips probes many different facets of the new economies spawned by digital recording and the DAW, portraying Do-it-yourself manufacturers, the rampant consumer condition of "gearlust," as well as online collaborations for group-purchasing of expensive audio equipment (Phillips 2010, 184). Phillips also touches on the workflow of DAW-based producers, assessing the qualities of digital recording as well as the excess of manipulatory desire that can infect screen-based producers.

While Phillips largely covers participants who are interested in recording performers or simulating performances of rock music, Matthew Duignan focuses more intently on electronic music producers and the visual abstractions of the DAW. Through interviews and observations of seventeen professional producers, his dissertation portrays the pros, as well as the cons, of working with the abstractions presented by various DAWs (Duignan 2008). Through the in-depth examination of four classes of abstraction—process abstraction, voice abstraction, temporal abstraction and reuse and versioning abstraction—Duignan concludes his dissertation by proposing many improvements (some large and some small) to the workings as well as the representations of the DAW (ibid., 3). Building on this dissertation, Duignan et al. explore the issues that producers have with the visual abstractions of the DAW. Utilizing the same categories

as Duignan's dissertation, this article clearly summarizes several areas in which the DAW needs improvement in its visual representation of music (Duignan et al., 2010). Finally, Duignan et. al.'s creation of a taxonomy for software sequencers aided me in my own examination of the features of the DAW (Duignan et. al. 2005).

Adam Patrick-Bell's dissertation focuses on home studio producers through interviews and video recordings, dissecting ways four producers learn and utilize recording devices (from microphones to DAWs), as well as examining some of the implications for music educators (Patrick-Bell 2013).

Kristian Gohlke et al. seek ways to improve the DAW's visual representations, removing excessive visual clutter while incorporating more expressive and goal-oriented visualizations, such as better global views, more extensive representation of pitch and timbre, as well as an ameliorated comparison between the before and after of a manipulation (Gohlke et al. 2010). Mycroft et al. maintain that the mixer-board emulation of the DAW quite often hinders a user's ability to mix and navigate a composition (Mycroft et al. 2015). More specifically, they contend that scrolling interfaces, where a portion of the visual information is located off the screen, are detrimental to a producer's workflow when mixing. To examine this assertion, they tested nine participants, utilizing three different interactive visualizations of multi-track audio (including the DAW's representation), testing the participants with specific mix information (such as the location of sonic representations, as well as the panning of specific audio tracks), and then timing their responses. Through "real-time computer data, video recording and unstructured and semi-structured interviews," Ralf Nuhn et al. study the working methods of electroacoustic music composers in order to discover how composition software aids or hampers the creative process (Nuhn et al. 574).

Moving to examinations of different kinds of music software, Robert Tubb and Simon Dixon sought to emphasize a serendipitous form of software-based composition, where users could stumble upon unexpected musical combinations and manipulations (Tubb and Dixon 2014). Questioning users and logging interactions with their music app, featuring a number of different interfaces, Tubb and Dixon discovered methods to design an interface that could balance the level of control afforded over navigation and manipulation, allowing the creation of happy accidents without resorting to a completely random interaction style. Whereas David Cecchetto's *Exurbia* provides an excellent example of sound manipulation software that avoids the visual emphasis of the DAW (Cecchetto 2013).

Chris Nash and Alan Blackwell provide two fascinating and in-depth articles studying the usage of music trackers, a form of music creation software that represents sonic events as numerical values and is almost entirely controlled by the computer keyboard (Nash; Blackwell 2011; 2012). In their extensive two-year study of the workflow of over 1,000 tracker users, utilizing "interaction logging, user surveys, and a video study," these authors explicate that the tracker's method of interaction enables the user to create in a more fluid and virtuosic manner than those who have to deal with the complex visuals and multiple windows of the DAW (Nash and Blackwell 2012, 1).

Investigating more esoteric systems for musical performance, Thor Magnusson evaluates the constraints of performing while interacting with the computer (Magnusson 2006; 2009). As opposed to the options for control an interface affords a musician, he believes constraints are what define "the primary character" of a computer-based instrument, as they are only "understood through engagement and experience" with the interactive system (Magnusson 2006, 71; 64).

In the area of music analysis, several authors' explications of the metaphors we use to comprehend, analyze and discuss music provided me with an excellent base for comparison with the visual metaphors put across by the DAW (Cox 1999; Johnson and Larson 2003; Zbikowski 2002). Also, Mark Evan Bonds' excellent history of the spatial representation of music, Martin Boykan's repudiation of this type of representation, as well as Daniel Rosenberg and Anthony Grafton's general history of the influence of the timeline in the spatialization of temporal events provided the scaffolding for my own analysis of the DAW's spatial representation (Bonds 2010; Boykan 2004; Rosenberg and Grafton 2013). Steve Goodman and Julian Sefton-Green's examination of the timeline in sound recording, as well as video and animation software also proved invaluable (Goodman 2008; Sefton-Green 2005).

Many monographs examining the history of electronic music were assistive in compiling my dissertation. For instance, David Cronin provides an overview of the evolution of digital instruments from sequencers to software synthesizers to *Ableton Live* (Cronin 2008). Focussing on user interfaces, he discusses elements such as fluency, simplicity versus complexity, visual feedback and the changing definition of musical instruments in the digital realm. Moreover, through an analysis of several recordings made by pop music producer Trevor Horn between 1979 and 1985, Timothy Warner provides a detailed enumeration of the changes brought about by the rise of digital recording (Warner 2003).

In contrast, Jay Hodgson traces the history of recording practice from the 1940s to modern times. Providing numerous musical examples, he enumerates various forms of recording technology, lists their characteristics and catalogs various techniques utilized by recording engineers (Hodgson 2010). Taking a different angle, Mark Brend focuses on the 1960s, detailing the rise of electronic music in the mainstream through the stories of manufacturers, popular and

avant-garde musicians, as well as television and film composers (Brend 2012). Curtis Roads, Nick Collins and Simon Barber also offered excellent resources for historical as well as technical details regarding computer and electronic music technologies (Roads 1996; Collins 2010; Barber 2012).

A particularly illuminating history of electronic music, as well as an extensive collection of interviews with popular and avant-garde musicians, can be found in the collection *Modulations: A History of Electronic Music: Throbbing Words on Sound*. Of particular interest were Chris Sharp and Kodwo Eshun's examination of Jungle and house music, Mike Berk's analysis of analog and digital technology, as well as Kurt Reighley's excellent interviews with electronic musicians (Sharp 2000; Eshun 2000; Berk 2000; Reighley 2000). Finally, books detailing the accounts of specific albums and recording artists, DJs processes, as well as many excellent histories of popular electronic music, hip-hop and recording technologies served to enlighten many aspects of my dissertation (LeRoy 2007; Weingarten 2010; Emerick and Massey 2006; Brewster and Broughton 2006; Katz 2012; Reynolds 1998; Chang 2010; Milner 2009; Suisman, 2009). Furthermore, Joseph G. Schloss's excellent ethnographic research with hip-hop producers, Tara Rodgers' analysis of the process and aesthetics of digital samplers as well as Paul Théberge's examination of the commodification of sounds in electronic music informed many of my thoughts on looping and digital samplers (Schloss 2004; Rodgers 2003; Théberge 1997).

Many monographs and articles helped me to understand the elusive phenomenon of groove. For instance, Charles Keil's theory of participatory discrepancies, as well as Simon Zagorski-Thomas' interrogation of its application in the realm of recorded sound were helpful in addressing several methods utilized by DAW-based producers to create grooving rhythms (Keil

2007; Zagorski-Thomas 2007). Vijay Iyer and Anne Danielsen's extensive analyses of the microrhythmic deviations in the rhythms of African-American music in general, as well as specific works by James Brown, Parliament and Michael Jackson, assisted in portraying ways these stylistic deviations translated to processes on the computer screen (Danielsen 2012; 2006; Iyer 2002). Jeff Greenwald and Zagorski-Thomas also produced informative incursions into the processes and conceptualizations of groove in the areas of sample-based music and recording software (Greenwald 2002; Zagorski-Thomas 2010). Also, my survey of producers' understanding of swing was ameliorated by the writings of several authors (Friberg and Sundströöm 2002; Honing; De Haas 2008; Kvifte 2007). Finally, other authors aided in my speculations concerning groove, the body and the effects of certain rhythmic characteristics on listeners (Burrows 2007; Butterfield 2006; Huron 2006; Zeiner-Henriksen 2010). In particular, Tiger Roholt's highly informative monograph on the phenomenology of rhythmic nuance, which posits (amongst other things) that a groove can only be truly understood by the body, as well as Adam Parkinson's examination of embodied listening and the computer, which asserts that listening involves the whole body, provided many fascinating tidbits for my dissertation (Roholt 2014; Parkinson 2013).

Alongside consulting many historical reviews and technical articles from *Keyboard* and *Electronic Musician* Magazine, I also referenced numerous books that provided technical instructions for composing utilizing various recording technologies from the DAW to audio tape (Dwyer 1971; DeSantis 2015; Edstrom 2006; Izhaki 2013; Keane 1980; Mixerman 2012; Owsinski 2014; Roseman 2007; Sharooz and Felton 2010; Snoman 2008). To further flesh out my arguments, I pored over the instructional manuals from various DAWs, as well as other

forms of audio software (Ableton 2015; Adobe 2013; Antares 2014; Apple 2006; 2013; Avid Technology 2015; Bachmann et al., 2015; Dambrin et al. 2015; Digidesign 2008).

Lastly, various authors proved informative with regard to online ethnography, as well as the utilization of Reddit as a resource (Bergstrom 2011; Garcia et. al. 2009; Martin 2014; Walstrom 2004; Weninger et. al. 2013).

Chapter Two: Looped Affordances: The History and Process of Looping with the DAW.

> Human-Computer Interface (HCI) is obviously one area that should be turned to. This is, after all, the point at which the machinations of the computer are compelled to make themselves available in one way or another to a user. The way the computer makes available such use, and the assumptions made about what possible interactions might develop, are both fundamentally cultural. (Fuller 2003, 12)

> … the digital audio workstation, through its affordances of copying, pasting and looping, assures us that it is perfectly normal to repeat the same short performance over and over in the same track. (Magnusson 2009, 172)

> Is there anything on earth that doesn't sound better looped?
> (Tiga 2013)

Loops—brief repeated segments of recorded sound—are a consequence of the dissemination of audio recording. By harnessing the repetition of sonic events and subverting the temporal flow of recordings, looping artists make recorded time their own. Looping—the art of creating, combining, editing and manipulating short recorded passages as a form of musical composition—makes up a large portion of the music created with the Digital Audio Workstation. With the DAW, there are many on-screen visual structures and features designed to assist in the creation of loops. These features are constantly utilized by the hip-hop and Electronic Dance Music (EDM) producers that are the focus of my dissertation, as looping constitutes a large part of their process. Hence, through an examination of looping, I will provide an overview of the DAW's layout, enumerating various functions and biases as well as tracing the development of automated repetition from the earliest tape loops to the on-screen looping of DAW-based artists. Alongside the influence of the studio mixer board and elements of tape recording, I contend that

the looping act has a large influence over the design, workflow and marketing of various DAWs. Through the concept of affordances, I will portray that influence, cataloguing various ways the visual structures of the DAW impact the producer and assists in the goal of creating the perfect loop.

Coined by psychologist James J. Gibson, the term affordance connects perception to action. How an animal (this includes the human animal) perceives an object or an environment is entirely dependent on the possibilities the animal believes the environment or the object affords in the way of interaction. Gibson writes,

> … psychologists assume that objects are composed of their qualities. But I now suggest that what we perceive when we look at objects are their affordances, not their qualities. We can discriminate the dimensions of difference if required to do so in an experiment, but what the object affords us is what we normally pay attention to. (Gibson 1979, 133)

Thus, affordances are "perceivable possibilities for action" (Ware 2012, 18). This process is dependent on the object, as well as the viewer. Certain objects and environments emphasize particular forms of interaction, based on their physical qualities, and humans will perceive different affordances, based on their backgrounds and their needs. To Gibson, an "affordance points both ways, to the environment and to the observer" (ibid. 130). The particular affordances of an object do not dictate the only ways it can be utilized, just that the qualities of a specific object foreground particular methods of interaction. This theory has been adapted by many scholars as a method of analyzing ways certain objects emphasize various forms of interaction while minimizing others (Gall and Breeze, 2005, 417; Mollen et al. 2016, 366; Norman 2002, 9; Ware 2012, 20). The frequent example used by scholars is that of a chair. A chair affords sitting

as its most common mode of interaction; yet, a chair can also be carried or stood on. Clarke observes that to a human being

> … a wooden chair affords sitting on, while to a termite it affords eating. Equally, the same chair affords use as a weapon to a human being who needs one (a illustration of the way in which an organism's changing needs affect affordances)—as in the archetypal barroom brawl. The relationship really is dialectical—neither simply a case of organisms imposing their needs on an indifferent environment, nor a fixed environment determining strictly delimited behavioral possibilities. (Clarke 2003, 118)

By making certain interactions easier to accomplish, the DAW's visual structures afford certain ways of manipulating a musical composition.

With this in mind, I will first provide an overview of the DAW's affordances, portraying the ways the software's visual representations affect a particularly Western style of popular music composition, relating these visual structures to the Western bias present in most of the software visualizations we see everyday. The ways producers utilize the DAW also depends on their musical priorities—such as the style of music they are composing. To some users, the DAW affords the multi-track recording of rock bands, to others it affords the creation of loop-based tracks to accompany a rapper or drive a dance floor wild. While all DAWs have visual structures that assist both types of musical creation, some place more emphasis on recording, whereas others afford a more loop-based style of composition. I will address these affordances, examining several functions and operations, as well as the ways they are described in several user manuals, to portray the manipulatory and recorded emphasis supplied by various DAWs. Finally, I will focus my sights entirely on looping, depicting how the looping-act has evolved from tape loopers to the current screen-based era, commenting on these technologies' loop-based affordances and displaying ways earlier recording technologies, as well as the looper's misuse of

said technologies, were eventually inculcated into the workings of the DAW. In this instance, a history of looping has much to reveal about the visual structures and ways of operating afforded by the DAW and the ways these structures hold sway over the processes of current hip-hop and EDM producers. First, however, I need to introduce several features of the DAW and their representation within the Graphical User Interface.

The Graphical User Interface (GUI) and the DAW

The computer's Graphical User Interface (GUI) is the visual representation of data as interactive icons and navigable on-screen graphics. This representation usually takes the form of a simulation of a real world system. For instance, most operating systems with their files, folders, desktops and trash bins are a graphical representation of the traditional office. Instead of controlling the computer through code, typing in some lines to accomplish tasks, users could simply manipulate a graphic within their simulated desktop. However, the tactile immediacy of the GUI only functions if the user is familiar with the representation. People were familiar with the function of garbage bins and file folders, thus, the transition to the virtual workspace was greatly simplified. This is also true for DAWs, which adopt the mixer board representation, a highly familiar visualization for users who have worked in professional recording studios (Duignan et al. 2004, 116). Just as with a traditional mixer board, producers can control multiple tracks, changing the volume with faders, manipulating knobs to control effects and pressing buttons to mute, solo and set-up a track to record. Another important DAW metaphor is the waveform, the visual representation of sound. Inspired by "oscilloscope displays," the waveform shows sound amplitude vertically and the passage of time horizontally (ibid., 118). This visualization displays the rhythmic and dynamic qualities of musical events, allowing for easy manipulation. The other major sonic representation of the DAW is MIDI (Musical Instrument

Digital Interface). MIDI encodes performance details such as pitch, rhythm, velocity (the dynamics of each note) and tempo, as well as control data such as the knob turns of an external MIDI controller. Designed by Dave Smith in 1981, MIDI was originally considered a Universal Synthesizer Interface, allowing various synthesizers to communicate musical information to one another, locking tempos, as well as sending information concerning the temporal location, frequency and the volume of each note (Collins 2010, 47). In every DAW, MIDI notes are visualized as rectangles on the "piano roll," a grid that displays musical time on the horizontal axis and pitches (delineated by semitone) on the vertical axis (Apple 2013, 40; Ableton 2015, 138; Avid Technology 2015, 12; Bachmann et. al., 686; Dambrin et al. 2015). Thus, the length and temporal location of a MIDI note can be discerned by where it starts and how far it stretches across the horizontal axis, while its pitch can be seen by its location on the vertical axis. MIDI can be recorded utilizing an external MIDI controller (such as a keyboard) or the notes can be individually inserted by hand with a mouse. MIDI notes need to be applied to a MIDI instrument to be heard and most DAWs come packaged with various MIDI instruments (such as emulators of pianos, electric keyboards and synthesizers). There are also many third party companies who make MIDI instruments that can be purchased and easily inserted into the DAW. MIDI is a timbrally flexible way of operating as MIDI notes can easily be applied to any MIDI instrument. Utilizing virtual samplers, producers can drag their own sounds into the DAW, visualize them in the piano roll and trigger them with their MIDI keyboard, or insert the notes by hand.

All these visual representations of sound are arranged in the DAW's arrange window, where tracks are demarcated vertically and musical time is horizontally gridded into various musical and temporal subdivisions of the producer's choosing.[8] In this area, producers can

[8] Such as bars, as well as half, quarter, eighth, sixteenth and thirty second notes.

organize their various sounds, loops and samples into a full composition. Each DAW has a different name for this area: *Logic* calls it the "Tracks Area," *Cubase* the "Event Display," *Pro Tools* the "Edit Window," *FL Studio* "The Playlist" and *Ableton Live* the "Arrange Window" (Apple 2013, 69; Bachmann 2015, 44; Avid Technology 2015, 160; Dambrin et al. 2015; Ableton 2015, 89). Throughout this dissertation, I am going to utilize the term "Arrange Window" as an umbrella term to encompass these various titles.

In their 2016 poll, the website *Music Radar* lists the ten most popular DAWs: *FL Studio, Ableton Live, Cubase Pro, Logic Pro, Studio One, Reaper, Sonar, Reason, Pro Tools* and *Bitwig Studio* (Music Radar Team 2017). For brevity's sake, I will be focusing on: *FL Studio, Ableton Live, Cubase, Logic* and *Pro Tools*.[9] These DAWs all have a similar architecture and workflow (the way they represent and structure the audio interaction). They all contain a mixer-board simulation, represent sonic events as waveforms and MIDI as well as allow producers to organize their composition in an arrange window. They are also the DAWs that seem to be mentioned the most by my Reddit informants. According to Hodgson,

> I do not think it matters all that much which particular workstation Recordists ultimately choose to adopt. Almost every workstation shares most of its functionality with every other workstation. Only the workflow, that is, the sequence of mouse clicks that are required to make use of those capacities—and particular synthesis, sampling and signal processing capabilities—change from DAW to DAW. (Hodgson 2010, 559)

[9] These are also the DAWs that seem to come up the most during Reddit discussions.

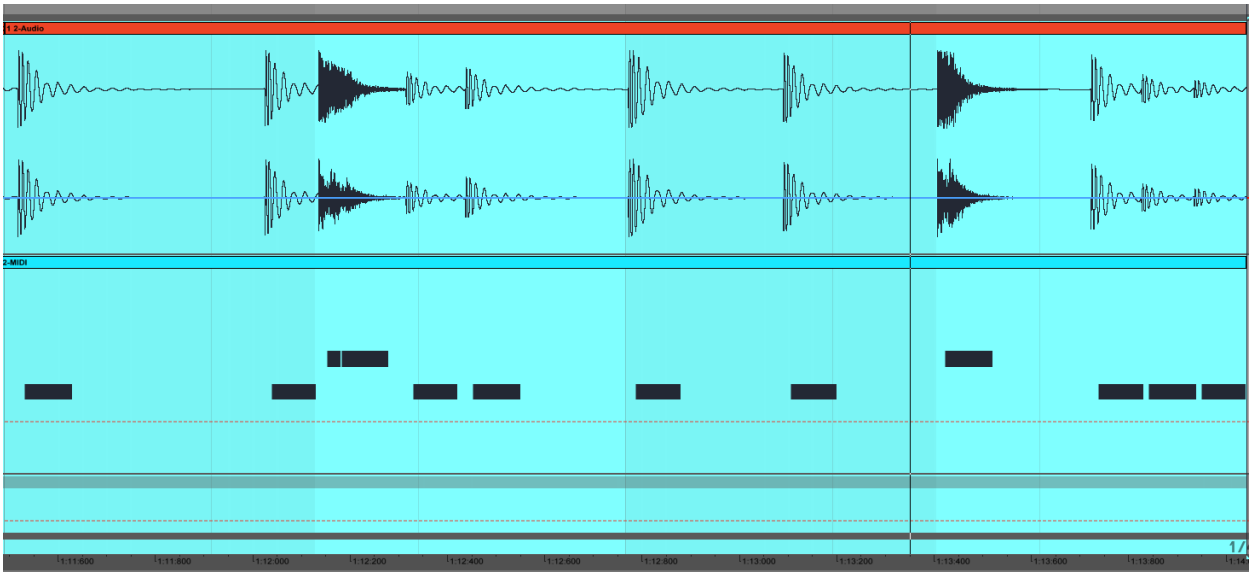

Figure 2.1: Waveform representation (top) and MIDI (bottom)

Figure 2.2: Mixer-board emulation in *Logic*.

While for the most part I agree with Hodgson that these DAWs do provide the same functionality for editing and recording sound, the ways particular DAWs structure their interactions, placing manipulatory emphasis on certain tasks while minimizing others, do exert an influence over the producer's process. In the next section, I will examine the visual structures that my chosen DAWs have in common, as well as the differences that separate them, highlighting the particular biases that they transmit to their users. I believe these five DAWs provide an excellent cross section of the different affordances that on-screen visual structures can offer a producer.

The Western Affordances of the DAW

Speaking of designing video games, Matteas and Stern observe that

> in interface design, Affordances are the opportunities for action made available by an object or interface. But Affordance is even stronger than implied by the phrase "made available"; in order for an interface to be said to afford a certain action, the interface must in some sense "cry out" for the action to be taken. There should be a naturalness to the afforded action that makes it the obvious thing to do. For example, the handle on a teapot affords picking up the teapot with your hand. The handle cries out to be grasped … Thus these resources not only limit what actions can be taken "the negative form of constraint" but cry out to make certain actions obvious (the positive form of constraint). (Matteas; Stern 2007, 653)

The visual organization of the DAW affords compositions created in the style of Western popular music. The DAW cries out for producers to compose evenly-subdivided, non-microtonal, temporally consistent music in 4/4-time. There are ways to circumvent these dictates (some easier than others), but by making certain compositional manipulations more straightforward the DAW definitely foregrounds the creation of tracks that have a Western popular music bent. For instance, the default setting for all DAWs when a new file is created is a 4/4-time signature at 120 beats per minute (bpm). The producer can easily change these parameters; yet, when creating a new composition, the most common time signature (and

depending on the style, the most common bpm) in popular music is emphasized. Kitchin and Dodge write,

> sophisticated applications have hundreds of functions and tools, most of which come with default settings that provide "acceptable" or "appropriate" results, from the perspective of the software designers and corporate vendors. Many users never change the defaults; some are little aware of the degree to which what they create is shaped by those defaults. The result is that the products of certain software applications can often have a look that is identifiably shaped by the default settings. (Kitchin and Dodge 2011, 123)

Another structure that offers a Western conception of music is the MIDI piano roll, which is organized on a semitone scale. Dependent on the MIDI instrument, microtonal changes can be achieved through a pitch bend operation (controlling the pitch variation through cents or hertz), but this would require more work, and the producer would have to draw in pitch variations by hand (Ableton 2015, 331). Usually, in the DAW, microtonal changes can only be achieved by pitch shifting waveforms and not in the realm of MIDI.[10] Furthermore, these microtonal operations are usually hidden from view, versus the semitonal organization of the MIDI piano roll that is constantly displayed in the producer's field of vision.

Additionally, the grid that the DAW utilizes to visually subdivide musical time can only be set to familiar Western subdivisions of the pulse. *Cubase* visually subdivides their grid up to 1/128th notes and 1/64th triplets, *Pro Tools*: 1/64^{ths} and *Logic* 1/192^{nds} (Bachmann et. al 2015, 240; Apple 2013, 148; Avid Technology 2015, 498). All these are multiples of the common subdivisions of quarter, eighth and sixteenth notes. Creating odd subdivisions, such as quintuplets, septuplets or nonuplets, would have to be accomplished by ear without the visual

[10] When discussing microtonal deviations, the Ableton Live manual compares them to the more familiar semitones, asserting, "The Detune field fine-tunes the clip in cents (100 cents = one semitone)" (Ableton 2015, 130).

assistance of the grid. Similarly, creating microrhythmic deviations that do not fall within any notational subdivision have to be accomplished by turning off the grid and dragging each note manually. It is possible to create odd subdivisions and microrhythmic deviations (and this is done quite often[11]); nonetheless, the visual representation of the DAW affords the composition of tracks that are subdivided by the common popular music subdivisions.

The grid of the DAW also visually affords a particularly Western pop music format for arranging a track. The grid provides a clear hierarchy that puts emphasis on particular metric locations through the use of bolding and shading. In all DAWs, the beginning and ending of each bar is accentuated through bold lines. In this way, beat one of each bar can be easily discovered and temporal lengths can be measured at a glance, subtly placing emphasis on the beginnings of bars as the most important metrical division. *Ableton Live* provides an even more detailed visual hierarchy for its grid, placing greater significance on four and eight bar divisions of time through the use of shading. These shaded sections change depending on the level of magnification. On a close view, every other bar is shaded. When the user zooms out, the arrange window swaps to shading alternating four bar sections and upon further zooming out, eight bar sections are alternately shaded (See Figure 2.3). In this instance, the most common divisions of popular song forms are visually stressed for ease of use, as the producer can look at the shaded or non-shaded sections and instantly know if it is a four or eight-bar division when building a song. This creates a hierarchy where these even divisions are deemed more important because they visually stand out. Johnson posits that a visual hierarchy

> … allows people, when scanning information, to instantly separate what is relevant to their goals from what is irrelevant, and to focus their attention on the relevant

[11] See chapter 5 for a discussion of this process.

> information. They find what they are looking for more quickly because they can easily skip everything else. (Johnson 2014)

By making these even divisions stand out, *Ableton Live* is reinforcing standard popular song forms through visual emphasis,[12] creating a visual affordance that tells producers what is relevant to their compositional goals.

As a visual guide for the producer's manipulations, the grid is an integral part of the process. Consequently, composing independently of the master tempo, in essence, turning off and ignoring the grid entirely, is a difficult task that is rarely discussed in producer communities. For instance, arranging a composition—copying, cutting and pasting notes, loops and sections—without the grid can be a challenge, as it is more work to ensure the ends of musical events match up with the beginning of the next ones. When creating repetitive popular music, the space of the screen can be daunting without the grid to provide a visually symmetrical guide for editing and manipulation.

Speaking of performing musicians, Zagorski-Thomas maintains that the DAW has fostered an increase in performing to a metronome in order to create tracks with a consistent tempo to "facilitate non-linear cut-and-paste techniques" (Zagorski-Thomas 2010, 206). When recording a performer, creating the perfect performance out of multiple takes is much easier if all the edits can be done with the grid lines as a guide. The performance must be temporally consistent so it can fit within the visually consistent grid lines for editing. This influence is no different for DAW producers as these types of cut-and-paste techniques constitute the majority of their art form. Thus, the DAW affords an easily viewed, precise and regimented map of a

[12] Moreover, as opposed to other DAWs which allow the user to turn off grid lines entirely, with Ableton, when the grid is turned off the lines are still faintly visible, constantly haunting the producer's process.

composition that pushes producers towards creating precise, evenly regimented, temporally exact compositions, because it is easier.[13]

The grid also affords a certain style of looping. When creating a loop on the grid, a musical figure that is intended for repetition can be chopped or algorithmically stretched until the beginning and end of the loop connects with the grid lines. Moreover, with the "snap to grid feature," producers can restrict the movement of their sonic representations to the grid, meaning they cannot enact any manipulation or edit that does not fall on one of the temporal subdivisions of their track (Ableton 2015 ,102; Bachmann 2015, 62; Apple 2013, 280; Avid Technology 2015, 776). In fact, in this manner, seamless loops can be created without actually listening to the results. In contrast, creating multiple loops in a composition without the grid is a challenge as they have to be precisely chopped without bar lines as guides. A slight difference in the length of one of the loops can quickly result in rhythmic phasing. Moreover, creating loops without the aid of the grid is a time consuming process, especially for longer multi-bar loops, as the producer must audition the entire loop while tweaking its start and end points. This can be a tiresome trial and error process as the producer must wait for the playhead to cross the body of the loop and return to the start before knowing if the end and the beginning of the loop are seamless. Without a large amount of work, a producer working without a grid could create tracks with sloppy transitions, loose out-of-time loops and rhythmic phasing issues. Yet, to the producer Burial (who creates music with the grid-less, mid-1990s audio editing program *Sound Forge*) this is the main characteristic of his music (Clark 2006). Speaking of the regimented grids in sequencers

[13] This is definitely not the only influence on the precision and rhythmic consistency of music composed with the DAW. There is a vast oeuvre of precise, rhythmically steady rock, funk and pre-DAW electronic music which is a definite influence. Yet, I believe the ease of creating this kind of music with the grid as a guide also affords this kind of composition.

and DAWs, he states: "…I've tried hard to use them but it's blocks in different colours and I'm only used to just seeing the waves…My tunes are a bit rubbish and messy but it's all I know[14]" (ibid.). While Burial's style of music could conceivably be created in the DAW, it seems, the grid of the arrange window is so dominant that he prefers to resort to the affordances of older software.

Emmerson writes,

> given the origins of the computer within western industrial society, it is not surprising that programs which have been developed have mirrored powerfully the preoccupations of western music. (Emmerson 2000, 121)

These Western-based affordances are not relegated solely to the DAW, they are also endemic to the visualizations of most software and operating systems that utilize the GUI. According to Tedre and Eglash,

> computers are cultural artifacts in which a Western understanding of logic, inference, quantification, comparison, representation, measurement, and concepts of time and space are embedded at a variety of levels. That is not to say that all aspects of the computer should be redesigned to aid its cultural fit but that one needs to be aware of the underlying viewpoints of computing. (Tedre and Eglash 2008)

[14] See chapter 5 for a discussion of Burial's method of creating grooves.

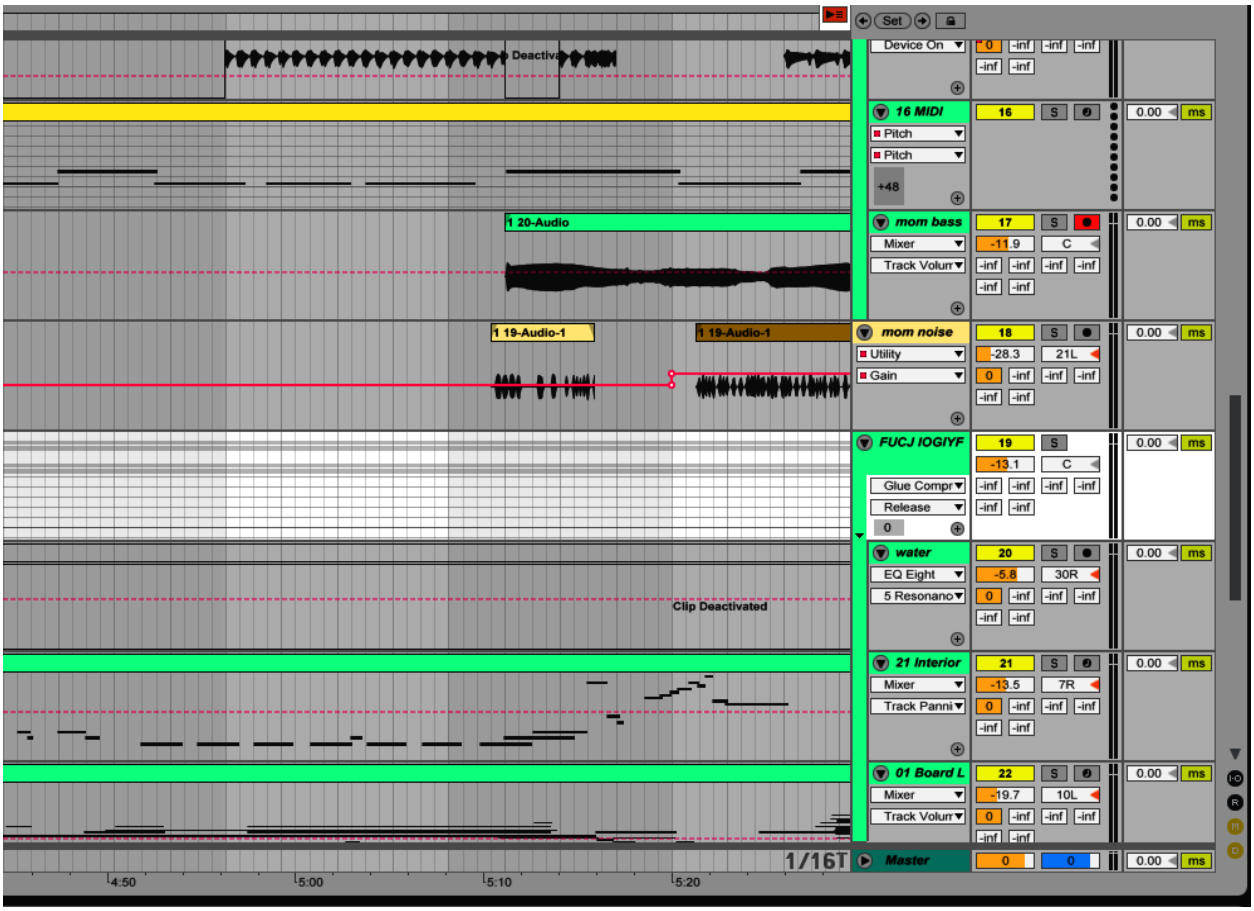

Figure 2.3: Shading in the *Ableton Live*'s arrange window

As a software program that heeds the dictates of the GUI and the WIMP interface (Windows, Icons, Mouse, Pull-down Menus), the DAW is designed with another layer of Western affordances.[15] For example, the DAW's representation of music stretched out along a timeline is a particular Western conception utilized in the majority of time-based media software (from video editing, to animation) (Rosenberg and Grafton 2013).[16] This particular visual affordance pushes the conceptualization of music as a spatial entity, made up of parts that can be navigated. Standardization within the GUI means that many of the general skills of computer usage—such

[15] This situation is not always a perfect fit, as Magnussen asserts, "the two-dimensional computer screen and the mouse are good for many things, but not particularly effective for controlling a mixer with hundreds of knobs" (Magnusson 2006, 442).
[16] See chapter 4 for further examination of the timeline representation in the DAW.

as dragging and dropping, copying, pasting and editing—are used in the manipulation of sonic events. The commands for cutting, pasting and moving text in a word file, for instance, are the same commands used for cutting and pasting music. Music can be cut and pasted and conceived of as a modular assemblage just as any other file brought into the digital realm.[17] Standardization has lowered the barrier of entry into musical creation, allowing anyone with a rudimentary knowledge of the GUI and a piece of music software to begin to edit, recombine and manipulate sound along the DAW's timeline. This has fostered a rise in producers who, inspired by the pop charts, compose at home, dragging, cutting and pasting loop files in their spare time. In this instance, certain DAWs provide more affordances for this looping-act than others.

Looping and Recording in the DAW

Pro Tools, Logic and *Cubase* have many features that afford the recording of a group of performing musicians. These DAWs have features that allow the producer to easily record and save multiple takes of a performance, so that the best parts of each take can be later combined into one perfect performance (Avid Technology 2015, 434; Apple 2013, 203; Bachmann et al. 2015, 146). *Pro Tools* even automatically saves each take in a sequentially numbered playlist for easy access (Avid Technology 2015, 434). A producer creating beats at home with a mouse and keyboard does not need this feature and it is not present in the more loop oriented DAWs such as *Ableton Live* and *FL Studio*. *Pro Tools, Logic* and *Cubase* also allow the producer to group multiple tracks together and collectively edit them. This is necessary when editing instruments recorded with multiple microphones, as it is much easier to edit the multiple recorded tracks of a

[17] I believe, this conception of music and sound is not entirely the GUIs fault and can also be originally accredited to the process of manipulating audio tape. See chapter 4 for this discussion as well.

drum set at once, for instance, then manipulate each track independently.[18] Also, *Pro Tools*, *Logic, Cubase* and *FL Studio* provide the option to zoom vertically as well as horizontally. This allows producers to easily control the number of tracks they can fit on their screen at one time, making selecting, editing and viewing many tracks in a large project an easier proposition. Once again, this could be an excellent feature for the producer wanting to view and then edit multiple recorded tracks or takes of a single instrument.

Another bias towards recording is present in the tools for manipulation. When cutting and splicing waveforms, *Pro Tools, Logic, Cubase* and *FL Studio* require the producer to select a specific editing tool from a menu (or utilize a keyboard shortcut), whereas with *Ableton Live*, the producer can enact these operations at all times without choosing a specific tool (Apple 2013, 39; Avid Technology 2015, 499; Bachmann et al.et al. 2015, 473; Dambrin et al. 2015). While a producer may enact many edits to perfect a recorded performance, being able to cut tracks at all times is not required when tracking a band, and if the cursor is constantly primed to cut, it could easily go off accidentally, creating unwanted edits when recording, mixing and navigating a project. Whereas with *Ableton Live*, geared towards beat making and marketed as the "fast, fun, intuitive way to make music," being able to cut audio without having to take the extra step of selecting an editing tool is a bonus (Ableton 2017).[19]

For looping artists, all DAWs allow the producer to create a loop and then extend it by dragging it horizontally across the arrange window. This automatically repeats the loop, allowing the repeated figure to fill any temporal space within a track. Moreover, if a part of the loop is

[18] *Ableton Live* and *FL Studio* allow the producer to group tracks together, but they cannot edit the tracks as a group; each track must be edited independently.
[19] See Chapter 3 for a discussion of cutting tools and their connection to playful forms of manipulation in the DAW.

changed, that change is applied to each iteration of the loop across the timeline of the arrange window. The *Logic* manual provides a particularly spatial description of this feature:

> You can loop regions so that they play repeatedly, and extend them to fill any amount of musical time in the Tracks area. When you play the project, the region repeats the number of times you have extended (looped) it. (Apple 2015, 300)

FL Studio provides a more painterly description of this process:

> Once a Clip is selected, select Draw(Pencil) or Paint (Brush) mode Left-click on a blank area of the [Arrange Window]. Dragging in Brush mode will repeat the Clip as you drag horizontally. (Dambrin et al. 2015)

With this feature, DAW designers are acknowledging the fact that a portion of the music created with their programs will utilize repeated loops. Nonetheless, *FL Studio,* and *Ableton Live* provide the producer with more loop-based affordances than the other three DAWs.

FL Studio focuses on loop-based composition with its step sequencer, which emulates the push button interfaces of external drum machines, an interface they claim is "ideal for creating drum loops" (See Figure 2.4; Dambrin et al. 2015). *FL Studio* also provides a tool called a "Loop-Tuner" which is intended for "smoothing loops," allowing the producer to manipulate several faders to create seamless transitions between the beginnings and endings of loops (ibid.).

With its "Session View," *Ableton Live* incorporates the manipulation and triggering of loops into a large portion of their interface (Ableton 2015, 112). In this area, separate from the arrange window, the producer can organize various musical phrases and loops into a spreadsheet-like grid of coloured boxes. Clicking on a clip's coloured box triggers its corresponding musical materials, letting the producer trigger various preset loops to arrange their composition in real-time. The session view offers easy manipulation, swapping of loops and a non-timeline-based

form of organization, allowing for reduced visual complexity when composing. When utilizing the session view, producers must perform their arrangements within the temporal flow of the composition, instead of working when the track is stopped. This performing of loops is made easier through external devices, such as the Ableton *Push*, which mimics the session view grid, allowing the producer to trigger the loops in their session view without using a mouse or the screen (Ableton 2017a). In order to understand how these loop-based affordances came to be included in the DAW, I believe it is integral to examine the history of looping, foregrounding the culture, artists and technologies that spawned a form of composition through short repeated snippets of recorded sound.

Figure 2.4: The *FL Studio* sequencer.

The History of Looping

Looping arose in the current popular consciousness over time through the confluence of an extensive tradition of performed musical repetition, the dance-centric culture of the DJ and the innovative musical exploitation of digital technologies. I believe a history of looping,

portraying various forms of recording technology, the musicians obsessed with recorded repetition, as well as their processes, will provide an understanding of how these repeated figures hold an important place in the visual structures of the DAW.

A history of looping, is also a story of recording technology and the various ways that artists have put that technology to use. Elizabeth Margulis argues that

> there can be no question that recording technology fundamentally shaped musical practice in the second half of the twentieth century. Technology … has always been a force in the development of musical styles, but since recording technologies are essentially repetition machines, the advent of these capacities is particularly relevant to practices of repetition in music. (Margulis 2014, 80-81)

Many artists—from minimalist composers, to hip-hop and EDM artists—have applied the rhythmic aesthetics of performed African and African-American music to looped recordings, transferring the dance-inducing, consciousness altering aspect of repetitive music to the recorded age. While mechanically generated repetition did change how artists conceived of music, the artist's use (or misuse) of technology has also influenced the development of recording machines. From its inception, looping is an example of the use of recording technology in a manner other than the manufacturer intended. Tape loops had to be strung away from the machine and manufacturers of early digital samplers were aghast at the theft perpetrated by hip-hop artists looping popular compositions with their machines. However, many manufacturers catered to these new uses, creating products such as the *Echoplex,* a tape loop device, or gearing specific software towards the loop-based producer (Holmes 2012, 163). As Kline and Pinch proclaim, "the use of an artifact or system has not only resulted in unforeseen consequences, but…users have helped to shape the artifact or system itself" (Kline and Pinch 1996, 764-65). Looping, now normalized as a form of composition, has shaped the architecture of the DAW,

influencing its workflow. I wish to examine this process of normalization, reviewing the history of the looping act's misuse of recording technology, as well as unpacking various issues and sea changes in the conceptualization of recorded sound and how these changes come to influence the visual and processual functioning of the DAW. Not laid out as a strict chronological history, this section will jump between three technological eras of looping: tape, pre-visual interface digital samplers and screen-based computer software, with the aim to portray how the concerns and issues of loopers have changed as their practices have crossed the analog/digital divide. Focussing on areas that connect to the visual representation of sound, I will examine specific looping artists throughout these eras, the technologies they utilized, as well as the processual, perceptual and commercial issues raised by their subversive acts of recorded repetition. Hence, this section is divided into four areas of interest: the concretization of musical time into space, recorded repetition as a process of sonic analysis, the automated process of looping and the rise of loops as modular digital commodities. These areas of interest also serve to introduce topics that I will address in more detail in later chapters.

Tape Looping

The tape recorder was invented by IG Farben in Germany during WW2. Discovered by American soldiers after the war, it was soon patented for consumers in the United States and became widely popular, as it was a more flexible and better sounding medium for recording (Holmes 2012, 43). Arguably tape's most important trait was its manipulability; it could be spliced, cut, reordered, reversed, and of course, looped. As Holmes writes, the advent of tape was

> a technological, psychological and social breakthrough without parallel for music, it made electronic music 'a composer's medium,' live performance was not necessary, artists could work at their leisure crafting their compositions in their

> studios, a performance would be a matter of pressing play. (Holmes 2012, 124; 157)

The influence of tape recording casts a long shadow over the development of digital recording devices, including the DAW. According to Holmes,

> many of the techniques associated with tape editing and analog sound processing are shared by software programs designed for editing and processing digital samples. As in any computer editing environment, one has the ability to cut and paste content, which is the equivalent of using a razor blade and splicing tape to make broad additions, deletions, and reorganizations of sounds. (ibid., 328)

The terminology utilized in the DAW, such as stop, play, rewind, fast-forward and pause, as well as the visual representations of these controls, takes its cue from tape recorders. Referencing the common tool for cutting audio tape, *FL Studio* even utilizes an icon of a razor blade to represent their cutting tool (Dambrin et al. 2015). Also, the manner in which the DAW's waveform representation is manipulated largely imitates the procedures of audio tape editing. For instance, waveforms can be cut, moved and spliced together; yet, like audio tape, to create a seamless transition the producer needs to "crossfade" between the two sections (Ableton 2015, 81; Bachmann et al. 2015, 247; Avid Technology 2015, 567; Apple 2013, 318). Similarly, bouncing, the term utilized to describe the action of summing multiple tracks of audio tape into one track, has the same meaning in many DAWs (Bachmann et al. 2015, 146; Apple 2013, 19; Avid Technology 2015, 859). In several DAWs, the moving line that visually indicates the current section being played is called the playhead, after the transducer that converts the information on audio tape into sound (Apple 2013, 72; Avid Technology 2015, 384). Finally, the linear layout of the DAW's main editing window can be said to emulate a strip of audio tape. As the Ableton Live manual states, "the *Arrangement View* displays the Arrangement, which contains music laid

out along a song timeline, like a multitrack tape" (Ableton 2015, 89).[20] The influence of audio tape editing was recognized from the early days of software-based audio manipulation. Michael Marans mentions this connection in his 1989 review of the visual editing software *Sound Tools*:

> And perhaps that's the true power of the system—its accessibility. If you want to record something, you set a level and press record. Anyone who has ever used a tape recorder should have no trouble with that. (Marans 1989, 119)

Time and Space

Creating tape loops required a subversion of the workings of the tape machine. A common multitrack tape recorder consisted of two reels next to each other with the playhead in between. The audio tape was fed from one reel, across the playhead and then collected in the second reel on the other side. To create a tape loop, the tape had to be fed from one reel and around an object placed away from the machine (like a microphone stand) and then across the playhead. The external object allowed the tape to be kept in a taut loop while it is played back (Keane 1980, 60). The Beatles had to call in other workers from Abbey Road studios to hold the pencils and drinking glasses that kept the various tape loops of "Tomorrow Never Knows" looping while they were mixed down to a track (Emerick 2006, 112). There are also spatial limitations to the length of a loop. Loops are restricted by the size of the studio[21] and a loop could not be shorter than the two reels on a tape machine. David Keane underlines the connection of looping to space:

[20] See Chapter 4 for a discussion of the suitability of this comparison.

[21] There are of course exceptions. Terry Riley would often create loops in an old cottage, stringing his tape loops "out the window of the studio, around the wine bottles, and back in the studio" (Potter 2000, 98). BBC radiophonic composer Delia Derbyshire claims to have created one of the world longest tape loops, maintaining, "it went out through the double doors and then through the next pair; just opposite the ladies' toilet and reception. The longest corridor in London, with the longest tape loop!" (Kember 2000). Nevertheless, for most tape loopers the size of their studio constrained the size of their loops.

> The longer a loop becomes, the more difficult it is to accommodate playback. Moreover, the greater the length of the loop, the less apparent the repetition of the sequence becomes. A 20-foot loop, for example, has a duration of 32 seconds and requires a considerable number of repetitions before its repetitiousness becomes apparent to the listener. (Keane 1980, 60)

According to John Cage, audio tape "made one aware that there was an equivalence between space and time, because the tape you could see existed in space, whereas the sounds existed in time" (Holmes 2012, 124). This connection of space and time has transitioned to the digital era; although, early digital loopers were concerned with sample space instead of physical space. Many of the early digital samplers were geared toward sampling short instrumental or percussive drum hits, as a result, they had only 10 seconds of sampling time. Many loopers recorded their multiple bar length samples off vinyl sped up to 45 RPM and at a lower sample rate, in order to fit their loops into their samplers (Weingarten 2010, 85). They would then slow their loops back down to a more appealing tempo once they were recorded into the device. This loop-based misuse would give their sampled loops a characteristic timbre that could be easily recognized.[22]

With the rise of computer looping, musical time was spatialized by the computer screen. As we've seen, in the DAW, sound is laid out along a zoomable timeline and delineated by a metrical grid that visualizes various temporal subdivisions of a musical composition, allowing loops and sounds to be spatially placed at any location in a track.[23] Here loops are viewed as waveforms, the peaks and valleys of a drum rhythm can be easily seen and looped with the click of a mouse. Moreover, for many producers, the small microrhythmic deviations that characterized a good performed drum rhythm are now reconceptualized as spatial deviations

[22] For example, the piano loop heard throughout *Public Enemy's* "Black Steel in the Hour of Chaos" from their album *It Takes a Nation of Millions to Hold Us Back* utilized this method with the EMU Sp-1200 digital sampler (Weingarten 2010, 85).
[23] See chapter 4 for a discussion of the implications of this representation in a producer's process.

from the precise metrical grid of the DAW.[24] In a *Keyboard Magazine* article, Marins details the visual editing of a sampled loop:

> Once you've sampled a piece of music, you need to determine the exact tempo at which it was played…so that the sample can be accurately looped…Determining the sample's internal tempo is easy, provided you have graphic waveform editing software…the next step is to find areas of the waveform that are recognizable as quarter-note beats. You'll be using the distance between two quarter-notes as the reference for determining tempo…In most pop/rock/funk music, either the kick or the snare drum falls on quarter-notes; these hits are usually characterized by a transient spike that has significantly higher amplitude than the surrounding waveform. As such, the hits are relatively easy to spot…Once you've found a hit, zoom in on the waveform so that you can locate the exact sample that marks the drum's attack transient. This is very important, because if you're off by more than one or two samples your loop length will be incorrect—not a big deal for a single iteration of the loop, but over time the error will accumulate and the groove will drift in reference to the other. (Marans 1991, 102)

From zooming in on the waveform to spotting beats, the visual and spatial terms used by Marans to describe the editing of sound with the DAW are striking. Even his description of musical tempo, as the distance between two quarter-notes, is tainted with a visual descriptor—emphasizing the spatial aspect of a largely temporal art.

The Sights and Sounds of Looping

Another concept proposed by early tape loopers was identical repetition as a way of deeply analyzing sonic events, sparking the recognition of different sonic qualities in a looped passage unavailable on the first listen. As Joanna Demers states, "recordings freeze moments in time and make them available for repeated contemplation. Simply put, recordings change the ontological status of sound from fleeting and impermanent to eternally present" (Demers 2010, 54). Electronic music pioneer Pierre Schaeffer was a great proponent of looping as a method of

[24] See Chapter 5 for a discussion of this phenomenon.

sonic contemplation. Starting with locked groove discs (a precursor to tape loops, basically a disc that was engraved with a groove in a never ending circle instead of the usual spiral[25]), before moving on to tape loops in the late-1940s, recorded repetition would transform Schaeffer's understanding of sound and influence his new style of music, which he called Musique Concrète (Palombini 2002, 434). By repeating everyday sounds—from train noises, to manipulated bell sounds—Schaeffer believed they could be musicalized, and in the process, could be divorced from their original associations in the minds of the listener. Through automated repetition, the listener's attention could be diverted from the meaning of the sound and its source to other sonic qualities. Margulis states, "when wrested from its ordinary ephemeral position in an ongoing temporal context, the sound could be contemplated and attended to for its own fundamental sonic characteristics" (Margulis 2014, 79-80). Needless to say this process is also utilized by modern digital samplers working in popular loop-based music. As DJ Kool Akiem indicates to Joseph Schloss,

> sometimes, I'll put a loop on and let it play for, like, two or three days. I've done it before. When you do something like that, you get to hear all different parts and pieces and elements of it that you never really heard before... it probably sounds strange to a lotta people, but you get to hear stuff that the musician didn't try to put in there. You know what I mean? It's just in there. (Schloss 2006, 137)

From Schaeffer to DJ Kool Akiem, we see similar sentiments about the perceptual qualities of looped sound. Nonetheless, Denis Smalley maintains that this change of perception through looping divorces the musician from the experience of the listener. He writes,

> particularly in tape composition, because of the need for the constant repetition of sounds during the honing process, the composer is too easily tricked into perceiving microscopic details which will be missed by the listener. (Smalley 1986, 81)

[25] This is another example of utilizing technology in ways not intended by the manufacturer.

The DAW also provides a visualization of these microscopic features, allowing producers to work with a loop and tweak various elements while their composition is playing.

Looping is not just a method of composition, but is built into the way producers summarily interacts and records their music (even if not creating loop-based compositions). All DAWs provide the ability to loop a specific part of a composition, letting the producer isolate a certain section for contemplation or manipulation (Apple 2013, 30; Avid Technology 2015, 167; Ableton 2015, 96; Bachmann et al. 2015, 201; Dambrin et al. 2015). This loop selection button resides in an exalted place on the screen, constantly in view in the DAW's transport bar, alongside the controls for playing and stopping a composition. With this feature, the producer can highlight a few bars (for example) and tell the software to endlessly perform them. This is a common method of working when mixing, allowing the producer to focus on a particular part of a track, repeating it until the mix is right. Moreover, many DAWs have a loop recording feature, allowing a particular section to be recorded on loop, capturing many takes until the artist perfects a particular section (Avid Technology 2015, 433; Bachmann et al. 2015, 214; Apple 2013, 314). The Cubase manual calls this *cycle recording*:

> You can record in a cycle, that is you can record a selected section repeatedly and seamlessly.
> 1) Click the cycle button on the Transport panel to activate cycle mode.
> 2) Activate recording from the left locator, before or within the cycle.
> As soon as the project cursor reaches the right locator, it jumps back to the left locator and continues recording a new lap. A cycle is set up with the left and right locators. (Bachmann et al. 2015, 214)

Nonetheless, many producers do not have the stamina of DJ Kool Akiem. Fatigue can set in and excessive contemplation and manipulation of a loop can stymie a producer's process. As one producer claims on Reddit,

> I find that when I'm working on music, it's incredibly easy to fall into the mindset of the "loop", spend a ton of time adding all these tracks that sound great together, but still only having 10-20 seconds worth of unique audio. I usually love the loops or grooves I end up with, but they're far from completed songs, and I have a helluva time taking them to the "next level". It's especially frustrating because by the time I've got a loop to the point I'm happy with it, I've been listening to it over and over so many times, it's difficult to think of what can change or what can happen "next" in the context of a song. (Appendix A1).

In the field of psychology, the recognition of different sonic qualities in a perpetually repeated word or musical phrase is often called semantic satiation. For instance, through constant repetition, a listener begins to focus on the sonic instead of the semantic qualities of a word. As Falk et al. maintain, "if a word is repeated for longer than one minute…listeners lose the sense of the meaning of the word as a result of semantic satiation" (Falk et al. 2014, 1491). In the 1960s, when tape looping was gaining in popularity due to minimalist composers and rock musicians, Dr. John Lilly investigated this phenomenon of recorded semantic satiation. While studying dolphins, he would play friends and colleagues tape loops of dolphin speech and he found that upon multiple repeats they begin to hear different English words coming from the squeals (Lilly 1973, 64). Lilly decided to try replicating this test utilizing human speech. So, for anywhere from fifty minutes to six hours he played groups of subjects the word "cogitate" on repeat and had them write down the various other words and gibberish sounds they heard as the tape repeated (ibid., 65). Interestingly, Lilly then took these alternate words and sounds, wrote them out on note cards and displayed them to a new batch of subjects while again playing "cogitate" on loop. He found that, more often than not, the subjects would hear the alternative word printed on the card, showing that "visual input can program what is heard" (ibid., 65).

The concept that the visual realm can influence the perception of looped sounds has great relevance to working with the DAW. I contend, the visual input of the computer screen can affect what is heard through the speakers. Recording engineer Mixerman writes,

> given the advent of DAWs, recordists are all too often preoccupied with what waveforms look like rather than what they sound like…we tend to rely on our sight first and foremost. This may seem rather obvious when spelled out like this, but it's critical to make audio evaluations by ear. To some extent you can learn to ignore the visual cues, but that takes years of practice, and even then you're still influenced by what you see. It's perfectly acceptable for an engineer to use visual information, but only to confirm or verify what's coming from the monitors. (Mixerman 2012)

Yet, there are "surprisingly few studies have examined the…ways in which visual information may influence the cognitive processing of music" (Boltz et al. 2009, 43). Various researchers have examined the opposite influence, the ways that sound can influence vision.[26] In his literature review of crossmodal studies—the field that examines the ways people correlate different modalities when perceiving the world—Spence cites several researchers who have found that "the strength of crossmodal coupling is a function of our sensory system's prior knowledge that certain stimuli 'go together' crossmodally" (Spence 2011, 984). He declares that many researchers have found several congruent crossmodal connections that are, for the most part, universal (the connection between "auditory pitch and visual elevation/sharpness," as well as loudness and pitch with brightness, for instance[27]) (Spence 2011, 975; 977). Researchers have also found that when participants were tested with audiovisual materials that were crossmodally congruent in this manner, response times increased. For example, when deciding on the elevation

[26]I am citing several crossmodal studies as illustrations of the fact that the visual and auditory realms can affect one another. If hearing can influence sight, then I hypothesize (alongside Dr. Lilly) that sight can influence hearing. However, more scientific studies examining producers during their process with the DAW are needed to draw reliable conclusions.

[27] See (Spence 2011, 979) for a table listing many of these universal crossmodal correspondences.

of a graphic (low or high), response times were faster if a high pitch was played alongside a highly elevated graphic, versus a low tone—and vice versa (ibid., 978). In another study, researchers found that when presented with an ascending pitch, participants were "significantly more likely to judge a simultaneously presented ambiguous visual motion display as moving upward (rather than downward)," and similarly, with descending pitches, the visuals were more likely judged to be moving downward (Spence 2011, 981). Researchers have found that these correlations between modalities can also be culturally and environmentally influenced, as "repeated exposure to…particular pairs of stimuli" can influence crossmodal connections (Spence 2011, 971; 986). Citing neuroimaging studies, Spence further maintains that many researchers theorize that through associative learning, people can create new "learned associations between auditory and visual stimuli" (Spence 2011, 987). I feel that for the DAW-based producer, the computer screen can foster a whole host of new crossmodal connections between sight and sound.[28] As Reyes maintains, one of the key areas for future academic research into the DAW is examining "visualization and new terrains of multisensory knowledge – such as how sight and sound work together to broaden participation and expedite the production process" (Reyes 2010, 336).

With the DAW, there are a vast array of visuals that can influence the perception of looped sound. On-screen visuals are often seen as a way to increase producers' analytical skills, which enables them to better understand various characteristics of their sounds in order to fashion better sounding compositions. Since most amateur producers create and release their

[28] See chapter 4 for further discussion of the crossmodal effects of working with the computer.

loop-based tracks by themselves, learning how to mix, equalize and compress each element in a track for release is integral to the process. As one Redditor claims,

> [*your*] best tool for this would be a spectrum analyser, you wanna be getting a visual representation of everything going on in the frequency spectrum if you're finding it hard to just use your ears, you'll wanna be analysing things like where the drums are hitting and at what level, where other instruments are sitting in the mix etc. (Appendix B4)

The visual analysis of sonic events is a widespread phenomenon in various facets of composing, mixing and arranging in the DAW.[29] *Ableton, Cubase* and *FL Studio* offer spectrum analyzers built into their equalization devices to show the frequency spectrum of sounds (See Figure 2.5; Ableton 2015, 337; Bachmann et al. 2015, 424; Dambrin et al. 2015). *Ableton* also offers visualizations in their gating and compression plug-ins and *FL Studio* provides producers with a spectrograph visualization (Ableton 2015, 348; 23; Dambrin et al. 2015). While many warn about an overreliance on visuals when mixing tracks,[30] there are also many external plug-ins, such as *iZotope Insight*, that profess to increase a producer's "visual intelligence" by providing "an extensive set of audio analysis and metering tools, perfect for visualizing changes made during mixing and mastering" (Appendix B; Izotope 2016). Touted in reviews as being "both informative and attractive!" and "looking quite spectacular," vision is often hyped as providing more insight into sonic events. (Robjohns 2013; MacDonald 2013). In our Western culture, vision is often emphasized as the modality of logic and precision. Jonathan Sterne attempts to combat this conception by creating a "counternarrative to Romantic or naturalistic accounts that posit sight as the sense of intellect and hearing as the sense of affect, vision as the precise, localizing sense and hearing as the enveloping sense" (Sterne 2003, 94). However, it seems as if

[29] The DAW as a tool for visual analysis will be discussed in chapter 4.
[30] As recording engineer Joe McGrath maintains, "You're an enginear not an engineye" (Mixerman 2012).

quite often marketers and reviewers agree with the Romantics, promoting visualization as the best way of precisely analyzing sound.

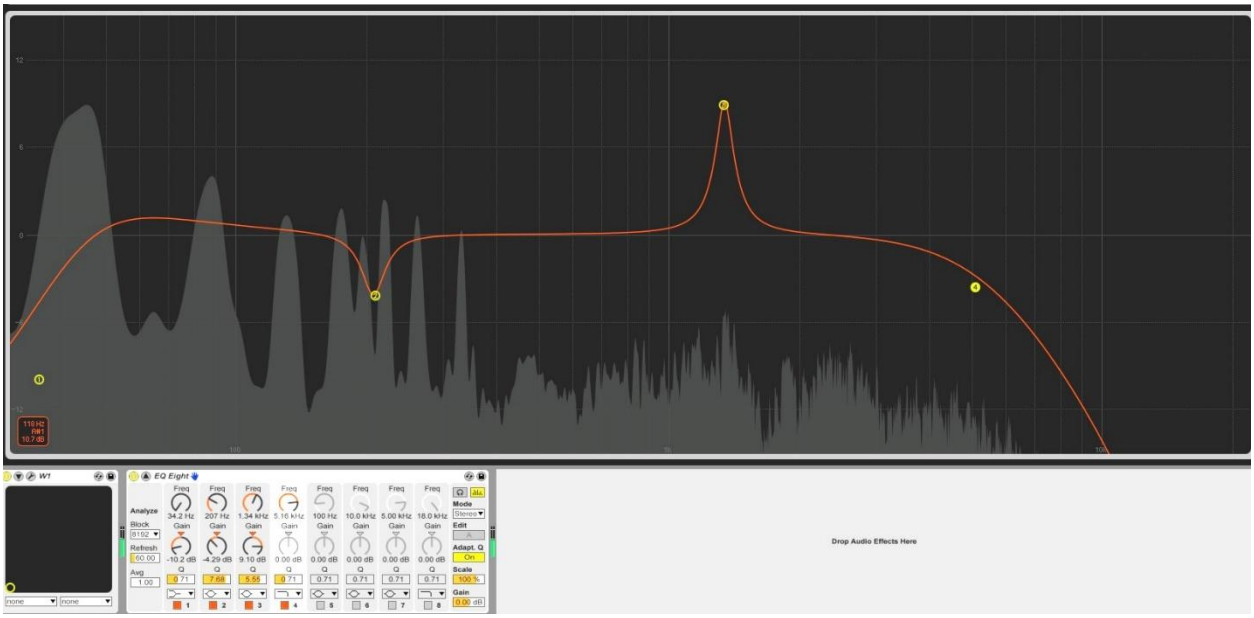

Figure 2.5: The spectrum analyzer built into the equalization effect in *Ableton Live.*

In her examination of computer visualizations of scientific data, Cox discusses "visaphors," which are "digital visual metaphors" (Cox 2006, 89). Like their linguistic cousins, visaphors map information from one domain into another, taking numbers and mapping them into interactive visualizations. To Cox, "visaphors can be interactive software applications or digital animations" (ibid., 89). She observes that

> visaphors shape our cultural beliefs and provide people with a scientific view of reality…most people believe that visaphors represent the ''true'' view of reality. However, data are not sacred, and visaphors are approximation models, not reality. (ibid., 109)

With the DAW, many producers on Reddit admit they prefer working with the more detailed representation of the waveform to the simplified notation of MIDI because the waveform represents a truer view of sonic reality. As one Redditor claims,

> I'm sure you're aware but the difference between the waveform and MIDI is with MIDI you're not seeing the sound you're seeing the notes. (Appendix E1)

I believe in this example, the more detailed visaphor of the waveform is considered the actual sound, whereas MIDI is just notation.[31] Nonetheless, in many instances, MIDI is the more flexible way of operating, providing many more options in the transformation of sonic events. Thus, the DAW and external plug-ins provide interactive visaphors that quite often promote the conception of visuals as the ultimate way to scientifically dissect, analyze and manipulate sound.

Through continual and identical repetition, looping can change the producer's perception of sound, allowing the recognition of sonic qualities that were not apparent on the first pass. This phenomenon, discussed since the early days of tape looping, has resonance with the ways producers create music in the digital age and, I contend, can be influenced by the visuals displayed on the screen.

The Automated Process of Looping

In the 1960s, tape looping became a more widespread phenomenon as popular music artists such as the Beatles and Pink Floyd (amongst others) began incorporating loops as textural and rhythmic elements in their compositions. During this time, many minimalist composers also began experimenting with tape loops, creating simple automated figures that were in stark contrast to the earlier serial complexity of musical modernism (Potter 2007). During an early experiment with tape loops, minimalist composer Steve Reich accidentally played two tape loops that were slightly out of sync and became fascinated by the new rhythmic counterpoints created as the loops began to increasingly drift out of time (Potter 2000, 166). He had discovered the

[31] See Chapter 3 for further discussion of this phenomenon.

technique that would dominate his compositions for years to come—phasing. Reich states, “I discovered that the most interesting music of all was made by simply lining loops up in unison, letting them slowly shift out of phase with each other” (ibid.). With phasing, Reich discovered a process that needed to be meticulously planned and then impersonally deployed to work itself out, crafting loops that would create interesting cross-rhythms as they phased. Reich poetically describes this musical process:

> … pulling back a swing, releasing it, and observing it gradually come to rest; turning over an hour glass and watching the sand slowly run through the bottom; placing your feet in the sand by the ocean's edge and watching, feeling, and listening to the waves gradually bury them. (Reich 1968)

When creating a tape loop, there is a fairly large distinction between creating the loop and playing it. Tape loopers had to find a section to loop, remove it from the tape machine and edit it using a razor blade, tape the ends together and then put it back on the machine for playback, where it would be recorded to another tape machine. Tellingly Reich writes, “though I may have the pleasure of discovering musical processes and composing the musical material to run through them, once the process is set up and loaded it runs by itself” (Reich 1968). The process has to be set up and loaded. Reich’s emphasis on two steps in the looping act, crafting the loop and then setting it off on its impersonal, repeated process is not really discussed in the modern age of digital looping. Reich seems to be still thinking in terms of composition and performance (even though the performance is just the impersonal playing of the tape). Since the advent of digital samplers, and especially with the DAW, editing and playback have become essentially one action; there is not much of a distinction between creating a loop and playing it. Finding a section to loop is a matter of pressing a few buttons on a sampler, or highlighting a passage on a screen. All DAWs let the user manipulate the loop in real time, changing the size of the looped

section, manipulating individual notes or sounds and transforming the entire loop, all during playback. Speaking of EDM producers, Butler calls this process riding:

> In modern times, moreover, the objects that humans spend the most time riding are our own mechanical inventions (trains, bicycles, cars, etc.), in most cases independently powered. Riding is also inherently processual and continuous. It involves motion, which is often but not necessarily goal-oriented. In a DJ or laptop performance, what is ridden is the sound itself. The sound offers itself as a vessel for such an engagement because it flows continuously; its motion is presented without interruption or cessation. Herein lies one of the chief liberative potentials of pre-recorded sound. For musicians who have learned how to marshal this capacity, technology that "captures" sound becomes a crucial source of freedom in performance … (Butler 2014, 220)

The difference between Reich's and Butler's description of looping is the amount of control over the loop's performance. Reich sends his loops off on their own, allowing them to complete their inevitable process, whereas Butler states the modern DJ and laptop performer ride their loops, controlling their voyage through a musical composition. For the DAW-based producer a large portion of this control is related to what is seen on the screen;[32] Butler's concept of riding is largely a visual affair. Moving loops, as well as their constituent notes, around the computer screen with a mouse and keyboard while the loop is playing is enacting a form of spatial performance that is uniquely related to working with the DAW.[33] In this instance, Reich's impersonal looping process is tamed and ridden by the producer utilizing the graphic representations on the computer screen.

I find it fascinating reading the writings of early loopers as they were grappling with the aesthetic and philosophical issues of the looping process. While there are many detractors

[32] Many early digital samplers allowed the producer to create loops on the fly in a similar manner; yet, they were not afforded the same amount of control over the looping process as provided by the DAW. See (Stillspitin 2009) for an excellent video of producer Pete Rock manipulating loops on the fly with the Emu Sp-1200 sampler.
[33] See chapter 4 for a more in-depth examination of this phenomenon.

outside of loop-based genres deriding “non-performed” music, for modern loop-based artists the nature of looped repetition is an integral part of their art and not really a subject of scrutiny. For these loopers, recorded repetition as a method of composition has become normalized. Whether a loop is left to its own devices or ridden, I believe it is highly important for this popular and widespread form of composition to be examined for a full understanding of the workflow of the DAW.

Departing from the era of audio tape, I now will examine the historical evolution of digital looping. From sequencers, to digital samplers, to the rise of the computer visual interface, I will demonstrate how the looping-act has evolved, subverting various technologies, influencing numerous popular genres, uniting the design of several software packages and eventually becoming a commodity that is sold, pirated as well as packaged with various DAWs.

Loops as Digital Commodities

Sequencing, another method of creating loop-based music that did not involve audio tape, was developed in the late 1950s (Brend 2012, 113). Sequencers were programmable electronic devices for storing and playing back musical pitches and rhythms. According to Hodgson,

> sequencers themselves don’t actually generate sounds. What a sequencer does is provide a connected sound-producing mechanism with control information, which tells that mechanism what sounds it should generate, at what volume and for how long. Viewed from this perspective, sequencing looks much less like a species of performance practice and much more like a kind of computer programming. (Hodgson 2010, 51)

Sequencers could be utilized to control synthesizers or digital samplers, creating looped melodic figures electronically without having to muck about with audio tape and razor blades. By the

1970s, there was a glut of synthesizer manufacturers releasing their own sequencers and synthesized loops could be heard from all areas of the pop music spectrum.

Beginning in 1959, with the Wurlitzer Sideman, the first mass-produced drum machine, sequencers began to be incorporated in devices for triggering drum sounds (Brend 2012, 113). These drum machines became the foundation of many popular styles of electronic music, allowing the quick and easy creation of repeating rhythms that drove people to the dance floor. One of the most popular (and enduring) line of drum machines—the TR-808, and its successor the TR-909—was released by Roland in 1983 and 1984 (Zeiner-Henriksen 2010, 76). Berk writes,

> the TR-808 and TR-909 Rhythm Composers ... featured an intuitive user interface and a variety of distinctly unrealistic analog drum sounds. The 808...was one of the first successful, fully programmable drum machines. It was also the first such unit that could store an entire song (verses, choruses, and fills) rather than just patterns. (Berk 2000, 193)

Originally intended as a device to accompany solo performers, the Roland TR-808 drum machine was discontinued for poor sales but was rediscovered in the mid-1980s by a generation of techno and hip-hop artists, who raised the machine's unrealistic drum sounds to an iconic status that still informs a large variety of music today (Brewster and Broughton 2006, 241). The simple interface of the 808, with a row of buttons with lights that represented musical time (a lit up button played a note, otherwise it was silent) and knobs to control attack, decay, tempo, as well as switch between various percussion instruments, has been incorporated into the visual interface of many different kinds of software and DAWs. For instance, the 1997 software package *ReBirth* by the Swedish company Propellerhead (according to *Sound on Sound* magazine, one of the most "plausible candidates for the title" of first software synthesizer)

emulated the TR-808 as well as the Roland TB-303 bass synthesizer, recreating their iconic sounds as well as their knob and button interfaces (The SOS team 2010). This form of sequencer emulation is also present in several DAWs. For instance, the *FL Studio* sequencer, consists of multiple layers of buttons that can be clicked on or off to create various rhythmic and melodic patterns (See Figure 2.4; Dambrin et al. 2015).

While sequencers and external drum machines are still sold and are regularly used, they have largely been supplanted by software-based digital tools. Unlike sequencers, which often triggered pre-set synthesized sounds, digital samplers worked more like tape recorders, allowing producers to record and sample their own sounds and loops, providing more freedom in sonic manipulation and arrangement. With this freedom, many producers chose to sample drum breaks (sections in popular songs where most of the instrumentation, other than the drums, dropped out) and reuse them as the foundation of their own compositions. As the technology became easier to use the looping-act gained in popularity, culminating with the dissemination of loop files online and the rise of the DAW, where loops could be quickly downloaded, visually inserted at any temporal location in a composition and stretched to fit any tempo. Coming to prominence with DJs manually looping drum patterns in the 1970s and exploding with the rise of digital sampling in the 80s, this popular form of looping was entirely concerned with creating the perfect loop, cutting out and closing the seams between a short drum break taken from a funk, rock or jazz recording in order to motivate dancing or provide a secure rhythmic foundation for rapping. Schloss professes, "… hip-hop in general—and the sampled loop in particular—is a logic of musical repetition as artistic differentiation; the producer's creativity lies in the ability to harness repetition itself" (Schloss 2002, 138). Thus, what the modern producer chooses to loop and how they manipulate the loop is where the artistry lies. Producers began searching through the history

of recorded music for the perfect drum break or musical interlude to loop. They would go to flea markets, garage sales and record stores searching for materials to sample based on seemingly arbitrary criteria such as album covers or record labels (Schloss 2004, 82; 87). As digital technology got cheaper, more artists began to harness repetition, as well as create more complex compositions. Producers who could previously only loop multiple-bar sections of recordings, began to chop out and reassemble individual notes to create even more complex patchwork loops. With the rise of software-based looping, many software designers began to cater to these loopers, giving producers the ability to look at their sounds and edit their loops down to a millisecond scale.

Alongside the growth of the looping act, there arose a parallel history of entrepreneurs who made a living selling the raw materials for looping. By imparting value to drum breaks, hip-hop DJs and producers unintentionally initiated a lucrative market for these entrepreneurs to sell cut-up segments of recorded sound. As loop-based producers adapted to the progression of digital technology, changing their compositional techniques in response to the technological transformations of the digital age, the loop industry followed suit, modifying their marketing tactics and their formats of dissemination (from vinyl records, to CD-ROMS, to Internet downloads). With each successive technological breakthrough, the looping act became easier to accomplish, attracting more loopers, who in turn increased the demand for raw materials to manipulate. Currently, given away with music magazines, packaged with *GarageBand* (for the majority of Mac users), as well as purchased, pirated and downloaded from a multitude of different websites, I believe this history of loops as a commodity will help in understanding the popularity and ubiquity of loop-based composition in our current musical culture. Moreover, the

commodification of loops during the computer age was greatly increased by the visual affordances provided by the DAW.

In 1973, DJ Kool Herc began DJing in Manhattan. In a few short years he would help the formation of a new genre of music, reconceptualise the turntable as a musical instrument for a new generation and unwittingly spawn a lucrative (and still thriving) market for cut-up segments of recorded sound. This was all made possible through Herc's discovery of what Mark Katz calls "the unifying force" of hip-hop—the break (Katz 2012, 16). During his DJ sets, Herc noticed that the dancers would "really get wild" during the instrumental breaks—where most of the instrumentation ceased, leaving (in most cases) the drums to continue playing (ibid., 79). He realized that playing songs with breaks was a way to distinguish himself from his DJ competitors and began searching for songs that featured these instrumental sections. As Herc states, "once [*the dancers*] heard that, that was it, wasn't no turning back…They always wanted to hear breaks after breaks after breaks after breaks." (ibid., 79).

Herc's reconceptualization of the break influenced many DJs, sending them off in search of their own rare and unique records with breaks to drive the dancers wild. This search for breaks created a new market for obscure records that would not have sold otherwise. Consequently, certain record store owners would overcharge for break records that popular DJs had played at recent shows (Dery 1988, 45). With the popularity of these break records, entrepreneur and amateur DJ Lenny Roberts saw a business opportunity and began recording the most popular drum breaks, compiling them on record and selling them to record shops in Manhattan. Under the title of *Ultimate Breaks and Beats* (UBB), Roberts would release twenty-five volumes that according to Mark Katz, "would change the culture of hip hop" (Katz 2012, 160). Many DJs resented Roberts for revealing their cherished breaks to the general public and would go

searching for more obscure breaks to play in their sets, which Roberts would subsequently compile into a new collection (Schloss 2004, 37-38). Nevertheless, by publicizing "hip-hop's building blocks" Roberts gave a whole new generation of DJs (who might not have the time or money to go digging for records) entry into the world of hip-hop looping (Weingarten 2010, 22). *UBB*'s influence would only grow larger with the release of digital samplers.

The first digital samplers were essentially digital tape recorders with a keyboard attached, allowing sounds to be recorded and played back on the keys "at any pitch" (E-mu Systems 1981, 2). The first commercial digital sampler was the Fairlight Computer Musical Instrument. Released in 1979, it was the brain child of Australian inventors Kim Ryrie and Peter Vogel (Leete 1999). Holding up to a few seconds of sonic material at low quality, taking up the size of a small room and costing $28,000, the Fairlight was not an instrument for the up-and-coming musician (Aiken 1985, 36). The Synclavier also premiered around the same time. It had digital sampling, as well as a 16 track sequencer, and it cost over $100,000. These instruments did find their niche with pop and rock stars such as Peter Gabriel, Michael Jackson, Stevie Wonder and Duran Duran, as well as being purchased for use by major studios (Holloway 2006, 104).

With the rise of cheaper samplers such as the Ensoniq Mirage and the EMU-Systems sp-12 (released in 1984 and 1985 respectively) a more diverse selection of musicians began sampling (Berk 2000, 195). The Ensoniq Mirage—with a price of "under $2,000"—was the first affordable sampler (Rodgers 2003, 313-14). It had a sampling length of 4.4 seconds and recorded at low digital quality; however, the Mirage was quickly adopted by musicians who didn't have the money to afford the Fairlight or the Synclavier. Berk writes, "the Mirage was important in that it made sampling a real possibility for struggling musicians…it took a set of innovations,

made them available to a broader market, and radically changed the way average musicians thought about creating music" (Berk 2000, 195).

Hip-hop lore suggests that the first producer to connect the DJ's practice of performing drum breaks to digital sampling was producer Marley Marl. Marl was familiar with early sampling, as he interned at a studio that had a Fairlight, and with the release of the E-mu sp-12 he was able to afford his own sampler (Chang 2010, 256). The popular story goes that while attempting to capture a vocal sample, Marl accidently sampled a snare hit and realized he could sample "that old drummer sound" and apply it to his beats (Brewster and Broughton 2006, 244). Marl quickly utilized this new technique, sampling the individual drum hits from the introduction of the Honey Drippers song "Impeach the President" and reassembling them for the 1985 MC Shan song "The Bridge." Soon Marl and other producers were sampling whole breaks to create their beats. Marl's discovery sparked off a "significant change" in hip-hop, as producers could now record and repurpose the breaks that DJs had been manually looping for years (Schloss 2004, 36).

Schloss claims that the sp-12 sampler was groundbreaking because, "unlike earlier samplers, which were intended to provide musicians with novel sounds for their keyboards, the sp-12 was created to allow a producer to build rhythm tracks from individual drum sounds that had been previously sampled" (Schloss 2004, 35). Hip-hop artists quickly adopted the sp-12 (and other cheaper, percussive-based digital samplers), using them in ways that transferred the DJ's obsession with breaks into the digital age. The sp-12 came already packaged with a wide variety of samples; yet many users, like Marley Marl, preferred to create and record their own samples, so EMU-Systems quickly released the Sp-1200, which had more space and no prepackaged sounds. However, EMU-Systems was not enamored by their product. They thought the pitch

shifting was poor and they were not happy with the sound of the instrument (Milner 2009, 332). In contrast, hip-hop samplers loved the Sp-1200 for its gritty sound as well as its intuitive interface. Marketing Director and designer for EMU-Systems Marco Alpert admits the design of the Sp-1200 was a total accident:

> None of us had any idea that what we were doing would be used in that particular way. But people love the interface. The SP-1200 was very approachable and intuitive and immediate. And then we couldn't even kill it.… Every time we announced we were discontinuing it, there would be this hue and cry, with people offering twice as much retail for them. (Milner 2009, 332)

EMU-Systems president Scott Wedge admits, "Rap…Politically, it was really ugly stuff. We kind of pulled [the 1200] out of retirement, but when we learned that what was being used for was this rap music, we went, while let's discontinue it, maybe that'll stop it." (Milner 2009, 332). One of the members of Public Enemy, Hank Shocklee, moved from the Mirage to the sp-1200, and with the hit album, *It takes a Million to Hold Us Back*, the sp-1200's popularity greatly increased. Shocklee admitted that the sp-1200 felt more like DJing…You had more control of the sound on a performance level" (Milner 2009, 334). It seems as if the control over looped events afforded by the sp-1200 brings Butler's concept of 'riding' to the forefront.

To hip-hop producers, samplers were tools that could expand the DJ's practice of isolating breaks—digitally recording and looping them as materials for composition. No longer limited to the live manipulation of breakbeats, hip-hop DJs could go "beyond the mere replication of "deejaying" techniques," digitally sampling popular breaks and combining them into vast sonic collages (Schloss 2004, 36). Digital sampler manufacturers, who marketed their products as tools for sampling and playing back individual notes, never anticipated hip-hop's loop-based usage of their product. As Roger Linn (designer of the popular Akai MPC sampler)

states, “the biggest surprise for me after creating the first MPC was that its sampling was used for entire sampled loops instead of just drums” (Freff 2011, 93). While most manufacturers saw digital samplers as keyboard-based instruments that could record and playback individual sounds, hip-hop artists conceived of digital samplers as sophisticated recording devices able to record longer passages and create complex sonic pastiches. Schloss maintains that this hip-hop conception of the sampler was in “no way inherent to the technology, but rather [*was*] a reflection of the specific social history of the hip-hop community” (Schloss 2004, 57). Katz affirms this social influence on hip-hop sampling:

> When hip-hop producers first got their hands on samplers, they did not approach the technology as if it were a blank slate—there was already more than a decade’s worth of DJ techniques to draw from. Moreover, the songs they sampled were often the same ones that DJs had been spinning for years. (Katz 2012, 122)

Naturally, while the influence of the DJ informed the hip-hop producer’s use of the sampler, it also influenced the materials they chose to sample. Thus, rare records with breaks became more in demand—as the digital sampler allowed the recombination of multiple breaks in one song, as opposed to the DJ who could only manipulate one or two breaks at a time. Schloss states that “as digital sampling became the method of choice for hip-hop… [*the producer’s*] preexisting hunger for rare records became of paramount importance” (Schloss 2004, 37). This hunger also resulted in the increasing popularity of Roberts’ *Ultimate Beats and Breaks* compilations. According to DJ Shadow, *UBB* records “were the blueprint for what everybody was sampling from ‘86 to ‘91” (Katz 2012, 159). Or put more succinctly by rapper KRS One in 1988, “I’d say just about 100 percent of all rap music uses some kind of idea or something from those break records” (Leland 1988).

In the late 1980s and early 90s, the various models of MPC samplers from Akai would become extremely popular amongst producers for their ease of use and their sampling quality. Seen by many artists as "a tape recorder without the tape," the MPC would allow loop recording, which enabled producers to overdub new loops while the track was still playing (Tingen 2005). The MPC's combination of tape-like interface with the editing freedom of digital would go on to influence the DAWs that appeared in the 1990s and 2000s. For instance, D'Errico asserts, the Drum rack sampler in *Ableton Live* is "a virtual simulation of the MPC interface, with sixteen sample blocks arranged as a four by four grid" (D'Errico 2011, 73). Furthermore, with the MPC Renaissance, Akai has created an external controller for use with various DAWs, connecting the "legendary MPC layout and workflow with the power of your computer" (Akai Pro 2015).

For many producers, looping with digital tools has inspired a playful and experimental method of working. With most of these digital samplers, and all DAWs, the artist is able to undo an operation if they make a mistake. Moreover, they can easily make an identical copy of the original loop or sample if they want to go back after a manipulation error. This eliminates the fear of ruining a loop, a prevalent problem in the tape era, when one wrong slice could cause irreversible damage. According DJ Kool Akiem,

> I just go though a lotta records and kind feel [it] out, "Well, this might sound good with that."...I mean occasionally, I guess I'm going for something specific. But usually I'm just randomly throwin' stuff on there, kinda feelin' it out. Tryin' to, you know, "Ooh, if I chop it here, it'll sound like that." (Schloss 2004, 152)

This process of randomly combining and editing loops is definitely aided by the non-destructive nature of the digital tools.[34] Speaking of the DAW, one producer on Reddit claims,

[34] See chapter 3 for a discussion of this style of composition in the DAW.

> even if you have "writers block", it's a case of trying a different workflow or fucking about with sounds until it sounds good or you get an idea. The /only/ way to overcome it is to make music. (Appendix D2)

Dragging random loops into the DAW and manipulating them in various playful ways is quite often seen as an effective way of creating music in the DAW. This process is greatly assisted by the panoply of loops that are available for purchase and download online.

While hip-hop was focusing on the break, most electronic dance music was focused on using drum machines, sequencers and synthesizers to create their repetitive rhythms. In certain genres, EDM producers began incorporating drum breaks into their music. Two of the biggest genres that incorporated looped breaks were Jungle and Drum and Bass. These genres are essentially founded on chopped and mangled variations of the drum break from The Winstons' "Amen Brother" (called the Amen break) (Reynolds 1998, 252). Sharp claims that drum and bass would not have existed except for the 1989 creation of the AKAI S1000 sampler (Sharp 2000, 134). This sampler could record in CD quality sound and had a new feature called time-stretching, which allowed the tempo of a loop to be increased without increasing its pitch. Most hip-hop producers did not need time-stretching, as they kept their drum breaks at (or close to) their original tempos in order to accommodate rapping. However, time-stretching was perfect for the EDM artists who wanted to drastically speed up the Amen Break without extensively affecting its timbre. These time-stretching algorithms have moved to the DAW, where there are various ways to time-stretch loops and quantize them to a producer-defined tempo. Here, the *Ableton Live* manual flaunts the benefits of its Warp time-stretching algorithm:

> Live's ability to play any sample in sync with a chosen tempo is a unique and important feature. In addition, you can "warp" the rhythmic flow of a piece, changing its "feel," or even move notes to other meter positions. (Ableton 2015, 139)

No matter the digital device, time-stretching was an incredible boon to the loop industry. Now, any loop could be inserted in a digital sampler or dragged into a DAW and instantly quantized to the tempo of a composition with minimal sonic distortion. Anybody familiar with the workings of a sampler or the interface of computer software could accomplish this task with a minimum of fuss.

Meanwhile, not having the influence of break-loving DJs in their past, the majority of rock and pop artists utilized their samplers as the manufacturers intended, to playback individual sounds. However, sampling your own sounds can be a challenging exercise and many musicians turned to third-party developers to purchase new and exciting sounds for their samplers (Gotcher 1988, 126). Thus, while hip-hop samplers were purchasing breaks at niche record stores, a larger market for individual sounds "began to gain a more national profile as classifieds and display ads for sound patches started to appear in musicians' magazines such as *Keyboard*" (Théberge 1997, 78). This market restricted itself to individual sounds for samplers and patches for synthesizers, selling them on various media devices such as "cartridges, cards [*and*] computer diskettes" (ibid., 75). By 1988, Théberge maintains that the sound industry had "apparently reached a kind of peak," avowing that the "brash, full-colour ads" for sound libraries had vanished from magazines like *Keyboard* (ibid., 80). This changed by 1991, when the big brash ads for sounds returned, this time supplemented by headlines announcing, "Nearly 300 Explosive break beats," "red hot loops!!" and "Stop the Machines! It's time for real drums!" (Needledrop 1992, 143; Valhala 1992, 100; Northstar 1991, 112; See Figure 2.6). Costing anywhere from $59 to $399, these early loop libraries consisted mainly of drums performed in the style of rock, pop, rap and dance music (Northstar 1991, 112; Valhala 1992, 100). Many libraries tried to distinguish themselves by trumpeting the pedigree of the recorded drummer or the skills of the superstar dance producer

who programmed the loops (Valhala 1992, 100). Several libraries continued the lineage of the *Ultimate Beats and Breaks* series, declaring, “included are some of the world’s most sought after breaks and hundreds that you’ve never heard before!” (Needledrop 1992, 143). One library even commissioned James Brown’s drummer, Clyde Stubblefield, “the world’s most sampled drummer,” to record his “best grooves” (Soundwarehouse 1993, 78). It appears the business of loop sales had gone from niche record stores to ads in national music magazines. Mentioning the backlog of loop libraries for review in their mailroom at *Keyboard* magazine, one writer asserted: “what used to be a handful of CDs has turned into a heaping boxload (and we expect more on the horizon)” (Rule 1993, 117).

The newly found popularity of loop libraries was influenced by four factors: the rise in popularity of hip-hop style break sampling (*Keyboard* itself had done a big feature on hip-hop and break sampling a year earlier), the popularization of the audio CD and the CD-ROM as a distribution medium, the rise of time-stretching algorithms as well as the increase in processing power and storage space of the computer—creating an all-in-one box where music could be stored and visually edited (Dery 1988). By the early 1990s, audio CDs had become ubiquitous and the price of CD-ROM drives had gone down, allowing the average user to have access to “up to 650 megabytes of storage” (Soundwarehouse 1993, 77). Companies who previously sold only individual sounds began to utilize this storage, selling loops packaged with both varieties of CD media. For instance, one ad offered package deals, selling their loop libraries as a “Bundle Special any $399 CD-ROM disc & CD-ROM drive for $999.00” (Q up Arts 1993, 64). Most importantly, the CD-ROM disks contained the loops as files that could be accessed and loaded immediately into a sampler and computer. As one ad professes, “best of all—our CD-ROMS are already sampled, edited, and mapped to keys—ready to play!” (ibid., 77). The digital storage of

loops as files signaled an important transition in the commodification of loops and completely transformed the process of loopers.

With the advent of tape recording, John Cage professed that tape composition demanded a new form of rhythmic measurement, as the tape collagist must work in seconds and inches of tape instead of "symbols of quarter, half, and sixteenth notes" (Cage 2011, 5). With the shift to digital sampling and recording, the measurement of music changed again. Samplers still worked by measuring sounds in seconds; however, the physical manifestation of tape was replaced by code, the measurement of tape and recording quality was replaced by storage capacity and sound resolution. Looping became about sample rates and minute temporal and (with the visual interface) spatial measurements. Sounds started to be stored in libraries on hard drives and CD-ROMS, accessed on the producer's whim and combined in various permutations with other sounds. This brings looping (and sound recording in general) into the realm of new media, where, as Manovich avows, "graphics, moving images, sounds, shapes, spaces and texts …have become computable; that is, they comprise simply another set of computer data" (Manovich 2001, 20). CD audio, while stored as a digital file, was generally still played and sampled in real-time, articulated like its media predecessors, tape and vinyl records. Conversely, CD-ROMS, containing loops as data files, didn't have to be sampled, played or recorded in real-time, they could just be inserted directly into the computer and manipulated. This form of composition, through modular assembly, lends itself ably to the commodification of loops. Loops as data building blocks can be purchased, easily packaged in a CD-ROM or (by the late nineties) as a download. Speaking of working in the DAW, producer Richie Hawtin makes the following observations:

> ... it's very easy for me to re-edit people's tracks, to take loops and breaks out or to take certain sections and repeat them to make a better track that I could work with. I'd mix those tracks with other ones. The more I did that, the more I thought about it, and the more I started to think about music in a nonlinear fashion. It was more of a collection of parts that could be reassembled in any way I wanted, as long as I had the technology that would make that possible. (Gill 2011, 179)

Loops as data are editable, portable and infinitely mutable files that can be seen as building blocks, elements that "are assembled into larger-scale objects but continue to maintain their separate identities" (Prior 2008, 30). Prior maintains audio as files give "rise to a kind of modular approach where segments of…audio data take the form of malleable data forms that can be cut and pasted into new formations" (ibid., 923). More importantly, in the DAW, this modular approach is driven by the fact that loops as files can be visualized and arranged as graphic objects along a timeline. This leads to an understanding of music as a series of modular building blocks, to be viewed at different levels of magnification, inserted into the DAW's temporal grid and united in a vast sonic pastiche of the artists' choosing.[35] As a 1989 review of the first version of *Cubase* states, "if you conceive of your music as a single seamless stream of consciousness, the orientation of Cubase toward small blocks known as parts may not be of much use to you" (Aiken 1989, 117). Or more recently, as one Redditor claims,

> think of patterns as lego pieces, what kind of lego pieces do you need most? Do you need a single kick drum that you're gonna paint over the playlist as you see fit, or will you write a 16 bar sequence that you end up looping for the rest of the song? It's easier for you to chop down your patterns into parts that are reusable. If you have a drum pattern 1 with a drum fill and drum pattern 2 with some alternative hats or snare rhytms, why would you keep those in the same block when you could just split the sounds that both need and reuse the patterns you already made. (Appendix C1)

[35] See chapter 4 for an examination of this representation in the DAW.

Once home computer technology had advanced enough to allow the recording and editing of sound, this modular form of composition was dramatically simplified by software's Graphical User Interface (GUI). As producers, The Dust Brothers maintain, pre-computer sampling "...was just painful. It took so long, and there was so much trial and error...there was no visual interface to show you what was going on." (Leroy 2007, 37). To flesh out this history of loops as files, I believe it is integral to depart on a brief examination of the history of the interface we all regularly use when interacting with computers, the GUI.

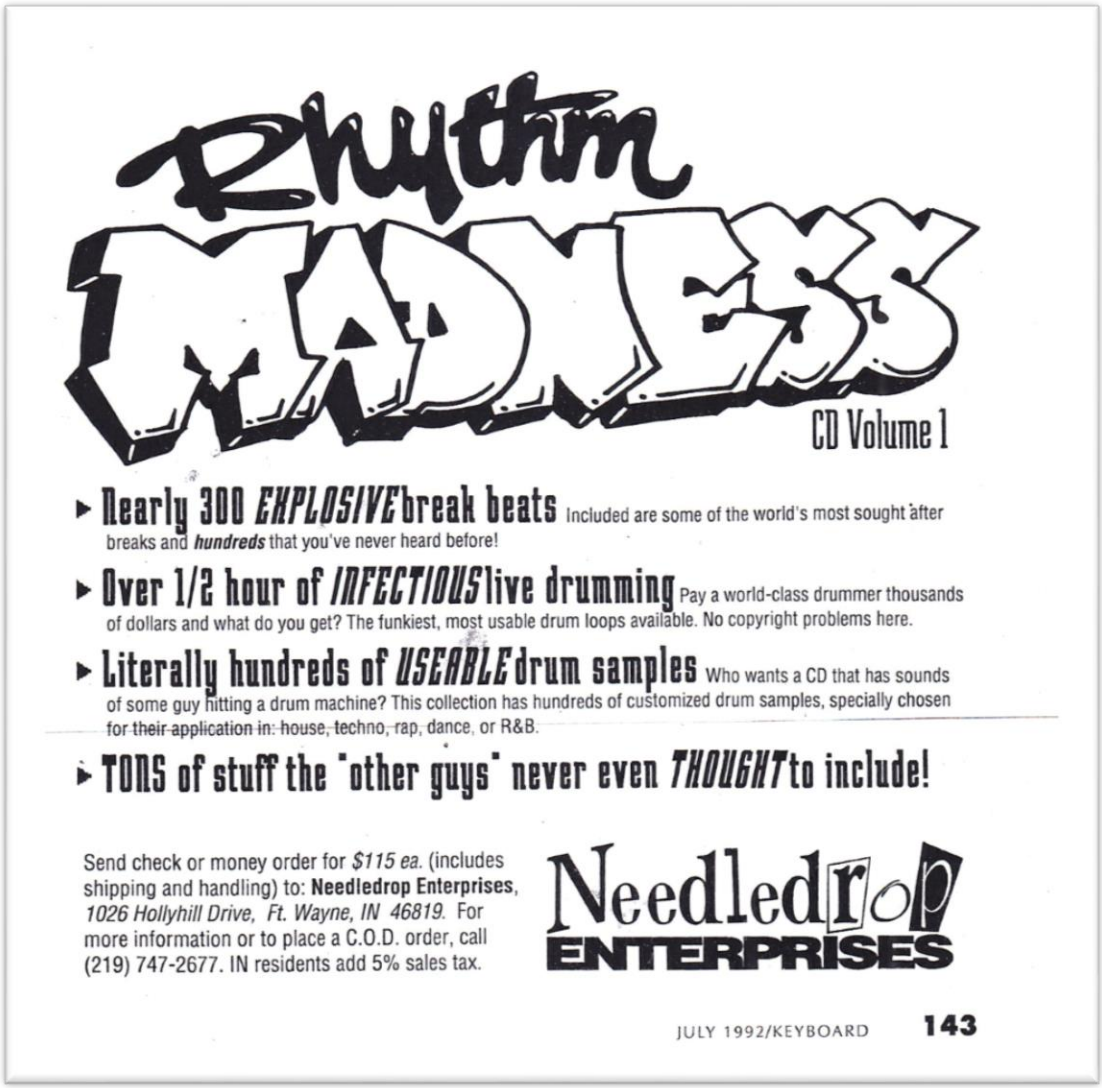

Figure 2.6: Loop ad in *Keyboard Magazine* (Needledrop 1992, 143).

The GUI

In 1968, working for the Advanced Research Projects Agency (largely funded by the United States Department of Defense), Douglas Engelbart demonstrated to a large crowd in San Francisco some of the new toys that his group had developed (Levy 2000, 42). Termed by Steven Levy as "the mother of all demos," Engelbart utilized his group's newly invented mouse to drag a cursor across a projected screen, opening, moving and scrolling a screen-based visual representation organized as a series of windows (ibid.). Describing the importance of this breakthrough, Johnson writes,

> there was, first of all, the wonderful idea of bitmapping…The word itself suggested an unlikely alliance of cartography and binary code, an explorer's guide to the new frontier of information. Each pixel on the computer screen was assigned to a small chunk of the computer's memory: on a simple, black-and white screen, that chunk would be a single bit, either a zero or a one. If the pixel was lit up, the value of the bit would be 'one'; if the pixel went dark, its value was 'zero'. The computer, in other words, imagined the screen as a grid of pixels, a two-dimensional space. Data for the first time, would have a physical location—or rather, a physical location and a virtual location: the electrons shuttling through the processor, and their mirrored image on the screen. (Johnson 1997, 20)

The concept of data having a physical on-screen location was revolutionary and, from music to word processing, would come to drastically transform most facets of everyday life. However, by the 1970s, Engelbart lost his funding and several members of his team left for the Palo Alto Research Center Incorporated (PARC), a division of Xerox, where the first Graphical User Interface (GUI) was developed. Utilizing and adapting many of Engelbart's ideas, PARC intended to design "an office workstation that would seem as invisible to the lay user as possible" (Parikka 2008). Perhaps the biggest breakthrough developed at PARC was the office representation, visualizing data as file cabinets, files, printers and windows that overlapped, just

like stacks of paper (Levy 2000, 70). However, the computer that PARC released (called the Star) was a failure and it was the Apple Macintosh that popularized the desktop and overlapping windows representation that we all utilize today.

In the late 1970s and early 1980s, personal computers would become available to the general public. Perhaps the most important developments were the Apple Lisa, and the Macintosh, its more successful and less expensive descendant. Taking and improving the GUI innovations originated by Englebart and designed at Xerox PARC, Apple popularized the easy-to-use desktop and windows interface that we all utilize today (called the WIMP interface—Windows, Icons, Mouse, Pull-down Menus) (Levy 2000, 80). These developments were not lost on software designers interested in music. Some of the earliest music programs for the Macintosh were sequencers. Similar to external sequencers, these programs sent pitch and timing information to external samplers and synthesizers. This allowed producers to design looped rhythms on their screens, send them to an external synthesizer and then record the results on an external recording device, such as a tape recorder. Enumerating the benefits of software over hardware sequencers, Milano claims,

> manufacturers can pack a lot more function into a menu-driven system because they don't have to add knobs and switches to the front panel. The computer monitor can be used to provide lots of visual feedback for functions that can be hard to keep track of on dedicated hardware-oriented devices. And if you don't count the cost of the computer itself, software-based systems can be pretty inexpensive. (Milano 1984, 81)

Once MIDI was developed in the early 1980s, sequencer software exploded in popularity. One MIDI sequencing program for the Macintosh was *Performer* by Mark of the Unicorn (MOTU) (Holmes 2012, 292). Jim Cooper of MOTU professes,

> in the early 1980s, when Apple Computer gave birth to the Lisa, the computer predecessor to the Mac, MOTU engineers took one look at it and said, "Now that's a computer musicians could relate to." More specifically, the Lisa's graphical user interface allowed notes to be displayed on the screen in what-you-see-is-what-you-get fashion. This was incredibly exciting stuff…Once the MIDI spec was ratified, right around the time that the Mac became commercially available (1984–1985), work quickly began on a MIDI sequencer software application for the Mac: Performer. (Payne 2006)

According to Cooper, MOTU's most influential breakthrough came in the late 1980s with the design of the interface for *Performer v.2*.:

> … we had enormous interface design challenges, as well. How could we possibly package all of this functionality in a comprehensible and intuitive design? We were breaking ground, and the early user interface conventions we designed in Performer, such as the transport controls and the event list, still reverberate today in just about every piece of music software you can find. Early on, we decided that the most probable road to success was to base the software design on the standard, familiar recording hardware of the time: tape recorders and mixing consoles. Plus, we threw in an overall graphic design that built on the conventions being established by the Mac System software (scroll bars, etc.) … Here was a computer not acting and looking like a computer, but instead acting more like a familiar — and cool-looking — recording device. (Payne 2006)

Here we have the visual and interactive foundation of the DAW, a multitrack mixing console and audio tape representation within the WIMP architecture. Reviewing the sound editing program *Sound Tools* (released a few years later), Marans praises the familiarity and ease of this design:

> Virtually all functions are accessed via screen menus and point-and-click icons. For example, the user enters the record module by clicking on a tape recorder icon. Don't you just hate it when high technology facilitates creativity? Us too. But that's what sound tools is all about: putting advanced capabilities into the hands of the creatively inclined, while keeping the complexity of the technology as transparent as possible. (Marans 1989, 108)

Nonetheless, the MOTU *Performer* software only utilized MIDI. The first true DAW, that combined MIDI and audio in one package was the aptly named *Opcode Studio Vision*

(Patrick-Bell et al. 2015). Here, Widders-Ellis describes *Studio Vision*, gleefully mentioning the features that are now present in every DAW:

> Picture this: There's a 16-bit DAT [Digital Audio Tape] recorder lurking inside your Mac. Only this particular DAT is magic…you can do razorblade edits on your recordings just like in the good old days of analog two-track tape. But we're talking virtual blades; you can move a selected passage—anything from part of a note or word, to an entire song section—with pinpoint precision to any location within your recording as quickly as you can move your mouse…Sound cool so far? We're not finished yet. Here, ladies and gents, is the real kicker: Your magic DAT machine is fully integrated into a powerful MIDI sequencer. Both MIDI and audio data share the same metronome, sequences, tracks, and even editing windows, so you don't have to hassle with syncing them up…You can even do regional edits of MIDI and audio data simultaneously. (Widders-Ellis 1991, 134)

While Opcode is no longer in business, it has the distinction of being the first to combine the two forms of sonic representation that currently dictate the processes of all DAW-based producers. *Studio Vision* was not suited for tracking an entire band, as it could only play or record two "simultaneous audio events at once" (ibid., 135). It wasn't until a few years later, with the rise of *Pro Tools*, *Cubase* and *Logic*, that most producer's multi-track sound recording and producing needs could be catered to entirely in the computer.[36]

Looping Software

While *Opcode Studio Vision* was viewed as a tool for "jingle companies" and "remix" engineers, allowing looped audio passages to be stored and visualized as a "linear series of events" that stretched across the screen, it was still too expensive[37] for the average loop-based producer (Widders-Ellis 1991, 140). By the early 1990s, alongside the mixer board-based

[36] In 1999, Ricky Martin's "Livin' La Vida Loca" was the first hit song to be recorded and mixed entirely in the computer (Milner 2009, 297).
[37] *Keyboard Magazine* listed *Studio Vision's* retail price as $995, which did not include the price of the computer, the audio interface as well as the hard drive (Widders-Ellis 1991, 134).

software programs, there arose a breed of music software that was dedicated solely to the creation and manipulation of the loop. As we saw earlier, the hip-hop artist's idiosyncratic usage of the digital sampler was highly influenced by the hip-hop DJ's passion for the break. This passion for sampling and creating loops also influenced the design of the music programs *ReCycle, Acid* and *GarageBand*. As Fuller claims, "… software ... gains its power as a social or cultural artifact and process by means of a better and better accommodation to behaviors and bodies which happen on its outside" (Fuller, 2008). In this case, these programs have been readily accommodated for the processes of loop-based artists.

Unlike other software, which allowed live recording, *ReCycle* (released in 1994 by Propellerhead software), was intended as a standalone program for creating loops (Howell 2005). *ReCycle* would take an imported loop and slice "it up into separate beats/hits, making each hit a separate sample" (ibid.). The software could then take each of these hits and "vary the distance between each of them, and hence change the tempo without changing pitch" (ibid.). Users would then take their newly recycled loop to a mixer board-based program to arrange into a song. *ReCycle* stored these cut-up loops in its own proprietary file format called ".REX," which allowed the user to "take almost any sampled pattern and use it at any tempo" (ibid.). While *ReCycle* has been overtaken by other more advanced loop-based programs, there is still a market online for the purchase of ".REX" files (ibid.). For instance, the popular loop library website Loopmasters has a plethora of ".REX" files (and the newer ".Rex2" files) from a variety of genres for sale (Loopmasters 2017).

Acid was another popular program for the creation and recombination of loops. Like *ReCycle, Acid*'s proprietary sound files became popular items for sale eventually becoming "a staple of the soundware industry" (Aiken 2003, 66).

GarageBand is also an important DAW to examine when discussing the rise of loops as a commodity, due to it being an entry level music software package that "comes free with every Mac" (Wherry 2007). Released in 2004, *GarageBand* is considered as a "loop-based composition tool" that also allows recording and it comes packaged with "more than 1,000 professionally recorded" Apple loops (Edstrom 2006, 5). The ubiquity of the software, its ease of use and the size of its loop library makes it the perfect platform for beginners to experiment with loop-based music. Upon starting a new project, *GarageBand* prompts the user for the key and tempo of their composition, allowing the software to automatically adjust the loop when dragged into *GarageBand*'s temporal grid (termed the "Timeline"). Another important aspect of *GarageBand* is its file management system which "lets you quickly find loops to add to your projects" (Apple 2006, 20). Every *GarageBand* loop, encoded in the proprietary Apple loop format, contains descriptive information such as tempo and key as well as allowing the file to be sorted by "instrument, musical genre or mood" (ibid., 20). With this method, a producer can just choose and drag in melodically, stylistically or rhythmically complimentary loops just by glancing at their title names. This feature is also present in *GarageBand's* more developed big brother, *Logic*, transferring the ease and organization of Apple Loops to the professional realm (Apple 2015, 50). Although *GarageBand* comes packaged with a large loop library, there is a thriving market for sales of 3rd party Apple loops (Owens 2004, 14). Moreover, Logic allows producers to create their own Apple Loops for sharing (Apple 2015, 259). For an example of the widespread use of Apple loops, the 2007 hit song "Umbrella" by Rihanna (produced by Tricky Stewart and Kuk Harrell) used the Apple loop "vintage funk kit 03" as its main rhythm (Totten 2016).

These loop-based software packages bring the producer's obsession with looping drum breaks into the era of the computer screen. This dedication to loop-based processes of creation is present in all modern DAWs; yet *Ableton Live*'s session view, as well as the sequencer of *FL Studio* seems to provide more affordances for the looping act. This focus on the looping-act was present from the earliest days of these DAWs. *Ableton Live* was designed in 2001 by electronic duo *Monolake* (Robert Henke and Gerhard Behles) who were interested in performing their music in a live setting (Prior 2008, 923). *FL Studio* was developed in the early 1990s (under the moniker of Fruity Loops) as a MIDI sequencer inspired by Propellerhead's *Rebirth* (which was partly inspired by Roland drum machines) before rebranding in the 2000s and adding audio recording to its repertoire (Image-line 2017).

With the plethora of loop-based software programs on the market and loop libraries now being disseminated online, soundware companies are no longer restricted to the limits of physical recorded media. Large multi-gigabyte collections offering a dizzying array of loops and sounds are sold on websites like LoopMasters.com and garishly displayed in computer music magazine advertisements. Similar to their earlier CD and CD-Rom based brethren, loop libraries are publicized by composer (usually a famous producer or drummer) or organized by instrument and genre. In an attempt to cater to the tastes of their clientele, theses libraries also act as a gauge for the current popular (and ever changing) genres and sub-genres of electronic music. From Grime, to Moombah, to Tribal house, the Loopmasters' website lists 63 different genres for their loop libraries. Moreover, from ".REX2" files, to Apple Loops, to *Acid* presets, to *Ableton Live* packs, they also list a plethora of different formats for these libraries (Loopmasters 2017).

It seems that all the DAWs that are the focus of my dissertation are courting the beat-makers and composers who are not as focused on live recording. Every one of these DAWs

comes packaged with various MIDI instruments, effects and sample libraries, providing tools for the producer who does not have access to the microphones and sound proofed space of a traditional recording studio. *Ableton Live* touts its "3000+ sounds (54GB), 9 instruments and 41 effects" as a way to "get you making music even faster" (Ableton 2017). *Cubase* proclaims its "comprehensive set of 8 outstanding instruments with over 3,000 sounds" (Steinberg 2017). According to the *Logic* website,

> Logic Pro X comes with a massive collection of instrument and effect plug-ins. The Sound Library provides thousands of Patches and Apple Loops created by top sound designers. Whether you're sweetening a melody, grinding out trap beats or building toward a big drop, you'll never run out of possibilities…play and explore a huge library of over 3000 sounds…audition one of 2700 Patches, instruments and effects for voice, bass lines, brass, strings, woodwinds and so much more. (Apple 2017)

Even *Pro Tools*, "the industry standard digital recording solution," comes packaged with a "2 GB high-quality loop library from Loopmasters to wake up your mix and give projects that sonic edge" (Avid Technology 2017).

Conclusion

In this chapter, I have provided a whirlwind tour of the DAW's layout, assessing many of its functions, features and biases, as well as briefly stressing the influence of the graphical user interface as a form of representation integral to the structure of many producer's on-screen musical interactions. As my dissertation focuses on the online discussions, conceptualizations and works of hip-hop and EDM producers, I feel the loop-based affordances of the DAW are a particularly relevant topic for examination. The rise of looping as a form of composition provides a fascinating viewpoint on the ways manufacturers of recording technology and the users of said technology enacted a creative dialogue (a back and forth of technological misuse,

derision and eventual acceptance, if you will), that culminated in the development of many visual and manipulatory structures that are inculcated into the graphics on the computer screen. From the spatialization of musical time and the influence of visuals on the perception of sonic events, to the evolving process of looping and the rise of digital loops as modular commodities, my review of the looping act has served to introduce many concepts that I will further address in later chapters. With this in mind, in the next chapter, I will focus on the interactional aspect of the DAW, examining ways the concept of direct manipulation—the act of pointing at a visual object on the screen and affecting a visible result—has influence over the producer's workflow.

Chapter Three: "Circus Tricks with the Sound": Play, Agency and Manipulation in the DAW.

> The trick, then, to motivating your users in the most productive direction is to engage their playfulness. Your highest priority is to encourage a sense of playful experimentation. (Crawford 2003)

> To experience agency, it must be possible to build reliable hypotheses about action and reaction, but experiencing agency also means viscerally enjoying the outcome of a certain action, such as watching the monster you've just hit with a grenade exploded into bits. (Rusch 2008, 29)

> No tutorial here really, it's just me messing around in [*Ableton*] *Live* and seeing what happens.
> (Mr. Bill 2013, 14:50)

In a 2013 *YouTube* video, producer Mr. Bill demonstrates his method for defeating writers' block—aimlessly playing around in the DAW. For the majority of the hour and four-minute video, he experiments with a recording of a synthesizer, rapidly chopping, moving, stretching, reversing, fading, compressing, distorting and transposing the crisp on-screen waveforms in an attempt to stumble upon unique and interesting sounds (Mr. Bill 2013). In this chapter, I intend to analyze several ways the interactive structures of the DAW[38] encourage this abundance of sonic manipulation. I believe, the level of complexity of the DAW's visual feedback, as well as the way this feedback is structured, has an influence over the compositional process, fostering an unplanned style of creativity that invites artists (such as Mr. Bill) to endlessly play around with the visual representations on the computer screen. Moreover, while

[38] For the purposes of this chapter (unless otherwise noted), I will not be considering distinctions between the various DAWs, as I believe their architecture and workflow are similar enough to be negligible in discussing the influence of interactivity.

not as viscerally engaging as a video game, for certain producers, these interactive visuals also instill feelings of agency and control when manipulating sound, which tends to encourage even more manipulation. Finally, all these incentives to manipulate have an affect on online musical critiques, creating an aesthetic where the amount of sonic manipulation is highly esteemed.

By focusing on play, agency and aesthetics, I hope to reveal many ways the manipulation of sonic events are encouraged by the interactive structures of the DAW. Producer Steve Albini has commented on this manipulatory emphasis:

> From a practical standpoint, digital recording systems did not grow out of digital recording devices. They grew out of digital editing devices or digital editing software. That is, Pro Tools didn't come from a high-quality audio recording program. It came from a program that edited pre-existing audio, Sound Designer. The development and evolution of digital recording systems has concentrated on increasing the capabilities of editing and manipulation, not on increasing the integrity and sound quality of the initial recording. So virtually all of the development involved with digital recording workstations, Pro Tools and all of its competitors, have focused their attention on increasing the manipulative capabilities of their software so that you can do more circus tricks with the sound. (Phillips 2010, 278)

For DAW-based producers, whose art form is entirely predicated on the manipulation of sonic events, these circus tricks transform the ways they interact with sound. Mr. Bill's compositions involve hundreds of tracks with many manipulated waveforms individually placed in the DAW, using only a keyboard and mouse (Mr. Bill 2012). His disorienting style of timbrally fragmented instrumental hip-hop would not be possible without the visuals provided by the computer screen. While I believe the sonic visualizations of the DAW are in no way the sole reason for the sonic characteristics of his music, they do exert a definite influence that needs to be analyzed. By imparting feelings of agency, as well as encouraging playful experimentation, on-screen visuals heavily promote the manipulation of sound; nonetheless, it must be understood that there is no

clear dividing line between agency and play. A sense of agency can spur methodical composers to increase their systematic sonic manipulations; yet, this same sense of agency is required for a producer to aimlessly play with sound.

Play

There is a tendency for the DAW to overwhelm producers with an overabundance of options; however, this bounty of possibilities can also encourage artists to aimlessly experiment, playing around with the on-screen excess of knobs, sliders and sonic visualizations in the search for unique sounds. These endless choices for transforming sound can then be quickly and effortlessly combined in a myriad of ways, the results of which cannot be easily predicted, allowing the producer to stumble upon unique sounds.[39] As a result, this particular form of interactive play[40]—as exemplified by Mr. Bill's method of defeating writers block—is proposed quite often by producers online as an integral part of their workflow (Appendix D). As one electronic music producer admits on Reddit,

> everything I end up liking is as a result of happy accidents. In a way it's frustrating because I feel like whenever I happen to make fire it's just total fluke. But on the other hand it happens fairly consistently, so there must be some method to the madness. Bangers just materialise imho, for me it happens rarely and seemingly by accident. But as long as I occasionally shit out an absolute slammer I'm cool with it. Few things feel better.[41] (Appendix D1)

[39] In fact, I believe the sense of delightful surprise that follows the discovery of a unique sound has a part in encouraging this playful workflow.

[40] The word "play" has a multitude of meanings (for a thorough enumeration of the various forms of play see Sutton-Smith 1997, 4); however, in this chapter, I will be taking Katie Salen and Eric Zimmerman's definition of play as "free movement within a more rigid structure" (Salen and Zimmerman 2004). This framework was also utilized to great effect by Ian Bogost in his examination of the "procedural rhetoric" of video games (Bogost 2007). As we've previously seen, the DAW provides the producer with strict methods of musical creation that encourage composition in the style of repetitive, Western-style popular music; nevertheless, when composing within those dictates, the DAW can provide a large amount of freedom in the playful and unplanned manipulation of sonic events.

[41] Bangers, slammers and fire are all descriptions of successful tracks and "imho" means, in my humble opinion.

I intend to examine the ways various elements of the DAW encourage the creation of these happy accidents. By examining studies on human computer interaction (HCI), scholarly analyses of video games, as well as guide books for interface designers, I will show how many of these playful feelings evoked online by producers correspond to the Graphical User Interface's (GUI) main style of interaction—direct manipulation. In fact, the direct manipulation nature of the GUI—manipulating a graphical object on a computer screen with a mouse (or other peripheral) and affecting a visible result—is predicated on this type of play. Creating structures that encourage the user to playfully experiment is an important feature in the design of many direct manipulation interfaces. Interface designer Chris Crawford stresses that, in the 1980s, experimentally playing around with on-screen graphics allowed American workers to quickly and easily learn the fundamentals of personal computing without taking classes (Crawford 2003). I maintain, this method of interaction does not cease once a software user clicks on the DAW. In fact, interface designers have created processes and structures within the DAW that can encourage this style of playful interaction.

Based on the writings of psychologist J.P. Guilford and video game theorists Katie Salen and Eric Zimmerman, I propose three necessary characteristics for DAW-based playful interaction: flexibility, fluidity and discernability (Guilford 1967, 138; Salen and Zimmerman 2004). Fluidity refers to ways the DAW simplifies workflow, making certain processes and sonic manipulations easier to accomplish; flexibility, to the ways the DAW accommodates the divergent[42] whims of a producer, allowing the latter to fearlessly depart on creative tangents

[42] Writing years before the development of the direct manipulation interface, psychologist J.P. Guilford devised the term divergent creativity to explore a style of creative thinking that stressed "abilities having to do with fluency of thinking and flexibility of thinking, abilities concerned with the ready flow of ideas and with readiness to change direction or to modify information" (Guilford 1967, 138). Robert Tubb and Simon Dixon incorporate divergent creativity into their design of a musical software interface that includes "unpredictability and serendipity" in the creative process (Tubb, Dixon 2014, 233).

when a novel sound is discovered; and discernability, to the visual response the DAW provides to these fluid and flexible actions, the visually discernable means in which the DAW instills feelings of pleasure, control and agency, which, for certain producers, can be a call to play. In short, flexibility and fluidity are mobilized through the visual design, as well as processes and functions that encourage playfulness, while discernability highlights the producer's interaction with the visual representations of sound.

In a 1994 magazine review, Peter Freeman stresses the integral elements for a successful DAW-based interaction: "… speed, fluidity, ease of use and immediate, detailed, visual feedback" (Freeman 1994, 44). Although I intend to examine the influence of these interface characteristics on sonic playfulness, they are not always an enticement for play. Many producers utilize the DAW solely for a methodical composition style, while others move back and forth between playful and more thought-out composition. As with most interactive forms of software, there is no general consensus on methods of working with the DAW. Salen and Zimmerman declare that video game designers cannot dictate the way their games are played, they can "only design the structures and contexts in which play takes place, indirectly shaping the actions of the players" (Salen and Zimmerman 2004). They call this design space, the "space of possibility," describing it as "the space of all possible actions that might take place in a game, the space of all possible meanings which can emerge from a game design" (ibid.). With this in mind, I wish to examine the DAW's particular space of possibility that encourages the playful manipulation of sound.

Flexibility and Fluidity

Playful creativity has been present in most pre-DAW forms of sample-based music. In the late 1940s, musique concrète pioneer Pierre Schaeffer would grab random records from his studio to mix into his compositions, discovering interesting sonic combinations while recording them live onto disc (Schaeffer 2012, 19). In the 1960s, Terry Riley would compose by splicing together and looping random sections of audio tape in the search for "strange things that would happen" (Potter 2000, 117). More recently, pre-visual interface hip-hop samplers would create tracks from random records in their collections, discovering new and unexpected sounds in the process (Schloss 2004, 152). Often, however, these divergent processes were more akin to gambling than playful experimentation as many results had to be discarded if they were not up to snuff. In contrast, DAW users rarely have to deal with the dangers of ruining a particular composition. If their playfulness does not produce satisfactory results, they can simply walk back any manipulation by utilizing the undo function. This provides the safety to experiment without consequences. Here Nuhn et al. describe a producer's flexible process of sonic experimentation:

> This quite logical and problem focused action would then often lead her astray from the original intentions, because the new sounds inspired her to wander off in a completely different direction and not return to the original arrangement for quite some time. (Nuhn et al. 2002, 577)

Being able to easily return to an original arrangement enables producers to explore a new avenue of creation without the fear of losing their previous work. Crawford writes,

> Undo is thus a primary tool for supporting exploration in software user interfaces. It allows users to reverse one or more previous actions if they decide to change their mind. A significant benefit of Undo is purely psychological: It reassures users. It is much easier to enter a cave if you are confident that you can get back out of it at any time. The Undo function is that comforting rope ladder to the surface,

> supporting a user's willingness to explore further by assuring him that he can back out of any dead-end caverns. (Crawford 2003)

This reassurance that there are no permanent consequences for any action has an incalculable effect on the workflow of producers, allowing them to be flexible, to perform a large amount of experimental manipulations in the DAW without fear of ruining their composition by making unsuccessful creative choices. Recording engineer Trina Shoemaker claims,

> I certainly take advantage of the digital loopholes, the get-out-of-jail-free cards, and the escape hatches, and the emergency lifeboats. And this boat won't sink, and you're not going to die. There are so many ways out of error that there did not use to be. It was serious when you recorded over something; it was gone. That's it. It's done. It's gone. You can't make it come back. It hurt … (Phillips 2010, 262)

Each DAW has an undo function, *Pro Tools*, *Cubase* and *Logic* even create an undo list where the user can view the manipulations they enacted and the times they occurred, negating unwanted manipulations with the click of a mouse (Bachmann et al. 2015, 65; Apple 2013, 111; Avid Technology 2015, 488). If these multiple levels of undo are insufficient, users can also use the 'save as' function to save different versions of their composition, taking "snapshots" of various stages of their compositional process (Duignan 2008, 241). This provides producers with the flexibility to go off on longer manipulatory tangents while still retaining the ability to return to an earlier version of their composition by opening a previously saved file. Beyond Undo, the speed and processing power of modern computers, as well as the cheap availability of a ridiculous amount of hard drive space means the flexible creativity of producers is rarely thwarted by physical concerns. Waiting extended periods of time for the computer to process manipulations and worrying about hard drive space is not conducive to flexible creativity. While flexibility is important for playful creativity, in order to transform a composition on a whim, the

creative tools must also provide a fluid environment that allows producers to effortlessly manipulate sound.

The ease of the visual manipulation of sound has been remarked upon since its inception. In a 1989 *Keyboard Magazine* review of Digidesign's *Sound Tools* (a visually-based software package for sound editing and a precursor to *Pro Tools*) Michael Marans writes,

> we found ourselves trying out wild ideas simply because the tools provided by the system made acting on them so simple that we just couldn't resist the temptation. (Marans 1989, 119)

In the 27 years since this review was written, this temptation to manipulate sound has grown exponentially, fertilized by the aforementioned computer's increase in speed and power, as well as the creation of various processes and functions that make it easier to playfully engage with sound. One benefit of the increase in the power of the personal computer is the ability to apply effects and manipulations in real-time while the composition is playing. Stopping the creative process to watch a progress bar slowly inch across the screen as the computer processes an effect is not conducive to fluid or flexible manipulations. Freeman discusses his favourite method of composition in a 1994 review of several popular DAWs (back when they were called Digital Audio Sequencers):

> I often loop a short section of music-usually four or eight bars-adding and changing elements "on the fly" until I'm satisfied…I want to be able to edit everything: change the pitch, position, length, velocity, and other aspects of single or multiple MIDI and audio events. And all edits must be enacted smoothly, without having to stop recording or playback. It's a definite plus if the program displays music in a simple, easy to grasp way, so that making changes is as effortless as possible. (Freeman 1994, 44)

Working in real-time, hearing your manipulations as they are enacted without stopping the music, contributes to the fluidity of a producer's workflow. A delay between a manipulation and the sonic results can be extremely frustrating as the process may have to be repeated several times before the desired results are obtained. Moreover, as Freemanwrites, working 'on the fly'[43] means the DAW must allow the producer to work quickly and fluidly with a minimum of effort.

Referring to this type of fluidity in working with an interface, Hutchins et al. use the term "directness," asserting that, "the feeling of directness is inversely proportional to the amount of cognitive effort it takes to manipulate and evaluate a system" (Hutchins et al. 1985, 317). Thus, reducing cognitive effort can be achieved by minimizing the amount of steps needed to accomplish an action. For example, if producers have to click on a scroll-down menu, choose an option from a list, then select even more options from a resulting pop-up window to accomplish a single action, they are exerting a large amount of cognitive effort and are less likely to playfully experiment with their composition. When discussing their process, the producers from The Orb claim,

> I think you should have everything in front of you—all the parameters should be immediately available, as in old analog synthesizers and manual sequencers. It's such a human thing to do. It's not human to go through pages. (Rule 2011, 107)

Hence, in the DAW, various processes and visual structures circumvent a more cumbersome selection process to make certain manipulations more cognitively direct, increasing the fluidity of the producer's workflow.

[43] I will examine working "on the fly" more extensively in Chapter 4.

One way to increase fluidity in workflow is with shortcut keys. These keys allow the producer to perform an action quickly by pressing a combination of buttons on the keyboard, avoiding the selection of menu items with the mouse. Most shortcuts are designated for operations that are utilized frequently by producers.[44] For instance, the *Ableton Live* manual has nine pages dedicated to various shortcut keys from, "cut, copy, paste, duplicate, delete" to "Zooming, display and selections" (Ableton 2015, 665-674). *Pro Tools* dedicates a whole chapter to "Keystroke and Mouse Shortcuts … For increased operational speed and ease of use" (Avid Technology 2015, 21). *Logic X* even allows users to customize the shortcut keys, changing the available options or mapping their favourite, less popular operations to the keyboard (Apple 2013, 916). Nash and Blackwell provide insight into the use of the keyboard for music creation with their study of trackers—a style of music software that is "almost exclusively controlled through the computer's QWERTY keyboard," eschewing most of the dense visuals of the DAW (Nash; Blackwell 2011, 575). In their extensive two-year study of the workflow of over 1,000 sequencer and tracker users, "combining interaction logging, user surveys, and a video study," Nash and Blackwell assert that the use of the computer keyboard "supports a level of virtuosity and flow that is currently lacking in aspects of the user experiences of other mainstream computer music methods" (Nash; Blackwell 2012, 1). Referencing the visuals of the DAW directly, they observe that

> this aspect of virtuosity and the fluidity of the user experience is defeated by dynamic, moveable screen layouts and the constant visual attention demanded by the mouse pointer. Within the multiple-window context of the DAW, users spend significant time managing the arrangement of windows, rather than interacting with the music itself. (Nash; Blackwell 2011, 580)

[44] Quite a few DAW keyboard shortcuts are common to most GUI-based software packages. For instance, common shortcuts such as 'control x,' 'control v' and 'control z' for cut, paste and undo (command x, v and z for Mac), amongst others, are also used in graphics and video editing, as well as word processing software (Adobe 2013, 76).

While mouse navigation and management of visuals can be a challenge in DAW-based music creation, trackers are mostly used to synthesize sound and not manipulate audio, making them unsuitable for the majority of DAW-users. Moreover, becoming virtuosic in tracker software involves the memorization of many more keyboard shortcuts than required with the DAW. Splitting the difference between the two styles of music control, the *Ableton Live* manual asserts that the combination of shortcut keys with visual editing "lends itself to an efficient division of labor between the two hands: One hand operates the mouse or trackpad, while the other hand issues the keyboard shortcuts for the menu commands" (Ableton 2015, 100). Our favourite producer, Mr. Bill, has even created a *YouTube* tutorial to demonstrate his "speed editing" when using *Ableton Live* and a keyboard (Mr. Bill 2013a).

Another feature that allows users to fluidly manipulate their composition by using the keyboard is the "Hot-Swap" function in *Ableton Live* (Ableton 2015, 60). Usually in Ableton, an effect, instrument or a sound is added to a composition by selecting it in the library with the mouse and dragging it onto the relevant track. When experimenting with new sounds constantly using the mouse to drag various items from the library can become an arduous, cognitively demanding task. With hot-swap, users can scroll through their library with the up and down arrows of the keyboard and the highlighted effect or instrument is instantly inserted into the pre-selected track with the click of a button. This can be done while the track is playing allowing producers to switch the instrument playing their main melodic line with one keyboard press, for instance, without looking at the screen. Instruments and sounds can be changed and effects can be auditioned rapidly without specific planning, nor the visual and spatial awareness required for dragging and dropping various items. Emphasizing the fluidity of hot swap, one Redditor claims,

"… with the "Hot Swap" feature and now the Live 9 browser, it feels like I can try something almost as quickly as I can think of it" (Appendix U1).

In addition, the large amount of sounds, instruments and effects that come with the average DAW, as well as others that can be easily downloaded, purchased and pirated from various sources, means the average producer could conceivably have a library of thousands (to hundreds of thousands) of sounds, MIDI instruments and effects to scroll through when hot swapping. A producer would most likely not have working knowledge of all these sonic options, thus, there is a large amount of unplanned, playful experimentation involved in choosing sounds and effects, and hot swap reduces the cognitive effort required in this selection.

Ableton Live also encourages play through its method of editing. In other DAWs, such as *Cubase*, *Pro Tools* and *Logic*, in order to cut a recording, a specific editing tool must be selected (Apple 2015, 39; Avid Technology 2015, 499; Bachmann et al. 2015, 473). For instance, here is the procedure for cutting audio described in the Logic manual:

> Split a region using the Scissors tool
> 1 Select the region you want to split.
> 2 Select the Scissors tool, then click-hold the region.
> The help tag shows the current split position.
> 3 Release the mouse button. (Apple 2015, 39)

Cooper et al. call this method of interaction *entering a mode*, "because, when a tool is selected, the behavior of the program conforms to the attributes of that tool. The program can only behave in one way" (Cooper et al. 2007). Requiring a change in tools seems to signal that the software programmers view the editing of audio as a separate task from mixing and recording. In comparison, *Ableton Live* lets the producer split, cut and paste using the main cursor, without necessitating a change in tools. In essence, editing audio is *Ableton Live's* default

mode. The selection of a tool to edit audio is not a highly cognitive undertaking; nonetheless, jumping back and forth between modes can become cognitively demanding when enacting a large number of manipulations. Mr. Bill's playful *YouTube* video would be less fun, involving much more cognitive work, if he had to select the scissor tool every time he wanted to cut a waveform.

Finally, I believe, one of the most important elements for fluidity of manipulation is the DAW's visual layout of sonic events. Mullet and Sano write that

> … organization and visual structure provide the user with the visual pathways needed to experience a product in a systematic way. Structure affects the visual experience at its most primitive level because it is the first aspect of the display to be perceived as information is extracted and used to guide subsequent interaction. Because they are experienced effortlessly and automatically, phenomena at this level provide critical communication channels … (Mullet and Sano 1994, 89).

The DAW tempts the producer to come play by constantly showing the sonic elements available for interaction and manipulation. As Murray mentions, the computer "is always suggesting processes to us even when it is just displaying information. Anything we see in digital format – words, numbers, images, moving pictures – becomes more plastic, more inviting of change" (Murray 1997, 154). This phenomenon has already been remarked upon by Lev Manovich in his examination of the animation software *After Effects*:

> Because the software interface makes directly visible every parameter for every object in the composition, assigning each its own channel on the timeline, it literally invites the designer to start animating them. You are invited to start moving and rotating objects, changing their opacity- colors, and so on…As a result, although a particular software application does not directly prescribe to its users what they can and cannot do, the structure of the interface strongly influences the designer's thinking. In the case of moving image design, the result of having a timeline interface with multiple channels all just waiting to be animated is that a designer usually does animate them…the interfaces of computer animation

> software quickly led to a new aesthetics: the continuous transformations of most (or all) visual elements appearing in a frame. (Manovich 2013, 310-311)

The parallels between this description and the DAW are fascinating.[45] Just as with *After Effects*, the visibility of every parameter of the sound object, planted on the grid and separated on its own audio track, invites the producer to manipulate. This interaction is incredibly fluid as very little cognitive effort is required to manipulate these visualizations. DAWs are often used solely as a tool for recording and mixing, where the manipulation of sound is not an issue; yet, the inherent visibility of the sound object on the grid seems to encourage a producer to manipulate audio. In fact, one software musician stressed to Nuhn, et al. that he solely uses text-based composition tools because manipulating sound in a DAW requires too *little* cognitive effort, asserting, "in very user-friendly applications like Pro Tools he feels he often does too much" (Nuhn et al. 2002, 578). The layout of these visual representations of sound are not the only enticements to playful manipulation, the DAW's visual responses to these manipulations are also highly important.

Discernability

While flexibility and fluidity involved processes and interactive structures that encourage playful creativity, I will now examine the influence of discernable visual feedback provided by the DAW, focusing on its two main representations of sound: MIDI notation and the waveform. Salen and Zimmerman claim,

> discernability in a game lets the players know what happened when they took an action. Without discernability, the player might as well be randomly pressing

[45] In an earlier article, Manovich makes this connection to multi-track audio recording implicit, asserting, "Most importantly, just as multitrack recording redefined the sound of popular music from the 1960s onwards, once digital compositing became widely available during the 1990s it changed the visual aesthetics of moving images in popular culture" (Manovich 2007, 73).

> buttons or throwing down cards. With discernability, a game possesses the building blocks of meaningful play. (Salen and Zimmerman 2004)

It must be noted that in the DAW, aimless play can only go so far; there still must be a substantial amount of control and predictability in the manipulation of sonic events. Although interesting sounds can be discovered by randomly combining various manipulations, if each individual manipulation does not offer a consistent cause and effect (e.g., the knob turns when clicked or the waveform changes when cut) the producer can become frustrated and play will not occur. As Korhonen declares, the "feeling of *Control* is relevant to playful interactive products" (Korhonen 2009, 278). Consequently, to many producers, the complexity of the DAW's visual response seems to encourage feelings of control and agency, as well as playfulness. More specifically, these feelings are often intensified by the complex visual detail of the DAW's waveform visualization. Furthermore, through the operation of rendering—where MIDI notation and audio effects are converted to the waveform—many producers' preference for this visually complex representation is often correlated with more control over manipulation, as it provides a more detailed representation of the sound coming out of the speakers. First, in order to fully understand the influence of the visual response on playfulness and agency, we need to examine the characteristics of both MIDI notation and waveform representations.

In the DAW, sound is mostly represented in two main ways: as MIDI notation or as a waveform (See Figure 3.1). MIDI notation is a highly simplified notation of sound—displaying the length, position and pitch of a note as a rectangle on a grid called the "piano roll" (Ableton 2015, 138; Avid Technology 2015, 12; Bachmann et. al., 686). In contrast, a waveform represents the amplitude of a sound over time as peaks and valleys that can be magnified to reveal more visually complex details. A MIDI signal encodes a musical performance "as a series

of digital events" (Machrone, 1990). Instead of documenting the enormous amount of information contained in a traditional microphone recording (such as instrument timbre and room reverberation), MIDI serves to abstract performance details from these sonic characteristics, capturing pitch, attack, duration and velocity. As a result of this abstraction, MIDI provides the producer with a plethora of options for composition; any MIDI instrument can be easily applied to a particular set of performance details, switching a syncopated melody from a piano sound to a distorted synthesizer with the click of a mouse. Moreover, the timbral qualities of a MIDI instrument can be manipulated individually from the performance, usually by manipulating virtual knobs and numerical values. Finally, the pitch of a sequence of most MIDI notes can be "easily edited as text in a word processor" without affecting the sound; whereas, changing the pitch of a waveform passage, while impressive with software such as *Auto-Tune*, can still introduce unwanted "artifacts" (Patrick-Bell et. al., 2015; Antares 2014, 36).

In contrast, waveform manipulation largely emulates the procedures of audio tape editing. A waveform can be cut, moved and combined; however, like audio tape, seamlessly pasting together waveforms requires "crossfading" (Ableton 2013, 81). In this instance, to avoid abrupt transitions and unwanted noises, the beginning and end volumes of two overlapping clips are faded out and in, as an emulation of the tape editing technique in which the "gradual rise in the attack of the new sound can be created by cutting the tape at an angle" (Keane 1980, 41). The pitch of waveforms can be changed as well as algorithmically stretched to conform to different tempos; nevertheless, these operations do change the timbre of the sound, sometimes drastically, depending on the magnitude of the transposition or stretching. There are many producers who enjoy the tape-based editing style of the waveform and delight in the glitchy, artifact-laden sounds that result from overly manipulating the waveform.

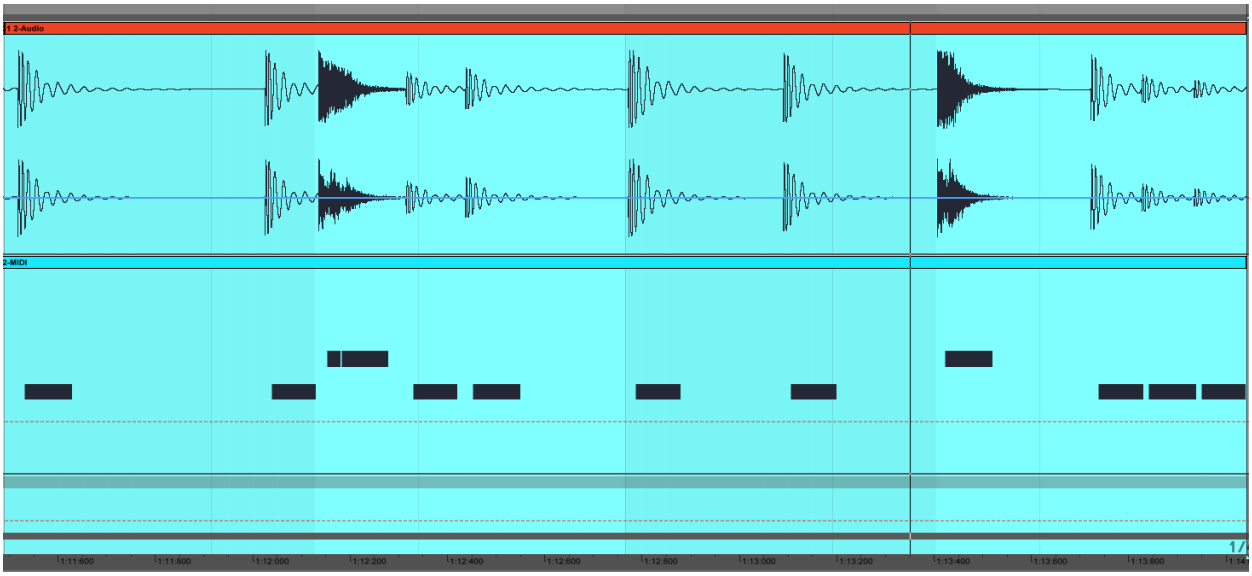

Figure 3.1: Visual representation of same drum groove in *Ableton Live* waveform (Top) and MIDI (Bottom)

One reason the waveform might be preferred by producers is because it is the representation the DAW uses to display sounds recorded directly into the computer from a microphone (Ableton 2015, 22). As a result, the waveform is often referred to as "audio," positioning it as the more authentic representation than MIDI, which is often spoken of as "notation" (Patrick-Bell et. al., 2015). This is gleefully confirmed by Reddit user *Webstersamw*:

> Working with Audio is incredibly important … when you see it all in audio on the grid, and you start cutting parts out and pasting them elsewhere, taking little 1 beat section[s] and make them repeat, reverse parts here and there, going to town making the tiniest little cuts and fadins/fade outs, wow ... the track just exploded with life. Long story short, working with audio freed me from the restriction of midi and completely changed the way i looked at mixing. (Appendix E2)

Or, as *Bocephus_Huxtable* writes,

> I'm well-acquainted with the idea of MIDI but I really can't wrap my head around looking at 'audio' tracks on my screen and seeing little friggin' tetris blocks instead of the fuzzy wave forms that I'm familiar with. (Appendix E3)

This aversion to the MIDI representation could also be due to a producer's lack of formal musical training. MIDI notation is directly modeled on Western music theory and a producer who works by ear, never learning the names and characteristics of particular scales and chords, might consider the MIDI visualizations to be unnecessary compared to the graphical complexity of the waveform. Lacking particular knowledge of the theoretical underpinnings of the MIDI representation, a producer is unable to connect the graphic "Tetris blocks" depicting scales and chords to the sounds emanating from the speakers, viewing the Western theoretical affordances of MIDI as a useless abstraction that does not connect to the process of music production with the DAW. One Redditor summarizes this theoretical dilemma:

> Whenever I try to learn about theory, my brain just stops functioning, I just can't seem to pick any of it up and retain it. I completely understand and acknowledge how important theory is but my brain just can't make the connection between theory itself and music and it makes me upset sitting down for hours and getting nothing out of theory lessons. I want to learn theory in order to use it and be an effective producer but I really have no interest in theory itself, I find it extremely boring, tedious, and I have a negative reaction to in-depth theory discussion because, well, it's simply boring and stuffy and there's no sort of engagement that you get from actually learning something tactile like playing the piano.[46] (V1)

The waveform provides a more exact visual representation of the sound coming out of the speakers and while it does provide some manipulations that are lacking in MIDI, overall, MIDI provides many more flexible options for transforming the sound of a composition. However, to these producers, the waveform is 'real audio' and MIDI is a simplified, boring representation that restricts the user's process. In my mind, it seems as if the manipulatory options provided by MIDI are being overridden by the sparse visual detail of the 'friggin' tetris blocks'. I believe this connection of visuals to manipulation also underlies the interface concept of direct manipulation.

[46] One Redditor considers music theory to be a constraint that could hinder a producer's creative freedom, "learn [*music theory*], but be careful. Don't let it restrict you into needing your music to make "theoretical sense" (if you will)" (V2).

As Cooper et al. maintain, "It might be more accurate to call [*direct manipulation*] 'visual manipulation' because of the importance of what users see during the process" (Cooper et al. 2007).

In 1983, Ben Shneiderman conceived the term "direct manipulation" to describe pointing at a graphical object on a computer screen with a mouse and affecting a visible result. According to Shneiderman, the three important features of direct manipulation are,

> … continuous representation of the object of interest.
> Physical actions (movement and selection by mouse, joystick, touch screen, etc.) …
> [and]
> Rapid, incremental, reversible operations whose impact on the object of interest is immediately visible. (Shneiderman 1983, 57; 64)

To Shneiderman, direct manipulation instilled feelings of mastery, competence, confidence, enjoyment and eagerness in the user (ibid., 57). Similarly, Wendy Hui Kyong Chun states,

> the notion of interfaces as empowering is driven by a dream of individual control: of direct personal manipulation of the screen, and thus, by extension, of the system it indexes or represents...Changes in visibility and causality seem central to the creation of a truly pleased user. (Chun 2011, 62-63)

These definitions of direct manipulation have a clear connection to the preference many producers have for working with the waveform representation. With waveform manipulation, many producers feel like they are working with Audio, not sparse MIDI notation. As Hutchins et al. remark, with direct manipulation "the goal is to permit the user to act as if the representation is the thing itself" (Hutchins et al. 1985, 320). Therefore, to some producers, MIDI is too abstract to represent the complex phenomena of sound.[47] Moreover, manipulating the waveform

[47] This preference for detail can even be subconscious, speaking of user attention in digital environments Rensink maintains, "… viewers prefer items in regions with a greater level of detail, even when the differences in detail are not consciously noticed" (Rensink 2011, 76).

provides a more complex and direct visual feedback than manipulating sparse MIDI notation and, to many producers, makes it easier and more enjoyable to create edits throughout a composition. As *Retriax* claims, “maybe it's just me, but sometimes working in audio is more "fun". I sometimes find it more fun to drag around audio loops” (Appendix L1).[48]

Thomas and Calder refer to the visual feedback provided by direct manipulation as a sense of “liveness” (Thomas and Calder 2005, 345). They assert, the more an object responds visually when manipulated (usually as some form of animation displaying the progression of the manipulation), the stronger “the sense of direct manipulation that the interface conveys, thus making the interface more satisfying” (ibid., 345). They maintain that the “extra information” provided by this visual feedback “gives the user a better understanding of the results of an action on an object” (ibid., 342). In a similar vein, Löwgren discusses pliable interactions, where

> the use of a digital artifact is characterized as pliable if it feels like a tightly connected loop between eye and hand, between action and response … the user is drawn into a sense of shaping the digital information with his/her fingertips, even though the actual artifact might employ standard, non-tactile interaction techniques such as mouse, keyboard, and display monitor. Pliability is a sensuous quality, having to do with how it feels to use the artifact in the here-and-now of the use situation, and as such it plays a role in understanding the aesthetics of interaction. (Löwgren 2007, 86)

For many producers, the waveform is more pliable than MIDI, providing a greater sense of liveness, as observing the complex character of a waveform change as it is manipulated affords a superior feeling of individual control over a composition. The waveform displays greater detail, dramatically changes when zoomed, stretches when moved and has complex visual responses when reversed or pitched. This sense of pliable liveness can be an

[48] Or as another Reddit producer eloquently asserts, “wave forms give me boners” (Appendix L3).

encouragement for the producer to manipulate audio. As Wang asserts, in his article on visual design for computer music, “graphics can reinforce physical interaction ... Animate, create smoothness, imply motion: it is not just about how things look, but how they move” (Wang 2014, 391).

Beyond visual feedback, the structuring of commands in the direct manipulation interface allows for digital data to be easily manipulated in various ways. Cooper et al. contrast the object-verb ordering of commands in the direct manipulation interface with the verb-object ordering of the English language. In an English language command, the producer transposes a sound (verb-object); yet, with direct manipulation, the producer selects a specific sound then transposes it (object-verb). Cooper et al. assert the object-verb ordering mirrors our way of interacting with the world, as “we pick up a can, and then use a can opener on it” (Cooper et al. 2007). More importantly, they assert that this real-world ordering of direct manipulation commands makes it easier to perform multiple manipulations on multiple objects:

> If a user chooses a verb, the system must then enter a state — a mode — to indicate that it is waiting for the user to select an object to act on. In the simple case, the user will then choose a single object, and all will be well. However, if a user wants to act on more than one object, the system can only know this if the user tells it in advance how many operands he will enter, or if the user enters a second command indicating that he has completed his object list. These are both very clumsy interactions and require users to express themselves in a very unnatural manner that is difficult to learn. (Cooper et al. 2007)

By selecting the sound(s) to be manipulated first, the producer can then easily execute a series of manipulatory verbs without the extra step of alerting the software to the amount of sounds they intend to manipulate, or the quantity of manipulations they intend to perform. This makes manipulation much easier and less cumbersome. Moreover, the process of announcing to

the software what you intend to accomplish beforehand seems detrimental to an unplanned playful interaction with the DAW.

Brian Sutton-Smith asserts that with play, "…repetitions go on for the sake of the associated excitement and do not normally disappear with habituation. Play is not just repetitive, it is obsessive" (Sutton-Smith 1997, 27). Through the characteristics of fluidity, flexibility and discernability, the DAW makes the manipulatory act a pleasurable experience and can encourage a workflow that obsessively highlights the playful manipulation of sound. While this type of experimentation with sound is nothing new in sample-based music, I believe the DAW-based producer's particular form of play is partly informed by the visual design, feedback and methods of interaction inherited from the direct manipulation interface. The tantalizing image of the waveform, easily accessible and interactively complex, seems to encourage many producers to play. Moreover, alongside the freedom from irreversible error and the sense of delightful surprise that often accompanies the playful discovery of a unique sound, the sense of control provided by discernable visual feedback can also encourage more manipulatory play. However, feelings of control are definitely not the sole provenance of the playfully inclined, as they are also important factors in a more methodical style of DAW interaction. Whether intended for playful manipulation or not, we will now look at producers who increase their feelings of agency and control by converting other sonic representations to the complex visualizations of the waveform.

Agency and Rendering

As we've seen, to many producers, the increased liveness of the waveform provides more feelings of agency than MIDI. They see the waveform as the representation that affords the most visual information about a sound, which in turn, allows producers the most control over

manipulating their composition. As one website proclaims, "… you can see the actual waveforms…instead of just midi notes. This provides a much more exact vision of what's going on and allows for ultra-precise editing of the timing" (Kärkkäinen 2013). Even if not enacting a playful style of manipulation, producers can feel delight and in control of their manipulations with an increase in the complexity of the graphic response. Speaking of interfaces, Murray observes,

> … when the things we do bring tangible results, we experience a second characteristic delight of electronic environments – the sense of agency. Agency is a satisfying power to take meaningful action and see the results of our decisions and choices. We expect to feel agency in the computer when we double-click on the file and see it open before us or when we enter numbers in a spreadsheet and the totals readjust. (Murray 1997, 126)

To highlight this delight of agency, I want to continue the discussion of the producer's visual interaction with the waveform by examining the operation of rendering. In the DAW, rendering is a visually-based operation where one representation of sound is transformed or converted to another. In graphics software like *Photoshop*, rendering is often used to "generate a high quality version" of a 3D image for presentation, as image manipulation and creation are usually achieved utilizing a "low-resolution preview" (Snider 2014, 903). As with *Photoshop*, DAW rendering (a process variously called bouncing, printing or resampling) is about a change in visual states, such as the transformation from blocky MIDI notation to the curves of the waveform. In this section, I will cover three ways that rendering is utilized by producers: rendering MIDI notation to waveform, the rendering of effects and the rendering of algorithmic glitches.[49] All three of these methods utilize rendering to create a more detailed visualization of

[49] While these types of rendering are popular in DAW-based composition, there are other more mundane reasons for enacting this technique. For instance, rendering can free up processor power, allowing the computer to run faster, as multiple instances of effects or MIDI instruments are more processor-intensive than the raw waveform. Moreover, rendering can also signify the combining of multiple tracks of audio into one file for usage outside of the DAW

what is heard in order to aid and diversify the process of sonic manipulation. I believe the rendering operation quite clearly reveals the producer's dependence on the visual in the composition process and nicely correlates feelings of manipulatory control with what is shown on the screen.

The rendering of MIDI notation to the waveform can be accomplished in several ways: by routing and then recording the MIDI channel to a separate audio track (similar to the way audio is routed in a non-computer-based multitrack recording studio), or by utilizing a command such as "flatten" (from *Ableton Live*), "render in place" (from Cubase) or "bounce in place" (from *Logic*)[50] (Ableton 2015, 578; Bachmann et al. 2015, 172; Apple 2015, 433). The fact that certain DAWs have a shortcut key that accomplishes the task of rendering MIDI to waveform, I believe, displays the popularity of this function[51] (Ableton 2015, 691; Apple 2015, 191).

Along with providing different options for manipulation, many users see MIDI as unreliable compared to the "static" waveform, because a MIDI instrument has to be retriggered by the software every time it is played (Appendix E2). For instance, Martin Walker states in *Cubase*: MIDI can present issues such as "…erratic timing, events that are consistently recorded too early or too late and doubling (or even tripling) of note data. In extreme cases no data may be

(Bachmann et al. 2015,172). However, for this chapter I am solely concerned with the rendering done by producers for manipulation within the DAW.

[50] It is interesting to note that in this instance *Logic* utilizes "bounce," a term from tape recording, whereas *Ableton Live* utilizes "flatten," a term that is used in image editing software such as *Photoshop* (Apple 2015, 191; Ableton 2015, 650; Howell 2005). In *Photoshop* flattening, the multiple, independently editable layers of an image file are combined into one image (Adobe 2013, 162). While this seems to be a clear-cut case of a concept from image software crossing to the sonic realm, this is not entirely true. Manovich asserts, "the use of layers in media software to separate different elements of a visual and/or temporal composition strongly parallels the earlier practice of multitrack audio recording" (Manovich 2013, 145).

[51] For an alternate view, see appendix K for the testimonials of many producers who state online that they see no benefit in rendering to audio whatsoever and are happy composing using MIDI.

recorded at all, or every single MIDI event recorded during a lengthy take may end up appearing at the start" (Walker 2007). One Redditor thinks the waveform is

> … much more stable; sometimes soft-synths will randomly change parameters or even completely reset the patch/initialize themselves for no reason. If you ever make a sound that you really like I would highly recommend resampling it just so you have the audio file stored on your drive even if you are still going to keep the sound in midi as well. (Appendix E5)

In this case, the variable nature of MIDI is seen as a hindrance and rendering to the waveform is seen as saving a sound for posterity. Producer Mr. Bill asserts that MIDI doesn't provide the precision of the waveform:

> MIDI is a bit temperamental and it doesn't quite sit exactly where I want it. For this kind of music I really have to be very particular about having things sit in the exact same parts and having things retrigger at the same time every time. Rather than having problems with MIDI where it doesn't retrigger at the correct time and stuff…I generally render everything down into audio…and I find that's a little bit less temperamental. (ADSR 4:40)

Hence, MIDI is often deemed not trustworthy and the visible waveform provides more precision and stability.

Many producers think rendering is especially important in large compositions with multiple tracks and a large amount of effects, where seeing every channel and a visual representation of all the effects on the grid makes it much easier for manipulation. This sentiment is echoed by Jeremiah Ross:

> Yeah, [it is so much easier] cause you can just grab the whole lot and select the bits that you want. Because you are not dealing with MIDI data or plugins or anything that is processing, because it is all committed audio…I'm just dealing with the sounds that felt right when I made the music. (Duignan 2010, 28)

Ross' last sentence is particularly illuminating, clearly highlighting his esteem for visualization. For him, dealing with the sounds is directly equated with seeing them as a waveform.

Rendering MIDI to the waveform is also a popular technique for creating the choppy synthesizer sounds prevalent in the popular genre of Dubstep. A producer will often create multiple melodically identical, yet timbrally different synthesizer sounds using MIDI. Then after rendering them to the waveform they will mix them together into one melody. Producer *Filthy* describes a technique for playfully rendering synth lines:

> 1- open up your synth... which ever one you like and just write a simple bassline (simple, i said simple.)…
> 2 - once you have it written than do shit with the sounds…bounce it in place (record it to an audio track.). just make sure to keep the original.
> 3 - than go to the original midi track, ***alter the LFO, FM, what ever the fuck you want to change.*** bounce in place (record to audio track).
> ***than repeat step 3 until you have 20 audio tracks of your bass line, each of them slightly or immensely different. than chop them up, piece them together until you get what you want, and remember, there is no real skill to this, its all luck. (Appendix F1)

Another example of the producer's dependence on waveform visualization is in the rendering of effects. Effects units (such as delay, reverb and distortion) can be easily added to a track; however, they are usually controlled with virtual knobs and faders as emulations of older analog and outboard digital effects units. The effects can be heard, but their transformations are not visually represented on the waveform. Many producers believe rendering effects, displaying the visual as well as the sonic results, gives producers more control over their manipulations. According to *Brockvelocity*,

> If the MIDI clips you're writing have reverb, delay, long release times or any number of other effects on them, they're probably leaking a bit of audio even after the clip ends. In most DAWs, this isn't represented visually, and so the result is that

> you've got extraneous sounds muddying up your mix that you're totally unaware of. Bouncing to audio lets you both see these tails and trim them. (Appendix G1)

Once again, the dependence on vision here is striking; instead of relying on hearing, the user needs to see the extraneous sounds to be aware they are present.

While visibility is definitely an important reason for rendering, there are also certain manipulations that cannot be achieved without the rendering of effects. If an effect is not rendered onto a waveform, manipulating the waveform will only transform the underlying sound, not the effect placed on top (See Figure 3.3). By rendering effects, the producer can no longer control the level of distortion, the size of reverberation or the rate of the delay; nevertheless, by making the effect visible on the waveform, they can enact different transformations, moving the effected sounds on and off the grid, truncating sections, stretching and reversing notes and so forth. Popular effects such as “reversed reverb” are obtained by rendering a reverb effect to a waveform and then reversing the sound (Appendix G2).

Figure 3.2: Delay and effect units in *Ableton Live.*

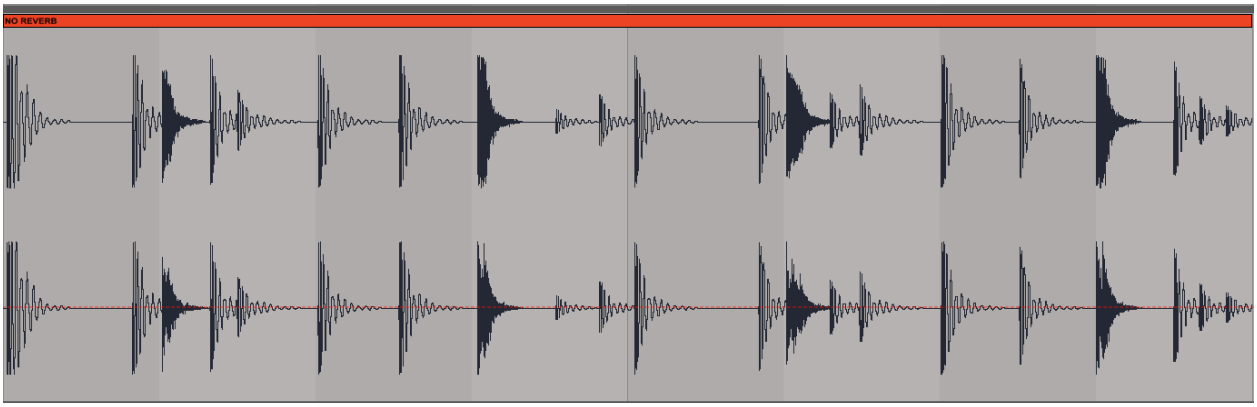

Figure 3.3a: Drum groove with no reverb

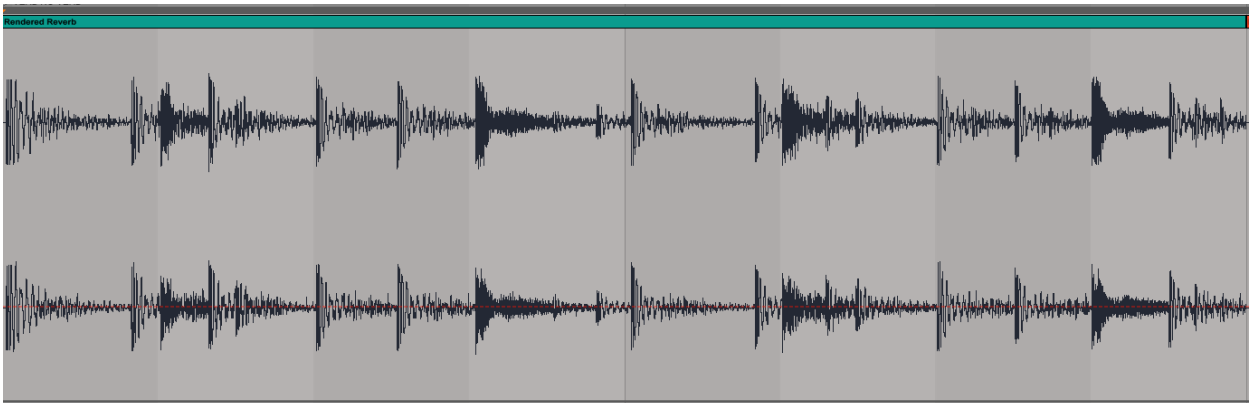

Figure 3.3b: Same drum groove with rendered reverb.

Once an effect is rendered to a waveform, it is fairly permanent. Which is why many producers utilize effects in conjunction with rendering the waveform, first, tweaking knobs until they get a sound they are happy with, then, rendering it to the waveform for additional manipulation[52] (Appendix G). Reddit user *oish1*, succinctly summarizes many of the benefits of rendering effects by listing a dizzying amount of manipulations available for the waveform visualization:

> … editing stutters, gating with different envelopes, reversing audio, looping audio, time stretching using different stretch algorithms, pitch shifting, reverse add a reverb or delay render and reverse again. It makes it more straightforward to cut and paste little edits here and there. Imagine a simple white noise riser from a synth, sure you could put different effects on it, but if you render to audio you can stretch it out, pitch it up or down, have the beginning or the end glitch out with

[52] Similarly to MIDI composition, there are many producers who don't render their effects and have no problem working with the graphic knobs and faders of the effects emulations (See Appendix K).

> some copy paste editing and changing the reverse stretch pitch envelope of the different slices. in this way you can achieve effects quickly that would be hard or impossible by trying to wrangle with a bunch of effects. (Appendix G3)

Time stretching is another effect not available to MIDI notation. Most DAWs provide algorithms that allow the producer to stretch waveforms, changing a performance by lengthening specific notes or matching a musical passage to a different tempo with minimal transformation of the sound (Paterson 2009). The manual for *Ableton Live* uses an interesting analogy to describe their stretching algorithm:

> Think of a sample as a rubber-band that you want to pin to a (musical time) ruler. In Live, the pins are called Warp Markers. A Warp Marker locks a specific point in the sample to a specific place in the measure…They can then be dragged or moved with the arrow keys to different points in time. (Ableton 2015, 140)

This function can also be misused to over-stretch a sound, so that the algorithm cannot seamlessly compensate (stretching the rubber-band to its breaking point, if you will), creating strange artifacts, or "glitch" noises—usually manifested as strange pops and bizarre stuttering sounds. Mr. Bill uses these artifacts in his music:

> … so I'll take a sound like a baseline or a drum or something and then I'll render that down and I'll stretch it and then I'll render that down again. I'll stretch it again and then play with the pitch and you get like all these weird artifacts and stuff. (ADSR, 2:21)

When first stretched, these artifacts, while audible, do not show up visibly on the waveform. By stretching and rendering them twice, Mr. Bill is making the artifacts visible, so he can easily manipulate them to create his complex compositions (See Figure 3.4).[53] Elliot Bates states that glitch-based music expresses "not the voice of the composer, but rather the voice of technology

[53] Moreover, there is an element of playful discovery in this process, as there seems to be no predictable pattern for the location and exact timbral character of these glitches.

itself" (Bates 2004, 280). In this case, Mr. Bill is clearly portraying the visual influence of the DAW, and his esteem for the waveform, by rendering this technological voice visible.

With this section, I hope to have shown several ways the DAW's visual interface encourages the manipulation of sonic events. By rendering MIDI notation, effects units and glitches, producers are showing their preference for the more complex representation of the waveform and consequently correlating visuals to feelings of control and agency in the DAW. Through this visual preference, I have portrayed ways on-screen visuals and processes induce playful manipulation through flexible, fluid and discernable interactions. In essence, the visuals make it easy and fun to manipulate audio, providing a greater sense of control and agency, which leads to more manipulation. In the next section, I will draw upon Malcolm McCullough's digital re-conception of craft and the degree of participation, to portray how all these temptations to manipulate often have an effect on the critiques and aesthetic considerations of many producers online.

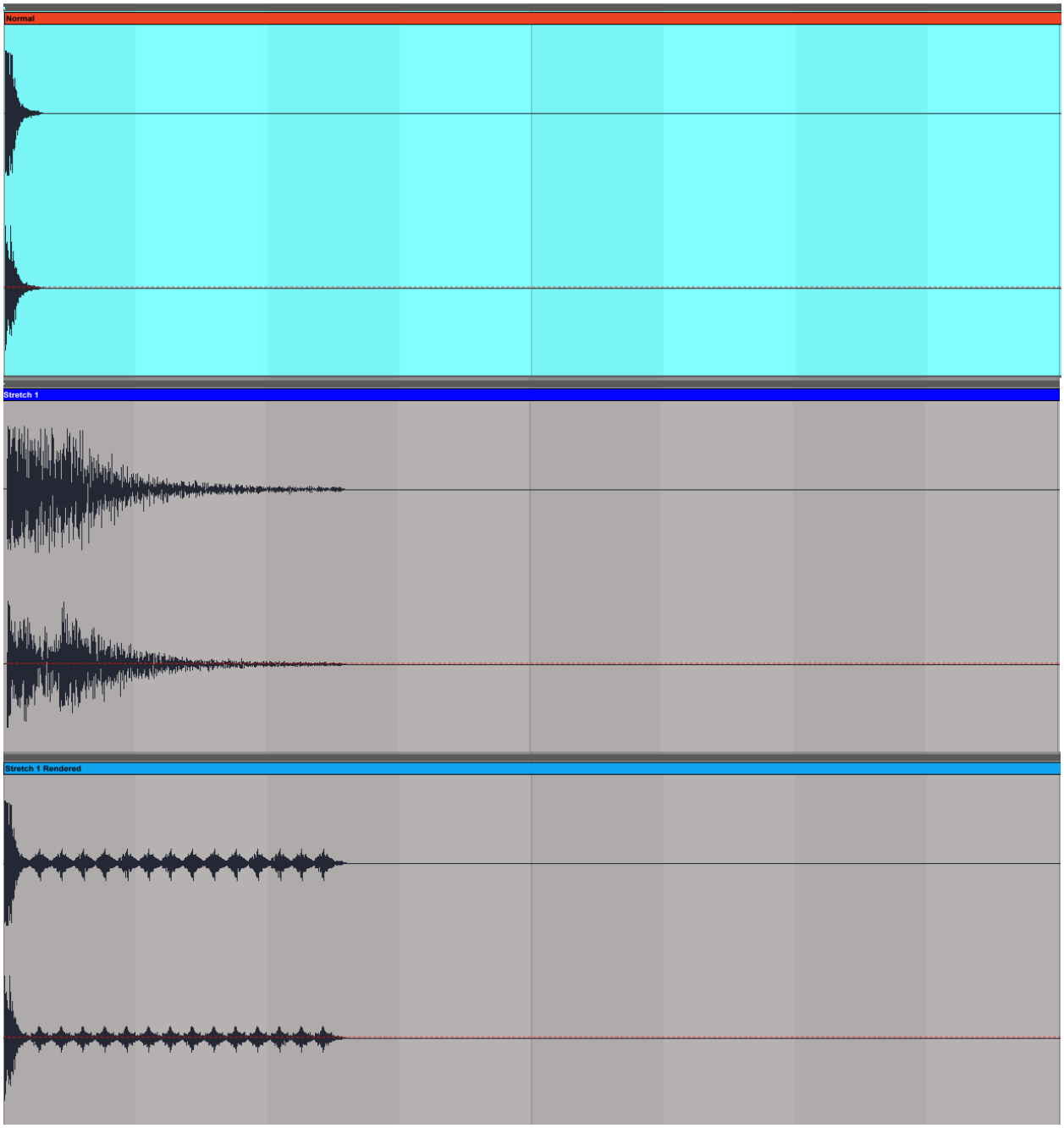

Figure 3.4: Normal drum hit (Top) drum hit stretched (Middle) stretched drum hit with glitches rendered (Bottom).

Manipulation and the Degree of Participation

In his PhD. dissertation, Phillips discusses the manipulatory bias of the DAW:

> … some of the most significant characteristics of digital audio workstations, their bias so to speak, are their manipulative capabilities. At the same time, DAWs also seem to have a visual bias as well … These two factors often go hand-in-hand in influencing certain patterns of the technology's usage, specifically, patterns that involve manipulating audio and performances, not as the result of a deliberate creative decision, but as more of an automatic habit, engaged in as a matter of course. These biases, then, seem to make it difficult not to use the powerful manipulative capacities of DAWs. (Phillips 2010, 279-280)

In the previous pages, I have portrayed several ways this visual and manipulatory bias encourages the manipulation of sound through the DAW's interactive structures. Nonetheless, Phillips' betrays his analytical focus on producers and engineers who record live musicians. He maintains that the ease of manipulation is often cited as a downside to digital sound, as the medium pushes the producer to over manipulate in "a quest for an overly ―perfect recording" (Phillips 2010, 270). While this is quite possibly a problem for recordists trying to capture a performance, Phillips' assumption that there is an original live performance to perfect through manipulation ignores many sample-based artists, whose workflow flouts the traditional dichotomy between live performance and recorded manipulation. For sample-based producers, sonic manipulation is not merely a creative choice to fix or embellish live recordings—it is the art form itself. For them, their creative voice is asserted through the manipulation of sonic events. However, as we've seen, the visual and manipulatory bias of the DAW definitely makes it easier and more tempting to manipulate sound than previous digital and analog technologies and I believe this has an effect on aesthetic considerations of producers online. As Manovich maintains regarding *After Effects*,

> … the interfaces of computer animation software quickly led to a new aesthetics: the continuous transformations of most (or all) visual elements appearing in a frame. (Manovich 2013, 310-311)

As opposed to the continuous transformation of visual elements, for many producers the DAW interface seems to encourage an aesthetic of increased manipulation of sound. For instance, many DAW producers consider looping—where the producer would cut out a multiple-bar length passage from a commercial recording and repeat it as composition—to be "cheating" (M2). While this process is the "fundamental basis of hip-hop" and many other dance genres, this form of manipulation was largely used by pre-DAW producers who did not have access to the precision and control allowed by the visualizations on the screen[54] (Brewster and Broughton 2006, 215). According to *tommytibble*,

> nowadays, it's all so accessible. any kid can download a demo version of fl studio, torrent a Marvin Gaye record, loop 4 measures of a random song, and overlay it with Funky Drummer. It's easy. and anyone can do it. If you want to be respected as a producer, you have to find other ways to stand out from the amateurs. (Appendix I1)

To many, looping and syncing up excerpts from different songs in the DAW is too easy and more manipulation is needed to display the producer's skill. This usually comes in the form of chopping a loop into smaller pieces for more fine-grained manipulation and reorganization. As *kingscountylighthaus* writes,

> nowadays, there's no excuse for not flipping the hell out of a good loop, re-arranging it fifteen ways to sunday and then sampling 4 more songs for accents… (Appendix I2)

[54]There are also many online producers who have no problem creating tracks by looping commercial recordings or even using pre-made loops purchased from loop libraries.

With the plethora of content packaged with the DAW, as well as available for purchase and downloaded from many other sources, the producer has easy access to thousands of different professionally recorded and producer-created loops that can be inserted into a composition with the ease of moving a file. To many producers, most of these loops do not contain a sufficient amount of manipulation. For example, a frequent critique on Reddit is that a composition sounds "stock," "generic" or "cheesy," usually meaning the song is overly repetitive, robotic or boring and a producer has not spent enough time adding variety by manipulating the track (Appendix J1; J2; J3). While these types of critiques are nothing new in popular and electronic music, I believe this current aesthetic of musical variety can be partially related to the visual layout of the DAW and the pleasure of direct manipulation. The DAW allows a producer nearly endless options of manipulation, as opposed to older non-screen based digital samplers, drum machines or even audio tape, in which editing and manipulating is a much more arduous task. Although the genres of hip-hop and EDM are still based around identically repeating rhythms and phrases, often producers will profess online to adding variety to their compositions, by creating subtle edits throughout the track, manipulating certain rhythms and effects, in essence, adding features that don't repeat endlessly (Appendix J4). The visualization and direct manipulation of the DAW makes it easy and fun to perform these manipulations, so they will be performed, and this reflects in the music and the aesthetic judgements of its online proponents.[55]

[55] Throughout this chapter, I have hoped to avoid portraying a form of technological determinism in which the technology is the only factor influencing musical aesthetics. The urge to create less repetitive and—in certain instances—more human sounding compositions cannot be reduced to the influence of what is shown on a computer screen; however, I believe the impact of visualization and direct manipulation needs to be considered. Moreover, the glitch music of producers like Mr. Bill—while utilizing the visual characteristics of the DAW to create complex and intricate music—is a definite case against technological determinism as they are using the technology in ways which the creators did not intend.

I believe the DAW-based producer's aesthetic regard for manipulation can be explained by what Malcolm McCullough calls the "degree of personal participation" (McCullough 1996, 69). McCullough states, in computer graphics, the ability to continuously and meticulously manipulate images on a screen (as allowed by direct manipulation) is a skill and an exacting task similar to a craftsperson working on physical media (ibid., 50). In essence, he considers that his definition of craft— "habitual skilled practice with particular tools, materials, or media, for the purpose of making increasingly well executed artifacts"—can be applied to the creating of computer graphics with the tools of the screen and a mouse (ibid., 22). Most importantly, McCullough states that, like crafts, computer graphic compositions are often valued by "the degree of personal participation, more than any degree of independence from machine technology" (McCullough 1996, 69). Therefore, the amount of work artists put into their craft is what is valued. In this instance, the visualizations of sound and the ability to continually manipulate the sonic object puts this form of DAW composition in the realm of craft. While the graphic artifact present in the DAW is, for the most part, not deemed an aesthetic object,[56] the amount of editing and manipulating producers enact (their amount of personal participation) is often viewed as the measurement of the worth of their composition and of themselves as producers. EricParkerr writes,

> focus on the small details. Samples will give you a pretty good base for a song, but don't underestimate the little things you can add. Think of all the beats you like. There's little things that give them they're signature essence, right? Focus on adding things to your samples that not only show off your personality as a producer, but also takes your beat to the next level. TLDR: don't underestimate adding little details. (Appendix I4)

[56]There are a few exceptions, like the Reddit user who asserts waveforms, "makes your projects look more kewl" (Appendix G4), or websites like *Soundwave art*, which assert, "your voice generates a unique pattern—we turn that pattern into art and jewellery" (Soundwave art).

The manipulation of audio is considered a skill that requires practice. Practice in learning the options and processes for manipulation within the DAW, as well as developing an ear for complementary and interesting combinations of sounds. According to *jack234*,

> practice is the only way you're going to get there. I started out just messing around with simple things in Garageband to get the hang of it. Every time I made a change, I'd listen to it before and after to see if it sounded better or worse. Then I played around with every button and option, until I felt its limitations and upgraded to a more powerful DAW … A big part of it is training your ear to figure out what meshes well, what two songs might have a similar key or beat or whatever. Think of the best mashups you've heard - what might the samples have in common? That sort of thing. Learn to pick out each individual instrument if you can … keep practicing, train your ear, learn from the masters, and find your own voice. (Appendix U2)

Elaborating on this concept of a producer's voice, one Redditor maintains,

> The way you chop a sample, you can tell a premo beat by the way he chops his samples, madlib, dilla, pete, 9th[57] etc. give em all the same sample they'd all chop it differently. There is an art in microchoppin and not just on the kick and snare … choppin is not a small piece to the puzzle, your chops are your ear. (Appendix I3)

These notions of craft and recording manipulation in sample-based music have been present since the invention of audio tape. To Terrence Dwyer, tape manipulation is

> ... a special skill of editing with scissors and razor-blade so that sounds give way to each other, sometimes with bewildering rapidity but always according to a pla n… I have found that for every minute of playing time in the final result, about one hour's work was necessary, on the average. (Dwyer 1971, 35; 39)

Currently, the ease and precision of DAW manipulation means, that for many producers, the degree of personal participation needed to create a laudable track has changed. A producer might spend hours creating a composition, but they will most likely be focusing on different

[57] DJ Premiere, Madlib, J Dilla, Pete Rock and 9th Wonder are all iconic hip-hop producers.

tasks than the tape manipulator or the pre-visual interface looper, as the various edits that take hours to create using a razor-blade and tape, or without the assistance of a screen can be achieved in seconds using the DAW. Producer Ritchie Hawtin repeats this sentiment:

> Now that Pro Tools has integrated MIDI, tempo mapping, and grids that can lock MIDI to tempo, it came into its own for this project. I was able to bring a lot of loops in and drop them into different grid paths. I could change my grids to 32nd-notes and get in there quickly to edit the loops. In the past, I would have had to do that by looking at the waveform and scrubbing over it. I wasn't necessarily doing anything I hadn't been doing before, but progressions in the software enabled me to do things much more quickly and efficiently…Because I was able to use a program like Acid to lock up some of the loops, it enabled me to focus my attention on other areas. (Gill 2011, 180)

Therefore, various forms of manipulation such as finely chopping and rearranging loops, splicing complex rhythms into rendered reverb tails, or over-stretching waveforms and precisely rearranging the aftermath are all examples of manipulations that would be extremely difficult or impossible pre-DAW, but are enacted regularly utilizing on-screen visuals. All these techniques for sonic manipulation (and many more) are heard regularly in popular DAW-created music, are taught in countless online tutorials and are stressed often in online advice and critiques. In this instance, online communities and commercially released music serve as another enticement for manipulation.

Conclusion

Inspired by the complex visual character of the waveform, as well as the fluid, flexible and discernable nature of the DAW's direct manipulation interface, many producers are tempted to playfully manipulate sonic events. This playful workflow is a common way of working with all direct manipulation interfaces, as well as a method of dealing with the overwhelming amount of options available to the DAW-based producer. Whether enacting a playful or a methodical

workflow, the increasing complexity of the sonic representation and its visual feedback when manipulated intensifies the feelings of control, mastery and pleasure in many producers, which in turn, encourages more manipulation. Portraying a commonly-held connection between control and visual complexity, producers often seek out the visual detail of the waveform by rendering MIDI, glitches and effects. Finally, the ease of the direct manipulation interface pushes an aesthetics where (for many) the manipulatory participation in the creative process is highly valued. This widely-held aesthetic of manipulation can be heard in many popular electronic tracks and underlies the tutorials and critiques of many producers online, forming another impetus to manipulate sonic events.

Steven Johnson asserts that “the power of manipulation is the sine qua non of the modern computer, its core competency” (Johnson 1997, 211). In this chapter, I hope to have shown how the visuals of the DAW bring this core competency to the forefront of many producers’ workflow. In the next chapter, zooming out from note-level interactions, I will examine the DAW’s placement of all these sonic manipulations along a timeline in the arrange window.

Chapter Four: "Totemic Power": Arrangement, Analysis and Performance in the DAW.

> In a narrative dominated by the ear, a panorama cannot occur because every event replaces its predecessor (even as it draws its meaning from its relationship to the past). (Boykan 2004, 27)

> We know that musical form is in one sense temporal: it reveals itself in performance only over the course of time; yet the power of the synoptic image is so great that in our minds the form of a work can become a kind of imagined space in which the music operates ... The gradual acceptance of the synoptic representation of form nevertheless reflects important changes in thinking about the nature of form, changes that in turn have shaped the ways in which we approach this abstraction today. (Bonds 2010, 302)

> Moving forward with a track that's in progress can sometimes feel like an impossible task, especially if you're starting from the beginning and working your way from left to right towards the end. (DeSantis 2015)

In his book *Silence and Slow Time*, composer Martin Boykan attempts to discredit the "visual fallacy" that he believes has infected much of Western musical analysis (Boykan 2004, 26). Disparaging theorists who rely too much on the conception of music as a "spatial object, something outside of time that we can perceive all at once," he asserts that this model "fundamentally distorts the way music is perceived" (ibid., 3). Taking up Boykan's cause is a challenge in the gridded, spatialized world of the DAW, where a spatial analysis of musical form is emblazoned across the screens of countless producers, making up an integral part of their process. This spatial representation is the centerpiece of a producer's workflow. Zooming out, producers can easily access the panoramic sightlines of their compositions, spatially interacting and auditioning any point in their track, selecting, manipulating, navigating and swapping out notes, phrases and sections across the graphic expanse of the screen.

Beyond standard musical notation, the spatial representation of musical form has been utilised for many years prior to software-based music, functioning as a way to analyze compositions;[58] however, with the DAW, this spatial representation is now centralized in the creative process. This on-screen synoptic representation, laid out as a two-dimensional diagram that makes "the relationship of the individual parts to the whole apparent in a single image," promotes the concept of a musical composition as an entity made up of modular parts to be manipulated and navigated, implementing a specific form of spatial knowledge that is endemic to ways of working with the Graphical User Interface (GUI) (Bonds 2010, 270). In this chapter, I hope to reveal certain ways the DAW's interactive abstraction of musical form reflects and shapes the ways producers conceptualize, analyze, arrange and perform their compositions.

By examining online producer discussions, software design guidelines and psychological studies of computer usage, I will unpack the importance of this synoptic image of music, portraying how this representation influences and hinders aspects of a producer's creative and learning process. To accomplish this, I will investigate three different modes of working with the DAW's synoptic representation (what I will be calling the arrange window[59]): arrangement, analysis and performance. First, I will examine many producers' methods of arrangement, portraying several ways that the arrange window stresses the perception of music as a modular collection of parts and discussing the use of transitions as a method to shape these parts into more cohesive compositions. Next, I will combat the dichotomous conception of the DAW as a tool that blurs the lines between performance and composition by adding a third element,

[58] Bonds cites Antoine Reicha's 1825 *Traité de Haute Composition Musicale* as the first Western critical or theoretical writing that depicts "musical form in an essentially spatial manner" (Bonds 2010, 266).
[59] I am going to utilize the terms "arrange window" as representative of the various DAW specific titles for this software space where tracks are delineated vertically and musical time is horizontally gridded into various musical and temporal subdivisions of the producer's choosing.

analysis, depicting how producers commonly utilize the spatial mapping of the arrange window to analyze their own compositions as well as commercially released tracks. To flesh out this discussion, I will then uncover some of the historical roots of spatial representations of time, their ubiquity in the GUI, as well as (through the example of the playlist feature) hypothesizing why the conception of music as a navigable space holds such sway over the producer's process. Next, by framing the process of auditioning and manipulating music on the fly as a multimodal form of performance, I will discuss some theories on the effects of computer usage on human learning and multimodal integration. Finally, I will end with a brief coda, examining how many producers see the dizzying array of on-screen visuals as a distraction while citing a few studies on attention and computer usage as support.

Speaking of musical analysis, Bonds asserts, "how we represent the abstraction of form both reflects and shapes the way in which we think about it" (Bonds 2010, 265). I contend, the DAW's particular synoptic representation of a musical composition greatly influences the producers' process, shaping their workflow and the ways they conceptualize music. To begin, I will discuss the main features of the arrange window and several of its unique temporal and interactive elements.

The Arrange Window

Evaluating the ways we conceptualize music, Zbikowski asserts that cross-domain mapping (mapping music to space, for instance) supplies "a way to ground our descriptions of elusive musical phenomena in concepts derived from everyday experience" (Zbikowski 2002, 64). With the DAW, the ephemerality of the sonic world is grounded by the computer screen which provides a particular visual conception of musical events to aid in the composition of

music. For many, creating music through these on screen representations is becoming an everyday experience affecting how music is conceptualized and understood. In the DAW's cross-domain map, the horizontal axis marks off various user-defined timescales[60] and the vertical axis consists of a mixer board emulation, containing recorded audio tracks and MIDI instruments. Here, a composition can be visually mapped out, sounds can be dragged in or recorded, various sections can be zoomed, moved and manipulated and effects can be inserted. Interacting with the arrange window, seeing the entire landscape of a composition, the producer can visually step out of time, looking ahead for upcoming musical events and enacting manipulations on the fly as the track is playing. Through this compositional overview, the producer can audition any part of a track by pointing the DAW's playhead[61] to any temporal location with the click of a mouse. Unlike an audio tape playhead, which stays in one place while the tape is dragged across it, the DAW's playhead (visualized as a line stretching vertically across the arrange window) marches horizontally across the screen in lockstep with the composition's tempo, triggering all sonic representations in its path. Similar to standard music notation, the arrange window is read left to right; however, most DAWs also include automatic scrolling,[62] which during playback, moves the producer's viewpoint across the body of the composition following the playhead. With this feature, the producer's visual field is always centered on the section being auditioned, highlighting the DAW's emphasis on constantly seeing what is heard through the speakers and foregrounding the conception of a musical composition as an interactive object to be navigated and viewed from a distance.

[60]Such as minutes and hours, musical divisions as well as timecode and frame rates (usually for synchronizing audio to video for composing soundtracks).
[61]With tape recorders, the playhead was the transducer that transformed the information on audio tape into sound.
[62]In various DAWs this feature is called, "Follow command," "Auto-Scroll," "Auto Scrolling," "Continuous Scrolling During Playback," "Scroll in Play" (Ableton 2015, 90; Bachmann et al. 2015, 204; Dambrin et al. 2015; Avid Technology 2015, 384; Apple 2013, 101).

As one of the main areas where a composition is arranged, manipulated and viewed, the arrange window holds a central position in the creation process. Online, producers highlight the centrality of the arrange window by describing it as a container, with different voices 'coming in' at specific temporal locations, as well as rhythms falling and then landing into the metrical subdivisions:

> Not completely feeling the synth that comes in around 1:10 or so. I think you should tighten up the rhythm on that a little bit and adjust the delay on that so it falls more in line with where the triplets would land, right now it's kind of cluttering up some of the other notes. (Appendix C2)
>
> Put the kick on 1 and 3. Snare on 2 and 4. Hats on eighth notes. That's the basics, and you can just add or subtract from there. (Appendix C3)
>
> He's incredibly precise with his drum processing… Hihat and kick drum hits are falling slightly before and after the grid lines, creating a weird but alluring organic feel to his beats. (Appendix C4)

Sounds being added, subtracted, falling in line, cluttering up the space, all metaphors that strengthen the arrange window as the container for the producer's process. Now, sound reified as an object for manipulation and transformation is a conception as old as electronic music.[63] Yet, the incorporation of the synoptic arrange window, almost constantly in the producer's visual field, where sounds are dragged in, transformed and arranged, is definitely a phenomenon unique to software-based manipulation.

[63] For instance, Pierre Schaeffer discussing Musique Concrète in the late 1940s writes, "there will be neither noise nor musical sound, neither drama nor symphony; there will be new materials for a new way of constructing sound" (Schaeffer 2012, 42).

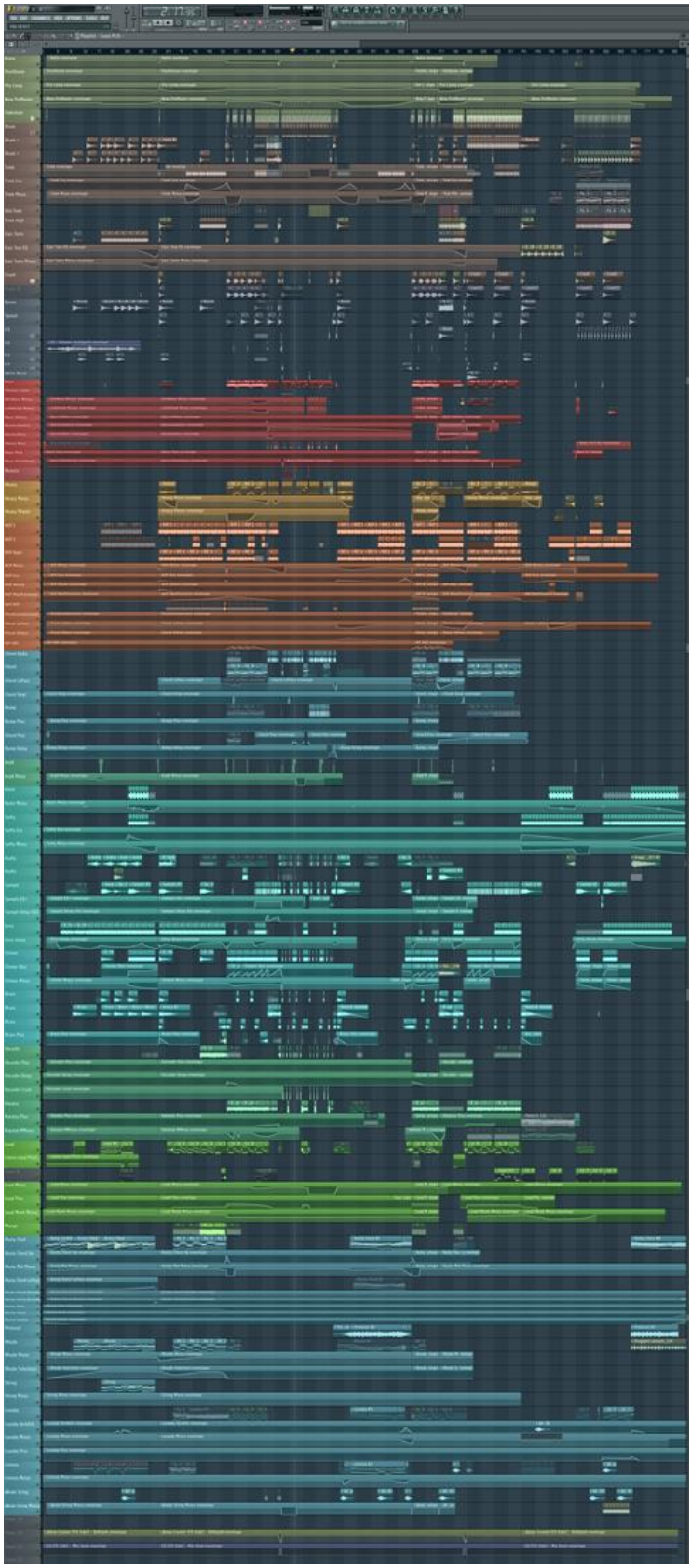

Figure 4.1: Producer Madeon's arrange window in *FL Studio* (Madeon 2013).

Vertically dividing the arrange window are the grid lines, which depict various musical subdivisions of the producer's choosing. Robert Rowe asserts, "we experience music with even minimal temporal regularities as conforming to a metrical grid" (Rowe 2001, 112). Standard musical notation implies this grid of musical time; the DAW visualizes it. Similar to the DAW, musical notation does equivocate the temporal duration of notes with spatial distances on the page (more space is normally allotted for whole notes versus quarter notes, for instance); however, with notation, temporal subdivisions are not as overtly mapped out. Marsden maintains that while musical scores are a definite example of an explicit representation of musical events, they rarely make "explicit reference to time" (Marsden 2000, 45). He continues, "only metronome markings commonly make reference to time, in the sense of specifying a relationship between events of a particular kind and a duration of actual time, but a great many scores do not include even these" (ibid.). With the DAW, metronome markings are integral to a producer's process, tying together composition and performance, as a track's bpm (beats per minute) dictates the rate at which the software will perform the producer's composition. The spatial influence of the arrange window is revealed by the fact that many producers prefer to work at a bpm that is twice as fast as their intended tempo in order to gain extra space for rapid notes:

> So, if you take a track that is 80 bpm, and change it to 160 bpm … and wanted it to sound the same, you would change all of the note lengths to double whatever they were at 80 bpm. The advantage of doing this is that your quarter note (one quarter note at 80bpm, one pulse of the beat) is now double its ordinary length at 160 bpm.
>
> This makes it much easier to make fast fills than it would be at 80 bpm, because everything is twice its normal size on the grid. You can hypothetically make a fast, 128th note fill at 80 bpm, but those notes will be so damned small that it would be difficult to give them swing, create variations, etc. But if you wanted to do a fast, 128th note fill for a beat that, by all accounts, sounds to be in 80 bpm, that is

> programmed at 160 bpm, those 128th notes appear as 64th notes, which are easier to work with since they aren't so narrow.[64] (Appendix M1)

This correlation of space to tempo is definitely not a characteristic of standard music notation; the tempo of a score does not change the amount of physical space on the page between the notes.

While being spatially vague in regard to time, a musical score is not reductive enough to capture the broad sweeps of the arrange window's synoptic representation. According to Bond,

> it might be argued that a musical score is itself a graphic representation of form, a set of directions, as it were, for moving through a work or movement. Yet there is nothing reductive or synoptic about a score or even a reduced score, for it represents not an outline of the work but the essence of the work or movement in its temporal entirety. A score does not highlight the directional moves that determine its larger form: the directional moves are there, to be sure, but they are in effect "hidden" by the totality of the whole, by the continuous nature of any score, be it full or reduced. (Bonds 2010, 273)

Through the zoom function, the DAW provides the best of both worlds, allowing the producer to zoom between the note-level detail and synoptic outline. There are various methods for zooming provided by each DAW. *Cubase* and *Logic* provide separate sliders for horizontal and vertical zooming,[65] where the producer can "drag the horizontal slider left to zoom out for a wider view, or drag it right to zoom in for a close-up view" and can drag "the vertical slider up for a wider view (more tracks), or drag it down for a close-up view (fewer tracks)" (Apple 2013, 286; Bachmann et al. 2015, 58). These zoom controls are always visible in these DAWs' arrange windows, allowing easy access for the producer's zooming needs. Moreover, *Cubase* and *Logic* also provide the producer with a zoom tool, an icon that can be clicked on (changing the cursor

[64] Of course, it must be noted that Drhook94's method seems to ignore the remarkable abilities of the DAW to zoom in on various levels of a composition to make the 128th notes larger.
[65] *Pro Tools* provides a similar function, except it utilizes buttons instead of sliders (Avid Technology 2015, 500).

to a magnifying glass) which allows the producer to click and drag any section for different magnifications of zoom.[66] This is a less fluid way of working as the producer cannot edit with the cursor when in zoom mode (Apple 2013, 100; Bachmann 2015, 58). In contrast, *Ableton Live* does not give users a series of sliders, buttons or a zoom tool. Instead, it provides a second window consisting of a more distant viewpoint of their composition, called the "Arrangement Overview" (Ableton 2015, 90). Located at the top of the arrangement window (its placement cannot be changed), the Arrangement Overview "always shows the complete piece, from start to end" (ibid.). The user cannot change the magnification of this viewpoint; yet, they can click on any spot within the arrangement overview and the arrange window below will automatically move to that section. Moreover, the producer can zoom in on various sections in the arrange window by clicking and dragging in the arrangement overview. Thus, no matter the zoom level of magnification within the arrange window, the start and end point of the composition is always in view; the arrangement overview always provides producers with panoramic sightlines and navigational control of their entire track. Cooper et al. write that with this feature, *Ableton Live* "provides context in a potentially confusing situation and simultaneously provides a direct navigation idiom where a user may move the rectangle to focus on a different part of the song" (Cooper et al. 2007).

Thus, as the central hub of the producer's composition process, the arrange window provides a zoom-able interface that rigidly demarcates musical time in a manner that largely digresses from the traits of standard musical notation. By slicing up the arrange window in this

[66] The *Cubase* manual offers this comprehensive list of its various kinds of zoom: "Zoom In, Zoom Out, Zoom Full, Zoom to Selection, Zoom to Selection (Horiz.), Zoom to Event, Zoom In Vertically, Zooms in one step, vertically Zoom Out, Vertically Zoom In, Tracks, Zoom Out Tracks, Zoom Selected Tracks, Undo/Redo Zoom" (Bachmann et al. 2015, 59).

manner, the grid also stresses the conception of music as an assemblage of modular parts which influences the process of arranging a song.

Arrangement

There are many features in the DAW that aid in the manipulation and arrangement of large groups of sonic materials in the arrange window. DeSantis calls this type of arrangement-working "horizontally in the arrangement mode," as the user is working beyond the vertical arrangement of overlapping loops, organizing the composition by arranging and linking sections horizontally across the screen (DeSantis 2014). One useful element is the ability to cut and paste time.[67] With this feature, producers can add or remove a section in the middle of their composition and the remaining sections on either side will be automatically moved to compensate. In this instance, the software automatically meshes arrangements together, avoiding the deployment of an excess of commands to create seamless compositions. Steve Cummings laments the lack of this feature in his 1986 review of sequencer software by the company MOTU:

> …when you delete data, whether you're working on tracks or groups of events, the space the data occupied is left open; the data following the deleted section is not brought forward to close the gap, as it would be with the wordprocessor. Leaving the gap open is what you want in many musical situations, of course. But what if you've decided that you're ABACA structure should be ABCA instead? In a case like this, you'll have to go through a series of cut-and-paste operations to get the desired result. Likewise, when you paste data into a track from the clipboard, or insert individual events, the existing data won't move further along in the file to make room for the new material. If you accidentally leave out a note in step-time entry, or if you want to add a chorus between two verses, you've got some reshuffling ahead of you. (Cummings 1986, 128)

[67] What Ableton calls "Time Commands," Pro Tools "Time Operations," Logic "Edit Regions" and Cubase "Range editing" (Ableton 2015, 103; Apple 2013, 292; Avid Technology 2015, 750; Bachmann et al. 2015, 194).

I believe this method of arranging (which is currently a common feature in every DAW) stresses the conception of a musical composition as a modular entity where each section can be swapped or moved with ease.[68] As Warner states, "… the visual nature of the computer screen presents musical material as simple blocks and, as a result, encourages the production of pieces with additive rather than organic structures" (Warner 2003, 26). This phenomenon is echoed by Phillips:

> … modularity informs the common sense of those who, like young people in our culture, have been socialized into computer use from an early age. As young people enter the field of music production—a field traditionally dominated by youth already—it is likely that the notion of modularity will increasingly inform their habitus and likely reinforce the practices in the field that emanate from it. (Phillips 2010, 316)

Finally, here is Redditor *Somatik*'s description of his method of arranging a song:

> I start with major blocks of songs that represent different musical ideas I'd like to use … So after I have these major blocks down I start playing with the order of them. From here I start adding elements of transition to smear these individual blocks into something much more cohesive. I don't necessarily finish one section before moving onto the next … (C5)

To *Somatik*, modular composing makes it easy to visually arrange a track; yet, this same feature must be overcome to create a cohesive arrangement. The same grid that visually chops up the screen, delineating sections based on temporal locations—making it easy to cut, paste and move sections—serves to create sonically non-cohesive tracks that have abrupt section changes.

To smooth over the seams between sections, there are various kinds of transitions discussed online, such as, breakdowns (where the main drum rhythms stop playing) and build-

[68] See Chapter 2 for a discussion of the connection of the modular nature of the DAW to the creation and dissemination of loops as digital files for download and sale.

ups (usually after a break down, featuring some sort of increase in dynamics, rhythmic density and/or a rising melodic line). Online, the automation of effects is touted as an important feature in the creation of transitions (Appendix N).

In audio recording, automation usually denotes the recording and playback of changes in studio-based parameters and audio effects.[69] In the DAW, pretty much any on-screen control, from volume faders to effects parameters can be automated, becoming another locus of musical change—a manipulable part of the composition no different than notes, harmonies or rhythms. When creating transitions, automation can involve compositional manipulations such as increasing the volume of an instrument during a section change (to create a dynamic rise during a build-up) or decreasing the amount of reverberation on a vocal.

In the 1960s and 70s, mixing engineers had to record changes to volume faders and effects levels in real-time. With the rise of 24-track recording, mixer boards became extremely large and audio engineers usually had to enlist several helpers to perform a mix, performing faders and knobs in time with the music. In the late 1970s, automated mixer boards were devised which allowed fader and knob moves to be recorded and recreated automatically (Izhaki 2013, 479). According to Roads,

> the benefit of mixed automation is that a lone engineer can perform a complicated mix in a number of simple steps…The extent of automation in mixing consoles varies. "Automation" can refer to features as diverse as console reconfiguration at the touch of a button, to fader automation (recalling the movement of the channel faders in time), to memorizing all functions and settings entered into a large mixing console for an entire session. (Roads 1996, 378-379)

[69] Or what Levi Whalen calls "a process which allows you to program knob-twisting robots to affect any number of parameters while you sit back and sip coffee" (Matla 2014).

In all DAWs, automation controls are visually represented as a line stretching across the arrange window, usually superimposed on top or in a pop-up lane adjacent to each individual track (Apple 2013, 522; Bachmann et al. 2015, 576; Ableton 2015, 49; Avid Technology 2015, 648; Dambrin et al 2015). In this automation lane, the X-axis represents time and the Y-axis represents the values of the parameter for automation—the circular or linear representations of a knob or fader stretched in time across the screen. Automation can be performed live; the producer moves a knob or fader (with the mouse or a control surface) in time with the composition and the parameter change is recorded and reapplied with each playback, or the producer can draw in the automation by hand in the automation lane with a mouse.

For the creation of transitions, Matla discusses what he calls "flow automation," where the producer automates various effects to create transitions, in order to "smooth things out" between sections (Matla 2014). Or as one Redditor writes,

> if you want to make good music, you're probably going to be automating a lot of things to make every transition or phrase as smooth to your ears as possible. For example, bringing something into the foreground, you might gradually increase reverb predelay, low pass filter frequency, and dry volume settings; and gradually decrease the reverb wet, early reflection, and stereo width. Or raise the low-pass filter on some chords to build intensity. You have to be automating. (Appendix N1)

One popular element in EDM transitions created with automation are musical phrases called risers. Serving to smooth out and create anticipation towards a new section, risers usually consist of a sustained tone or noise that gradually increases in frequency, drawing the dancers to a frenzy before the drop, where the beat returns. Instead of rising by a step, as in a piano scale, these risers are sustained tones that slowly and seamlessly increase in frequency in a linear progression from low to high. Making these risers is a simple case of tilting the automation line for an instrument's pitch at an angle; a process that can be enabled with two mouse clicks, or

performed in real-time with the gradual turning of a knob. This type of progression is perfectly typified by the linear interface of DAW automation. In fact, while there is a plethora of sample packs that provide premade recorded waveforms of risers for insertion, many maintain that making their own "is so easy it's insane" (Appendix N2). Nonetheless, through the creation of transitions, producers reveal that the modular demarcation of the grid, while an excellent feature for aiding in the arrangement of a track, is often not conducive to creating a seamlessly flowing composition. Beyond arranging, the modular and spatial layout of the arrange window is also conducive to the visual analysis of musical events.

Analysis

As a representation that displays the relationship between the whole composition and its independent modular parts, the arrange window is fairly similar to the synoptic forms utilized to analyze music since the 1800s. This analytical approach to musical form creeps into the producer's process when they utilize the arrange window as a site for mapping out commercially released tracks:

> Pull a reference track into your DAW. Listen through and insert markers[70] every 8 or 16 bars describing when things happen like:
> "Drums come in;
> "Start of breakdown" "Chord progression changes", etc.,
> then, put aside the reference track, and just use the notes that you have made to construct your song. This will make it easier to structure songs and help you get an

70 In the DAW, markers allow producers to spatially tag important locations in their compositions, permitting the labelling of their song's form for easy navigation when composing and arranging. These producer-created signposts allow the producer to "locate certain positions quickly" within the visual complexity of the DAW's arrange window (Bachmann et al. 2015, 281). In the various DAWs, Logic calls them "markers," Cubase calls them "position markers," Ableton Live "locators" and Pro Tools "memory locations" (Apple 2013, 574; Bachmann et al. 2015, 281; Ableton 2015, 93; Avid Technology 2013, 761).

> idea of how the pros do it, so eventually you can make structural and arrangement decisions intuitively.[71] (Appendix O1)

In this instance, the sounds of the reference track do not matter; it is the shape the track traces in the arrange window that is important (See Figure 4.2). Producers are marking the on-screen terrain based on well-worn commercial paths to provide a visual scaffolding for a new composition.[72] Mullet maintains "images we can see can be recognized quickly and committed to memory with surprising persistence" (Mullet and Sano 1994, 169). Many producers think pairing listening with a visualization of the structural relationships of a track speeds up the learning process. Through repetition of this process, many write online that popular song forms can be easily learned and eventually regurgitated intuitively (Appendix O). As one Reddit producer professes, by recreating song forms in this manner, "I started to recognize certain patterns that many people would use" (Appendix O2).

Speaking of the ways we conceptualize music, Zbikowski declares that cross-domain mapping is an important factor in understanding and transmitting musical analyses, providing a "way to connect musical concepts with concepts from other domains …" (Zbikowski 2002, 64). With the arrange window, the central representation of the DAW is a cross-domain analysis of music hiding in plain sight as an interface. These methods of analysis previously used to provide insight into a composition are now part of the composition process. While many scholars discuss the DAW's blurring of the lines between performance and composition,[73] few discuss its

[71] Notice how the above Reddit commentator automatically assumed the composition for analysis would have 8 or 16 bar divisions.
[72] See chapter 5 for an examination of a similar method used to analyze and recreate specific grooves.
[73] As Kvifte asserts, "the problem, conceptually, is that there are no clear boundaries between composition, recording and performance in DAW practice" (Kvifte 2010, 219-220).

incorporation of visual analysis into a producer's process.[74] Touted as a tool for composition and performance, at its core, the DAW visualizes data, taking the 1s and 0s that represent a collection of sonic events and presents them in a socially constructed manner to provide insights for the purposes of composition and performance. By framing it in this manner, I hope to negate the perception of neutral transparency that often comes with software interfaces. The configuration of graphic representations and interactions put forth by the DAW are a particular form of visual analysis and are definitely not the only way to represent the sonic world.

With the DAW, what is heard can also be seen on screen, providing visual insight and guidance for manipulation; this insight is inextricably entwined with interaction. Producers visually acquire information about the length or location of a particular note or section in their track and acts on that knowledge, moulding their composition to their whims. Speaking of audio engineers who utilize visuals when mixing, Reyes writes,

> one should also recognize that the analog era of recording was not without visual monitors, like volume meters, for example. The difference with digital audio technologies, however, is that the visuals themselves can be manipulated to change the sound. Now, visual monitoring is more than an adjunct to recording, it is arguably the focal point of digital music creation. (Reyes 2010, 329)

I believe the utilization of commercially released tracks as templates is one way the influence of this analytical focal point appears in a producer's process. In this way, producers are highlighting their belief in the importance of the arrange window's synoptic representation by incorporating it into their learning process.

[74] Which is ironic, as many of them utilize the DAW as a tool for visual analysis themselves (me included). See (D'Errico 2011, 52; Danielsen 2010, 22;23;24; Bjerke 2010, 96;98; Lacasse 2010, 144;145; Brøvig-Hanssen 2010, 166; Kvifte 2004, 65; Danielsen 2012, 157).

Beyond the DAW, utilizing visuals to provide analytical insight into a collection of information is an integral part of working with the GUI. Manovich maintains, with software, "many types of data acquired a new common property—their structure can be visualized" (Manovich 2013, 118). To him, these visualizations represent data "in a new way which allows us to arrive at insights and knowledge" (ibid., 30). According to Chris Ware,

> graphs, diagrams, and illustrations have only become widely available as visual thinking tools over the past two hundred years. More recently there has been an explosive development of diagramming techniques driven first by color printing technology and currently by the Internet. Graphic PowerPoint slides and the like have become a ubiquitous tool for information presentation. Increasingly, the tools that support cognition are computer-based, and increasingly they incorporate images and visualizations as well as words. The term visualization as it is used in the previous sentence is actually quite new. Visualizations used to be mental images that people formed while they thought. Now the term more often means a graphical representation of some data or concepts. Visualizations are becoming important in most areas of science and commerce … All of these artifacts are tools for visual thinking. (Ware 2010, 20)

The DAW is another example of this computer-based visualization phenomenon, allowing users to incorporate visual thinking into their creative process. In fact, the arrange window is also utilized as an analytical tool by producers who label and visually contextualize their own compositions.

In the complexity of the arrange window, creating a coherent visual organization that allows the producer to easily locate specific graphical elements is highly important. As one Redditor declares,

> … lately I've been working on a track that I am really proud of so far … but I decided to take a break because of how strangely tired I feel. I think it's because of the clutter of my track…This dependency on all these cluttered waveforms and automation clips as well makes my track seem like some shaky construction. (Appendix P1)

There are many ways to organize the arrange window so that it is easy to visually parse, labelling, colouring and grouping various elements in ways that play to the strengths of the visual system. Nonetheless, by creating an uncluttered screen during the creative process, producers are analyzing their creations, making a visual map of their composition, deciding which instruments and audio recordings function together, which are foregrounded, backgrounded, as well as visually labelling and organizing instruments and sounds and creating hierarchies of importance.

Making everything easy to find is one of the cardinal rules for interface design:

> … effective visual representations can be perceived effortlessly and involuntarily … This distinguishing characteristic of visual phenomena is apparent in the viewer's ability to holistically and automatically extract information from the "snapshot" of the overall display that can be perceived during the span of a single glance. (Mullet; Sano 1994, 176)

With this in mind, the DAW provides tools for producers to organize their arrange windows. For instance, the producer can customize track colours in order to distinguish specific instruments, phrases or sections[75] (Ableton 2015, 22; Apple 2013, 168; Avid Technology 2015, 98; Bachmann et al. 2015, 136). Redditor *Aurelleah* utilizes colour coding to create synaesthetic associations:

> I find it helps to associate the sound in a loop with a certain color…This works like associative thinking ... By that I mean, we associate warm with red, cold with blue. Here's some tips: Use similar colors for similar sounds, synths, OR sound TYPE (for example, it helps having all your percussion in the same color so you know that those particular audio files are percussion)
> … Use colors you can associate with a feeling or sound. For example, I use yellow for my leads cause to me, leads sound like bees. I use red for bass cause bass is warm, sub deep purple cause sub is deep, white for drums cause drum skins are white, blue for pads cause pads are cool/relaxing, etc. This makes it easy to spot the pattern youre looking for when you have a lot of patterns. For example, I know when I need to adjust my bass I know to look for the red patterns … You can color

75 Moreover, *Cubase* and *Logic* allow the producer to insert icons underneath their track titles for easier recognition (Apple 2013, 138; Bachmann et al. 2015, 137).

> the channels, the tracks, and the patterns, depending on how much coloring helps you stay organized. (Appendix P2)

Beyond colours, just as with the analysis of commercial songs, producers insert labels onto their compositional structures in order to easily find sections (See Figure 4.2). By labelling a composition for easy navigation, the producer is also performing an analysis of form, determining the boundaries, lengths and locations of sections. Moreover, by titling their markers (labelling verses, choruses or breakdown sections, for instance), producers are textually highlighting the function of these sections and the ways they relate to the entire composition. Labelling does reduce the frustration of searching for specific elements in the flow of the creative process. Yet, many producers also assert that organizing their arrange windows puts a crimp in this process:

> Sometimes spending time colouring and labeling things can really kill your flow once you get in that creative headspace, i usually make things more organized when i feel like im not doing anything productive or brick walling. (Appendix P3)

Through this type of organization, producers could be limiting their creative process by setting the function, location and size of sections before finalizing the composition.

Another way to declutter the screen is by grouping tracks (See Figure 4.3). With track grouping, a producer can collect multiple tracks into one fold-away group that takes up the same amount of screen space as an individual track (Ableton 2015, 218; Apple 2013, 516; Avid Technology 2015, 237). When grouping all percussion tracks, for instance, each subjugated track can still be accessed and manipulated individually, except they can now be hidden when not being utilized.[76] Online producers often suggest grouping tracks based on "frequency,"

[76]Groups can also be an easy way to control the volume levels of multiple tracks with one fader, as well as apply one effect (instead of various instances) to multiple tracks.

"instrument type" or "function" (Appendix P4; P5; P6). Speaking of grouping, one of Duignan's informants states, "I'll go through every instrument and get them sounding how I want them. I hide all the other tracks so I don't get overwhelmed" (Duignan 2008, 182).

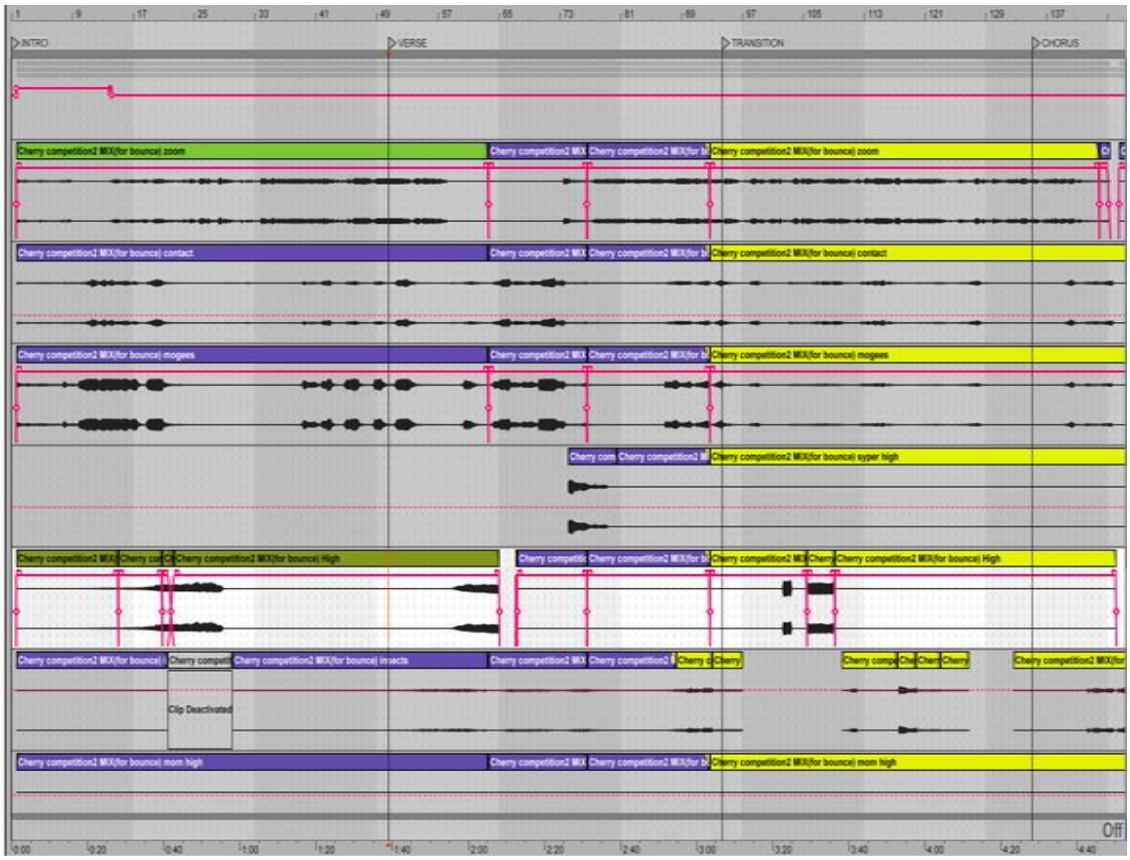

Figure 4.2: Colours and markers in *Ableton Live*.

By combatting visual overload, producers are also making musical decisions, grouping tracks together based on various criteria, creating an interactive visual hierarchy based on the track or section they are manipulating by concealing everything that is currently not important. Mycroft maintains that this mixer board design, where compositions are separated into different tracks,

> … may not be the best suited to exploring the mix. Due to the compartmentalisation into separate channel strips, global attributes and relationships between channels such as the relative levels of audio effects, gain levels, pan positions and processing become hard to discern [2]. Furthermore, the

> need to navigate through several separate channels can inhibit the engagement and 'flow' of the mixing process and impede the user's ability to quickly respond… (Mycroft et al. 2015, 682)

This compartmentalisation is made worse when multiple tracks are grouped and hidden from view.

By visually organizing their compositions for easy search and navigation, producers are in effect crafting and labelling a synoptic analysis. Creating visual clarity forces many producers to constantly think analytically, visually defining the form and function of various sections of their arrangement while still in the midst of the compositional process. Speaking of the different metaphors used to conceive of musical motion, Johnson and Larson inadvertently summarize the display of the arrange window and its connection to analysis:

> The second perspective on the musical landscape is an observer perspective. It is conceived as a distant standpoint from which you can observe the path through a musical landscape that defines a particular work. This is the perspective utilized most often by musicians who are analyzing a score … The advantage that the allegedly "objective" observer perspective supplies is that one can see the entire musical piece at once, because it is an abstract object that can be viewed from afar … The observer perspective on the musical landscape is typically the preferred metaphor for music analysis, because it allows one to treat the entire musical work as an abstract object and to study its features. Those features can supposedly be measured, analyzed, and looked at from various perspectives—precisely what the "objective" music theorist is regarded as doing. (Johnson and Larson 2003, 73)

In the analytical realm of statistical graphics, the musical landscape of the arrange window is known as a time-series plot. Tufte and Graves-Morris observe that

> the time-series plot is the most frequently used form of graphic design. With one-dimension marching along to the regular rhythm of seconds, minutes, hours, days, weeks, months, years, centuries, or millennia, the natural ordering of the timescale gives this design the strength and efficiency of interpretation found in no other graphic arrangement. (Tufte and Graves-Morris 1983, 28)

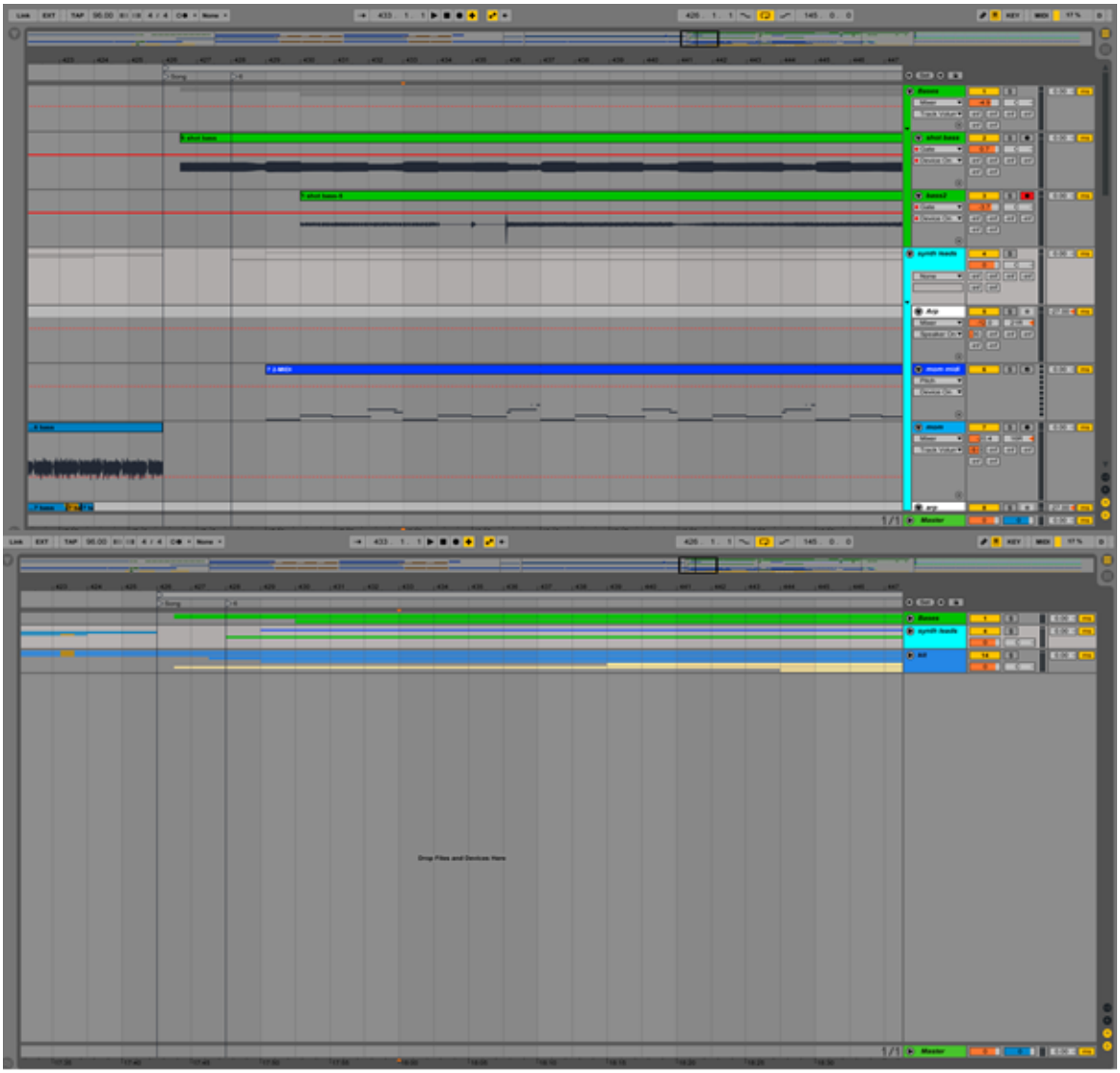

Figure 4.3: Grouped tracks revealed (top) and hidden (bottom) in *Ableton Live*.

The rigidly gridded, regular timeline of the arrange window provides an easily understood visualization of sonic events that efficiently represents the temporally consistent popular music created by the majority of its users. Despite its status as an ubiquitous cultural form for the representation of temporal events, the timeline is a fairly recent conception. Bonds writes,

> the spatial representation of events in linear time remained virtually unknown until the middle of the eighteenth century. The notion of a simple timeline did not emerge until the 1750s, and even then only tentatively. Until the early decades of the nineteenth century, the idea of representing linear time in terms of space was by

> no means self-evident, as either a general principle or a means of conveying the synchronic relationships of parts within a diachronic whole. Whereas a map projects the dimension of space onto the dimension of space, a diagram of musical form must project—or "map," as the word signifies—the dimension of time onto space. This latter kind of projection, particularly as it applies to the concept of linear time, required a conceptual leap taken for granted nowadays. (Bonds 2010, 278)

The conceptual leap of the linear timeline is no longer just taken for granted. It has been normalized into a regular way of working, an integral way of arranging temporal events through the interface of software. Rosenberg and Grafton maintain that "… along with the list and the link, the timeline is one of the central organizing structures of the contemporary user interface," stating that "the availability of dynamic, animated forms of presentation places special emphasis on time as an axis of organization. An important part of the appeal of the timeline in the context of the flat and ever-extending plane of information is that it offers stability" (Rosenberg and Grafton 2013). This stable timeline metaphor is utilized in other time-based forms of media software such as film editing and animation. Sefton-Green states,

> yet all time-based media use a timeline as a key metaphor. Whilst this might seem natural as a way of talking about film—after all, the computer's timeline looks like the unwound film spool—this is by no means as natural a way of visualising music. (Sefton-Green 2005, 105)

While I could argue that the DAW's timeline resembles an unwound spool of audio tape[77] (appropriating much of the terminology of the tape recordist to boot), I believe the monochromatic strips of audio tape do not provide a fruitful analogy for the multilayered graphical complexity of the arrange window with its movable playhead providing quick access to all parts of a composition. Moreover, solely attributing the arrange window to the influence of

[77] The *Ableton Live* manual professes this very fact, asserting, "the *Arrangement View* displays the Arrangement, which contains music laid out along a song timeline, like a multitrack tape" (Ableton 2015, 89).

the linear layout of audio tape obscures much of the history of the timeline as an integral way of organization in modern Western culture. As Rosenberg and Grafton state,

> What is notable about the function of the timeline in modernity is that it operates so seamlessly in the graphic background, organizing and structuring other forms of graphic representation, as if it weren't even there. (Rosenberg and Grafton 2013)

The seamless ubiquity of the timeline as a Western framework for temporal organization made it an obvious choice for incorporation into the visual interface. This spatial representation informs many ways in which music is conceptualized and understood through the interface of software. Aside from the DAW, software audio players, from *iTunes* to *Spotify*, display an interactive visual timeline with a movable icon progressing across the screen in concert with the track. The popular audio sharing site *SoundCloud* (which many Reddit producers utilize to upload and share their compositions) takes a cue from the DAW, spicing up its timeline by visualizing compositions as waveforms that stretch across the screen, allowing users to attach comments to specific temporal locations in a track.[78] The ability to interact with a linear representation of a musical composition, navigating quickly to any location while seeing its beginning and end at a glance is the hallmark of the musical experience with the GUI. In fact, I maintain the very conception of music as a spatial entity that can be navigated is a defining feature of the interactive software interface.

For many, these interactive timeline-based visuals seem to trump numerical representations of musical time. Freeman states in this 1994 magazine review comparing several DAWs,

[78] A *Bloomberg* article concerning *SoundCloud* highlights the allure of the visual complexity of the waveform: "The first version of SoundCloud evolved directly out of their desire for a better music collaboration tool. Instead of a ho-hum progress bar, the player used a waveform visual to display a track's progress" (Walker 2015).

> … although Digital Performer does allow positioning of events by SMPTE[79] addresses, its track overview is not as intuitive as the graphic overviews offered by the other programs. The biggest difference is the far more detailed information the overviews convey in the other three digital-audio programs. (Freeman 1994, 50)

Or as Marans claims in his 1989 review of Digidesign's *Sound Tools*,

> we found that during our tests, we preferred to view our locations in SMPTE time. However, the more we worked with the program, the more we found ourselves getting remarkably adept at interpreting the waveform data itself. Percussive hits, trills, fade-outs, and high-and low-frequency data were quite easily recognizable. After a while, we found ourselves relying almost entirely on the visual cues provided by the waveform, and using the SMPTE time scale marks simply to confirm our findings. (Marans 1989, 109)

We've already seen several ways these visual cues provide a powerful influence over how producers organize and arrange their compositions and I believe this influence can also be observed through an examination of the playlist feature present in several DAWs.

As previously mentioned, markers allow producers to organize their tracks, visually labelling important sections; however, *Cubase*, *Logic* and *Pro Tools* also permit markers to have duration, letting the producer to set the range of the marker in order to encapsulate the beginning and ending of a section.[80] These DAWs give the user the option of collecting this marker information in an editable playlist,[81] enabling the producer to view "marker names, bar position, and length information in a scrollable, editable list" (See Figure 4.3) (Apple 2013, 560; Avid Technology 761; Bachmann et al. 2015, 281). With this method, sections can be spatially marked in the arrange window and then collected in a spreadsheet style playlist in a different window for

[79] SMPTE time (Society of Motion Picture and Television Engineers) is a standard for temporally labelling frames of video or film. In DAWs, this provides an easy way to synchronize music with visuals for film composing.
[80] *Cubase* provides its own functionality for arrangement, separate from markers but serving a similar function, allowing the producer to separate different sections into what it calls "arranger events" (Bachmann et al. 2015, 259).
[81] *Cubase* calls its playlist the "arranger chain" (Bachmann et al. 2015, 259).

easier arrangement. All sections in the playlist can be easily auditioned and played in order, just as in the arrange window; however, as the playlist is organized as a spreadsheet, it eschews the link between time and space that characterizes the arrange window. The *Cubase* manual describes the manipulatory differences between the arrange window and the playlist, arguing that the playlist provides more options for trial and error manipulation than the spatial representation of the arrange window:[82]

> … you can define [playlist] events, order them in a list, and add repeats as desired. This offers a different and more pattern-oriented way of working, which complements the usual linear editing methods in the [Arrange] window … [You can] save different versions of a song within the project without sacrificing the original version. When you have created [a playlist] that you like, you have the option of "flattening" the list, which creates a normal linear project based on the [playlist]. (Bachmann et al. 2015, 259)

Thus, users can arrange their songs in the playlist and then when finished, "flatten" them into the timeline in the arrangement window. Speaking again of *Sound Tools*, Michael Marans touts many of the same benefits of playlist arranging as the modern *Cubase* manual:

> After the regions have been defined, they may be entered into the playlist, which determines in what order and what time they will playback … Regions may be moved, cut, and copied to other locations. Multiple playlist regions may be also manipulated as blocks, which is handy when you wish to repeat a specific series of events … (Marans 1989, 109-110)

[82] Many 1980s and 90s digital samplers solely used a playlist arrangement style instead of a timeline-based visualization—mainly because of their tiny screens and the lack of processor power for the elaborate graphics of a detailed arrange window. For instance, the MPC60 sampler (released in the 1980s) stresses the ease of manipulation in their playlist, asserting "The song structure can be created very quickly [*and*] The content of the sections of the song can be changed very quickly" (Linn 1989, 116). Earlier less-powerful software-based recorders also utilized playlists instead of arrange windows. In my mind, despite its origins as a computational necessity, it seems that there are many benefits to the arrangement of a composition through the use of a playlist rather than the spatial representation of musical time.

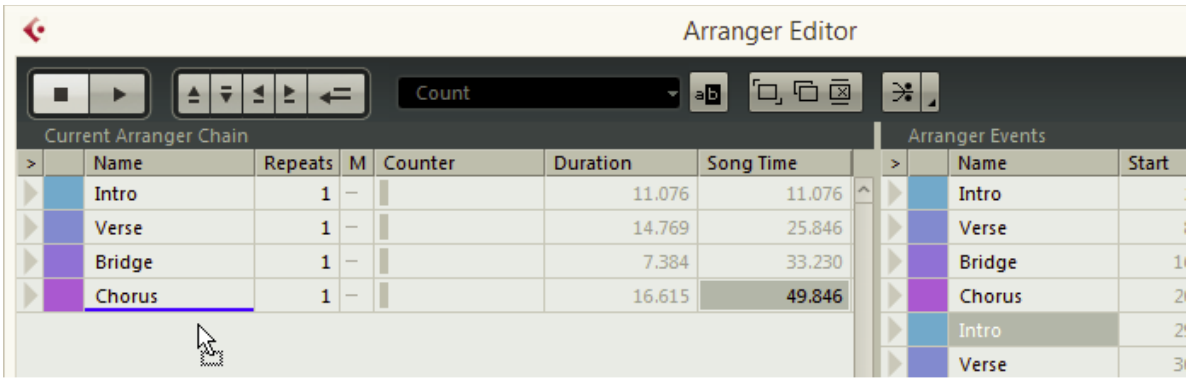

Figure 4.4: The playlist in *Cubase* (Bachmann et al. 2015, 261).

Playlists allow a fluid and playful form of arrangement where the producer can easily switch sections with the same ease as swapping cells in a Microsoft *Excel* spreadsheet. Calling this type of playlist arrangement a non-linear system, Duignan comments,

> the most pronounced ability of non-linear DAW systems is enabling spontaneous rapid rearrangement. This flexibility of action approaches the experience of working with musicians in a band situation, where specific arrangement decisions have a high degree of provisionality. (Duignan 2008, 195)

In contrast, arranging a composition in a complex arrange window requires producers to drag their mouse across the screen, making sure to select every waveform, MIDI note and edit before they can move an entire section. During this process, it is easy to leave something out, making the movement of an entire section a messy endeavour rife with error. In this instance, visual complexity and the linkage of time and space can be a detriment to playful experimentation. This dilemma is summarized by one of Duignan's informants:

> It gets messy when you are doing lots of changing around with big arrangements with lots of things [going on]. You do a lot of cut and paste, and then 'naa, I changed my mind', cut and paste again, and then 'naa, changed my mind'. . . In a linear time line situation [like this] it is hard to move big chunks around … it probably stops me experimenting too much because it is just a bit of a headache. (Duignan 2008, 209-10)

Despite their supposed benefits, playlists are hardly mentioned online as a fruitful method for arrangement.[83] Moreover, this feature is not even included in popular software packages such as *Ableton Live* or *FL Studio.*[84] I believe this is because, despite the ease of playlist manipulation, the DAW's spatial representation of time is too beguiling to ignore. According to Bonds,

> spatial representations hold an almost totemic power that even the most eloquent verbal descriptions can be hard pressed to rival. By allowing us to take in the form of a work at a glance—as a whole, as a Gestalt—diagrams by their very nature offer perspectives that verbal accounts alone cannot. (Bonds 2010, 302)

To my mind, this spatial overview seems to be much more visually vibrant and rewarding than manipulating a playlist spreadsheet.[85] Many of Duignan's informants prefer to arrange their completed composition in the linear arrange window because it provides "the ability to form finalised arrangements" (ibid., 190; 193). Seeing the composition laid out on a linear timeline helps producers to comprehend the arrangement of their compositions. Producer Christiaan Ecrolano admits to Duignan, when composing non-linearly,

> you're not doing a linear path of what a song should be … That arranging side of it was always hard. It was always way too miserable to think about. It is so much simpler in [Apple] Logic in a linear format. (Duignan 2008, 193)

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[83] I did not find any instances of producers discussing this feature when searching in the hip-hop and EDM Production subreddits. Not to say that it does not happen, just that it does not seem to be a popular way of working. Obviously, its lack of inclusion in several DAWs could be another possible reason for the playlist's lack of popularity.

[84] *Ableton Live* does furnish the producer with a visually simplified alternative to the playlist editor with its "session view grid" (Ableton 2015, 112; see chapter 2 for a more detailed discussion of this feature). In this area, producers can organize various musical phrases and loops into a spreadsheet like grid of boxes. While this session view has much in common with the playlist—easy manipulation, swapping and a non-timeline form of organization—it avoids the textural density of the playlists in other DAWS (which list metrical and temporal information as well as section titles, for instance) in favour of coloured boxes that can fit a few words of text.

[85] Creating a playlist also requires preparation, demarking each section in the arrange window before it can be viewed in the playlist. This could be seen as a hindrance to producers used to a more playful and free flowing way of operating.

Alongside providing a visualization of the path of a composition, the arrange window gives the producer feelings of power and control over time, navigating across the linear timeline as master of the usual temporal progression of music. The producer Scanner succinctly encapsulates this feeling:

> I become God very briefly. I'm playing with time, and I can put the sound up. You know, you have an image of the sound, and what intrigues me is the fact that, for that moment in time, you have such power. You can move forward in time and you can go back in time. And where the cursor is, where your mouse is at that very point, is now. It's real time. But then you can go back and you can go forward. (Reighley 2000, 186)

I doubt this sentiment can be recreated with a text-based spread sheet. The playlist, while easier to manipulate, does not give the user spatial access to the entire composition. The synoptic view provides a richer and complex visual feedback to manipulation than playlist manipulation, which in turn, provides a visualization of the path of a composition and induces a greater feeling of control over compositional choices, guiding the producer into a way of working that may not always be the most expedient.

Philosopher Henri Bergson analyzes the spatialization of time endemic to Western culture by differentiating between abstract time and lived duration. Abstract time is the spatialized and quantified conception of time utilized to measure, compare and quantify temporal events, whereas duration is the lived experience of time, a "qualitative process, a flow in which past, present, and future permeate one another to form a genuine continuum" (Cox 2013). To Bergson, abstract time, by reducing lived duration to spatialized and divisible moments, diminishes and misrepresents how humans actually experience time. Grosz observes that,

> duration must always be regarded as a continuity, a singular whole. When duration is divided, which fundamentally transforms its nature, it can be regarded as time,

> the scientific, measurable counterpart of space; but in itself, and not subordinated to the exigencies of practical and scientific action, it is indivisible, continuous, inscribed by movement, always a whole. (Grosz 2004, 183)

It is clear that the DAW's arrange window presents a scientific and spatialized version of musical time, allowing the producer to view, quantify, measure and compare musical events, while eliding an understanding of music that cleaves closer to time as a non-spatialized and undivided flow. As Aiken maintains in a 1989 review, "if you conceive of your music as a single seamless stream of consciousness, the orientation of *Cubase* toward small blocks known as parts may not be of much use to you" (Aiken 1989, 117). Prioritizing sonic manipulation by visualizing musical time as modular blocks that can be dragged, cut, copied and pasted is the hallmark of all DAWs. Linsted and Mullarkey write,

> … the artifice of spatialised time consists of segments which preserve nothing in themselves of any previous segment. They are all juxtaposed in an abstracted succession. This artificial time is created and thrown beneath real time for the practical purposes of action, of manipulating the world. As such, duration cannot be measured and its progress is not predictable … Movement, like real time, is qualitative and processual. It cannot be analyzed into motionless parts that are sequenced together. Yet for the purposes of manipulation, we are forever throwing this diagrammatic space beneath movement and attempting to prove that the former truly describes the latter. (Linsted; Mullarky 2003, 4)

Thus, we abstract time into motionless and sequential sections for the purposes of manipulation and measurement, fooling ourselves into thinking the abstraction is how time is actually experienced. Similarly, spatialized time is so ingrained in the DAW's visual representations that, for many producers, it has become the only way of comprehending music. Boykan's renunciation of spatialized musical time, his declaration: "you can easily compare lengths in the visual world, but it is rather a stretch to ask us to keep track of a ratio in a situation of gradual unfolding" would be nonsensical to most DAW-based musicians (Boykan 2004, 25-26).

Speaking of the widespread conception of the musical work as an artifact at the centre of meaning and aesthetics in Western Art Music, Lydia Goehr writes that

> … a concept can become so entrenched within a practice that it gradually takes on all the airs and graces of necessity. Thus it has become extraordinarily difficult for us nowadays to think about music—especially so-called classical music—in terms other than those associated with the work-concept. Yet for most of its history the tradition of 'serious' music was not thought about in these terms. (Goehr 1992, 13)

I believe the conception of music as existing along a spatial timeline that can be navigated is firmly entrenched in the modern software-based musical experience. While the mapping of musical time to space has been a common representation for many years, the way the DAW centers this spatial mapping in the producer's process is unique, making it difficult to conceive of music in any other way.

One interesting example of a different approach to musical time is David Cecchetto and William Brent's sound-editing software *Exurbia*. In "The Sonic Effect," Cecchetto lists some of the software's unique features:

- the interface is time-intensive, being predominantly aural and executed in real time;
- editing is destructive (i.e. there is no "undo" feature);
- all of the source materials (i.e. the sound samples) are shared among all users, but are used to produce discrete pieces;
- each edit on a single user's computer impacts every instance of a single file throughout the *Exurbia* community (i.e. the materials are dislocated). (Cecchetto 2013, 46)

With *Exurbia*, there is no synchronic representation of music, the user cannot visually jump, fast forward or rewind through a sample or a composition and each of the program's "twelve different parametric modifications" has to be implemented in real-time (ibid., 47). To enact a manipulation towards the end of a sound file, users must listen to the entire file and perform their manipulation at the opportune moment. Once the manipulation of a sound file is accomplished,

users insert the sample into their "master track" (where all the samples are arranged into a composition) by entering a "start time in seconds into a number box" (ibid.). Finally, upon leaving a session, every user's manipulations are inserted into the *Exurbia* community's shared sonic materials. When the user reopens the file, *Exurbia* updates the composition's sounds with the other user manipulations that have occurred in the interim. This means that a user's composition could drastically change in character between sessions as sonic materials are overwritten based on other users' manipulations.

To Cecchetto, sound editing with *Exurbia* "becomes less a process of 'cutting and pasting' and shifts instead towards 'channeling and remixing'" (Cecchetto 2013, 51). As the interface only allows users to work within the real-time flow of musical events, they cannot look ahead or backwards in time, cannot chop and move discrete segments and cannot return to a previous state by undoing manipulations. While users enact many of the clicking, dragging and typing actions inherent in the GUI (to implement manipulations), the software's focus is solely on sonic concerns as "the effects of [*the user's*] actions— in the sample, the composition, and in the networked community — are only registered aurally" (Cecchetto 2013, 51). There are no visual landmarks to display the order of sections and sounds, no grid to guide placement and aid in arrangement, as well as minimal visual responses to the user's direct manipulations. Manipulations are always performed within the flow of musical time and the user must always listen intently as there is no undo safety net. To create a composition that reflects some sort of artistic intent (and is not just a random collection of manipulated sounds) users must have knowledge of the sequential flow and the characteristics of each sound file in order to enact their manipulations at the proper time. Acquiring working knowledge of the sonic materials is a by-product of working with *Exurbia* as the user must listen to the entire sound file from the

beginning every time they want to manipulate a sound. Moreover, as the characteristics of each sound can be constantly in flux (due to the manipulations of the rest of the *Exurbia* community) users must remember the entirety of their composition in order to discern what elements have changed since the previous session. Cecchetto writes,

> … combined with the slowness of working in the *Exurbia* environment, this emphasis on memory creates a sense of intimacy with the work by giving the impression of a greater portion of the piece being stored "directly" in one's memory … in the same sense that an earworm can be said to crawl more deeply into our psyches than a memory of a visual image because it is persistent and involuntary. (Cecchetto 2013, 53-54)

The instant gratification of DAW manipulation, spatializing sonic objects and providing the powerful feeling of transcending musical time is replaced by a much slower workflow that avoids the mnemonic crutch provided by on-screen graphics. This results in a deeper knowledge of the work and its constitutive sonic materials.

Exurbia's real-time articulation of music highlights the "performative dimension of sound, which is always context-specific" (ibid., 45). This combats the computer's traditional conception of sound as atemporal and interchangeable data "which can be moved from one setting to the next seemingly without being changed" (ibid., 50). By forcing constant real-time articulation and manipulation, each sonic element in a composition must be also understood by its context, its location in the real-time flow, and this context cannot be changed once set-up. With this workflow, *Exurbia* provides an experience that is more akin to listening and performing music away from the computer screen.

Nevertheless, I do not see my Reddit informants sacrificing the simplicity and the speed of DAW-based manipulation any time soon.[86] Users said to Cecchetto that compositions created in *Exurbia* "take roughly 40 to 50 times as long to create as they would in a standard waveform editor" (Cecchetto 2013, 52). Moreover, due to its real-time workflow, *Exurbia* compositions lack the precise editing of DAW created tracks, exhibiting

> … a kind of coarseness or clunkiness that is particular to the environment. Where compositions produced with ProTools might dance lithely across the stereo field, *Exurbia's* compositions tend to stumble along with the impotently brute movements of a toddling child. (ibid., 60)

Yet, Cecchetto argues these "impediments to smooth usage" make the software a success, as they provide a workflow that is "fundamentally different from the way that sound is typically treated in digital settings" (ibid., 49). *Exurbia* emphasises ways traditional on-screen graphics influence how producers internalize and create their musical works by pointing to a radically different method of interacting with sound through the visual interface. Shedding light on the influence of the synoptic space by removing it from the composition process, Cecchetto and Brent's software reveals how much a user takes the visuals for granted when composing in the DAW.

Bergson's conception of duration, as well as Cecchetto and Brent's *Exurbia*, point to different ways of conceptualizing musical time other than the synoptic space of the arrange window. As the experience of musical creation is mediated by the visuals of the DAW for an increasing number of producers this becomes a highly necessary project, because the synoptic

[86] Furthermore, I believe it would be quite the challenge to create a loop-based style of composition favoured by EDM and hip-hop artists in the *Exurbia* environment.

form will only gain further entrenchment as the dominant way of conceptualizing temporal events. From the visual symmetry and temporal explicitness of the on-screen grid (connecting tempo to space and allowing modular arrangement), to the integration of spatial organization and analysis into the compositional process, the enticing power of the synoptic representation and the ubiquitous influence of the timeline serve to disseminate a conception of music as a spatial entity to be navigated while obscuring a more qualitative understanding of musical time. In the next section, I will further explore the influence of spatiality by investigating ways that producers navigate the arrange window.

Performance

As we've seen, the conception of music as a navigable space is endemic to the DAW's visual representation, inserting different interactive parameters into the compositional process. From video games to the on-screen desktop, navigating digital environments is a common and pleasurable way of operating with the GUI. According to Murray,

> one form of agency not dependent on game structure yet characteristic of Digital environments is spatial navigation. The ability to move through virtual landscapes can be pleasurable in itself, independent of the content of the spaces. (Murray 1997, 129)

Cronin calls on-screen navigation a "distinctly unmusical concept;" yet, music as a navigable object is integral to the process of a DAW-based producer and for better or worse is stimulating new ways of being musical (Cronin 2008). In fact, in the arrange window, auditioning sections by pointing the playhead to various locations is a form of navigation as performance.[87] With all

[87] As this process is done in real-time as the composition is playing, I am classifying it as performance; although as is common with the DAW, this could also be defined as a method of composition.

DAWs, the playhead's location can be changed during playback with the click of a mouse, allowing the producer to audition various locations non-linearly without stopping the music. Spatially performing their compositions, producers look across the arrange window, searching for areas for the software to perform next, then clicking on that location to hear what they see. With this form of real-time remix, producers can subvert the processual flow of their composition on the fly. In fact, with its "quantization menu," *Ableton Live* reinforces this form of performance by allowing the playhead's location change to be delayed based on a pre-set unit of musical time (Ableton 2015, 91). For instance, during playback, if the quantization menu is set to "1 bar" and the producer clicks to audition a new location in the composition, the playhead will not go to this location until it reaches the end of the current bar it is performing. Sonically, this allows for seamless section changes, simplifying the remix of a musical arrangement in real-time as the playhead will only change location based on the performed metrical grid.

Dragging and manipulating visual representations in the space of the arrange window, when enacted as the composition is playing, can be characterized as a form of a spatial performance. For example, in the DAW, a loop can be endlessly repeated, while the producer sculpts the sound, changing pitch, rhythm and timbre while watching the playhead traverse across the body of the composition.[88] The sound of the track is definitely paramount, but this type of performance is spatial. Listening intently, the producer's eyes sweep the screen on the lookout for salient details that presage upcoming sonic events, all the while turning knobs as well

[88]As Butler declares, "musicians frequently begin or develop compositions by setting in motion a pattern such as a loop or sequence, allowing it to repeat indefinitely, and improvising in relation to it while recording the results" (Butler 2014, 126).

as clicking and dragging sonic objects to new temporal locations, triggering muscle memories and spatial drag and drop judgements learned through a lifetime of computer usage.

Working with the DAW creates a new style of performance that combines the immersive character of sound with the analytical distance of sight. In this case, unlike performing musicians sight reading from a score, the DAW-producer enacts a different form of multimodal interaction by giving up many responsibilities to the machine. Butler asserts that an EDM producer steps into a unique style of performance and composition. Free from the worry of performing every note, a producer can "stand outside a temporal unit and perceive it even as it unfolds," becoming "a better listener, for he or she can…evaluate [the track] while it is ongoing" (Butler 2014, 106; 108). What Butler does not mention is that this process (particularly for the software-based producer) has a large visual component. With this style of machine-aided performance, I believe the sense of being able to stand outside the temporal unit is greatly accentuated by the overview of the sonic structure provided by the arrange window. Speaking of the visual perspective common to the GUI, Friedberg observes that

> the desktop metaphor of a stack of papers, in overlapping array, implies a view from above. The window metaphor implies looking into or out of an aperture, a "perspective" position facing an upright perpendicular surface … The space mapped onto the computer screen was both deep and flat. It implied a new haptics in the position of its user: in front of and above. (Friedberg 2006, 227)

By entering into the visual world of the Graphical User Interface, DAW-based music was gifted with a visual perspective. Positioned above the composition while looking through the arrange window, immersed in sound but also visually outside of it, the producer can evaluate and analyze the track while it is being performed because the machine is doing the work. With the

synoptic space, the arrange window accentuates this distance, allowing the producer to visually step outside of musical time. Johnson and Larson state that

> we cannot clearly separate our understanding and conceptualization of music from our experience of it. We do not merely experience a musical work and then understand it. There is not experience first, followed by our grasp of the meaning of that experience. Rather, our understanding is woven into the fabric of our experience. Our understanding is our way of being in and making sense of our experience. Thus, the way we experience a piece of music will depend importantly on how we understand it, and our understanding is intimately tied to our embodiment, that is, to our sensory-motor capacities and to our emotional makeup. (Johnson and Larson 2003, 78)

Through countless hours of composing in front of the screen, vision becomes a part of this conceptual embodiment, connecting the modalities of sight and hearing into a new amalgam that is integral to how producers compose music. According to Hamilton,

> when perceiving and experiencing rendered immersive graphical computer environments, humans have the ability to completely reorient their visual and auditory systems, allowing a generated reality to take precedence over a physical one … No commonalities of crossmodal interaction are guaranteed when stepping across the digital frontier and no limits exist to the potential mappings of sight to sound (and sound to sight) other than the creativity and whimsy of designer and developer. (Hamilton 2015, 126)

Discussing the influences of interactive software, Hutchins et al. mention the "gulfs of execution and evaluation" asserting that, utilizing software "… involves a relationship between the task the user has in mind and the way that task can be accomplished via the interface" (Hutchins et al. 1985, 317). Thus, users have a certain idea of how a task should be accomplished (execution) and how they should be notified of the consequences of their actions when attempting to complete the task (evaluation). The larger the gulfs between how the user and the software conceive the task, the harder the software is to use. Yet, Norman declares,

> … with increasing skill, a person mentally bridges the gulfs, so that the operations upon the artifact are done subconsciously, without awareness, and the operators view themselves as operating directly upon the final object. (Norman 1991, 24)

The way the software frames and organizes the task can become normalized through use. The user internalizes the software's processes and it becomes the obvious way of operating. By learning the DAW, the producer bridges the gulf between the sonic and the visual, between the ephemeral flow of music and the rigid grid of the arrange window. They learn to conceptualise the task of composing and performing music in the visual framework presented on the screen. Comparing standard music notation to an uploaded screen shot of a producer's arrange window, one Redditor claims,

> with notation you write and have it interpreted [sic] by a musician playing the piece. Electronic music composers don't have that luxury, every second has to be painstakingly described. Having learned notation then given up on it for being shit, every time I hear people talk about how good it is to know, or how it's better than automation and midi, it's all bs. Basically you could just do a complicated scribble on staff paper and say, here play this, some composers expiremented [sic] with that. That screenshot IS the music. (Appendix U3)

In this case, the DAW has become the expected representation of music. Notation is lacking: it does not make a sound and to be musically realized, the performer has to do all the work. In contrast, elements of performing that standard notation does not capture (such as microrhythmic deviations, instrument timbres and reverberation, for instance) have to be inserted and tweaked by the producer. Every graphical detail in the space of the producer's arrange window is a testament to the amount of work put into a track and what is shown on the screen is what is heard. Discussing the GUI, Johnson speaks of perceptual patterns and frames:

> Much of our lives are spent in familiar situations: the rooms in our homes, our yards, our routes to and from school or work, our offices, neighborhood parks, stores, restaurants, etc. Repeated exposure to each type of situation builds a pattern

> in our minds of what to expect to see there. These perceptual patterns, which some researchers call frames, include the objects or events that are usually encountered in that situation … Anyone who uses computers, websites, or smartphones has frames for the desktop and files, web browsers, websites, and various types of applications and online services. For example, when they visit a new Web site, experienced Web users expect to see a site name and logo, a navigation bar, some other links, and maybe a search box … (Johnson 2014)

These connections between sight and sound in the DAW influence how producers conceive of the musical experience and reframes their processes of musical composition. EDM producer Madeon maintains that he finds the *FL Studio* interface "very emotional and life-defining," remarking, "I've spent more time looking at FL Studio's interface than anything else in the world … I'm sure graphic professionals feel this way about Photoshop" (Weiss 2016). For many, the synoptic musical form becomes the expected representation for musical events, influencing the understanding and conceptualization of music. Basically, the arrange window inculcates a particular perceptual pattern of music in the mind of many producers. Hip-hop producer Soulja Boy maintains he visualizes the arrange window when he listens to fellow *FL Studio* user DJ Mustard, seeing "all the patterns in my head for every song" (Weiss 2016). In this instance, the cross-modal mapping of a track in the *FL Studio* arrange window has followed Soulja Boy into his everyday listening activities, becoming the totemic representation for other musical endeavours. British producer Burial brings his own visual associations to composing drums, stating, "so I know when I'm happy with my drums because they look like a nice fishbone. When they look just skeletal as fuck in front of me … I know they'll sound good" (Clark 2006).[89] In contrast, Canadian producer Deadmau5 believes the visual thinking provided by the synoptic overview creates formulaic music:

[89]See chapter 5 for a deeper discussion of Burial's process of creating drum rhythms.

> All the DAWs, the one thing that they all have in common is that you can see everything … it's really kinda formulaic. You look at a four-bar-long clip stacked to another one, and then with an eight-bar or a 16-bar loop or break down— but never a six-bar one … the structure of more or less every song ever played by DJ is so damn close. (Levine 2011)

Emphasizing the vertical arrangement of the DAW, Matthew Ingram observes that

> the fundamental visual paradigm of the DAW … is the first thing at fault. The user is encouraged to view music as if it were a giant sandwich of vertically arranged elements stacked upon one another. The tendency this encourages is one of interminable layering. (Ingram 2010, 136)

While I am not claiming that a visual of the DAW's arrange window mentally haunts every producer's listening activities or that formulaic, interminably layered music is the sole result of the synoptic visualization, I believe the synoptic visuals of the arrange window can have the tendency to encourage a producer to compose in this manner. Magnusson claims that

> when musicians use software in their work, they have to shape their work process according to the interface or structure of the software. As with acoustic instruments software defines the scope of potential expression. The musician is already tangled in a web of structured thinking but the level of freedom or expressiveness depends on the environment in which he or she is working. To an extent, the musical thinking takes place at the level of the interface elements of the software itself. (Magnusson 2006, 163)

Music as a navigable space has become normalized through the interface of software, creating a new multimodal method of composing and performing where vision is integrated into what is heard. Whether foregrounding a composition as a modular collection of parts or fostering an overt dependence on visual analysis while composing, I believe the arrange window has a definite affect on the producer's process.

Distraction

While useful in many regards, many producers do perceive the arrange window as a distraction from the flow of the music, distorting the perception of their track (Appendix Q). For instance, while looking ahead to future musical events, producers are dividing their attention from the current musical flow. Moreover, many producers claim that seeing these upcoming events on the screen can prejudice their understanding of the music, as it divorces them from the experience of the listener who (most likely) does not have the benefit of visuals. Matthew Duignan maintains, "because producers can see visual representations of edits during playback, it was often very difficult for them to get any real sense of how the material would be perceived by users who did not know that the edits were there" (Duignan 2008, 166). I also believe looking at a graphic representation of a particular edit, section or instrument often causes its corresponding musical sound to be sonically foregrounded in the producer's perception. This is echoed by producer Tim Prebble:

> If I can see an edit coming up it informs me, so you are not listening to a sound-track, you are listening to a detail of it. (ibid., 166)

Or as a Redditor writes,

> I could see the sense of editing with your eyes if you were planning on distributing screenshots of your music rather than sound files. The danger is that your eyes always overrule your ears - it's just how the human brain works. If you see the sound, your ears will lie to you to fit in with what your eyes tell your brain you should be hearing. When the end product is sound, that's usually a bad place to be coming from. I guess I'm just struggling to tell what useful knowledge you'd garner from watching a waveform change shape. (Appendix Q1)

One of the "classic" scientific studies that illustrates this type of cross-sensory conflict is the McGurk-MacDonald effect (Soto-Faraco and Alsius 2009, 580). McGurk and MacDonald

found that a speaker's lip movements could change the perception of sounds. For instance, watching a video of a speaker mouthing the utterance [ga] with the sound [ba] overdubbed on the soundtrack resulted in the participants hearing the utterance as [da]. McGurk and MacDonald highlight the power of this effect, writing, "we ourselves have experienced these effects on many hundreds of trials; they do not habituate over time, despite objective knowledge of the illusion involved. By merely closing the eyes, a previously heard [da] becomes [ba] only to revert to [da] when the eyes are open again"[90] (McGurk and MacDonald 1976, 747).

Similarly, when discussing their elevation discrimination experiment—where participants had to judge the elevation and direction of visual and sonic cues involving multiple loudspeakers and lights at different vertical and horizontal positions—Driver and Spence maintain that

> … when people voluntarily attend to a particular location in one modality (because they expect a target there in that modality), their attention also shifts in the same direction for other modalities … even when this cannot be to their strategic advantage (indeed, even when it is somewhat disadvantageous). For instance, [focusing] visual attention on one side, because of a strong spatial expectancy concerning visual targets, leads to better auditory judgments on that side also. (Driver and Spence 1998, 258; 255)

While Driver and Spence's experiment is different from the experience of working with the DAW, as the location of the source of sound and visual cues are not a surprise in the arrange window, it points to the fact that for many of their participants, increased visual attention to one location similarly increased sonic acuity at the same location.

[90]I am citing several crossmodal studies as illustrations of the fact that many believe that the visual and auditory realms can affect each other. This does not mean that these exact crossmodal effects appear in the producer's process. As Soto-Faraco and Alsius assert, "the authors argue that multisensory integration is a multifaceted process during which different attributes of the (multisensory) object might be bound by different mechanisms and possibly at different times" (Soto-Faraco and Alsius 2009, 580). More studies examining producers as they work with the DAW are needed to draw reliable conclusions.

Another visual distraction from sonic events is the dizzying array of graphics (from volume meters, to waveforms) that are constantly in motion during the playing of a track. Ronald Rensink notes that when designing graphic interfaces,

> … sudden changes should be minimized. In particular, the use of motion in a display should be avoided whenever possible since it is a particularly effective feature for attracting attention…only about four moving items can be tracked at the same time; attempting to track more will inevitably result in some being lost. Indeed, for most tasks, attentional capacity is about four items. The exact value differs for different observers, but is usually around 3 to 5 items. A limit of three is a reasonable restriction for displays intended for most users; if more items need to be attended to at any time, performance will tend to deteriorate. (Rensink 2011, 80; 84)

Although most of the DAW's visuals usually move together in concert with sonic events these moving graphics can definitely become overwhelming, overloading a producer's attentional capacity when listening to compositions. Electronic duo Autechre declare that

> there's nothing better than turning the screen off and just going analogue … You're not looking at data representation and so you can drift off and just listen … When we're putting things down and mixing things and are trying to make things sound right, the screen has to go off. It's an illusion that totally pollutes what you're thinking and what you're listening to … (Tingen 2004)

I believe the multimodal character of the DAW can create distractions from sonic events, polluting the composition process. This sentiment is echoed by Redditor *Padrek*:

> Watching levels, automation envelopes, midi patterns, etc. can affect how you hear the track … Along with being distracting, I think watching meters and all that can put ideas in your head. I usually close my eyes unless I have a reason to be watching the screen. (Appendix Q2)

Conclusion

I contend the DAW's synoptic representation definitely inserts many different ideas into the heads of its users. Its particular visualization of a composition as a compound graphical object, temporally delineated and stretched across a zoom-able timeline highlights a modular form of arrangement that centers a spatial analysis of music in the producer's process. By visually organizing their compositions and spatially recreating commercial song forms in the arrange window, many producers reveal the importance of visual analysis in their process, demonstrating how they conceive of musical events by what is shown on the screen. Furthermore, the arrange window's presentation of music as a navigable space is an influential and ubiquitous representation that is the dominant way of conceptualizing, understanding and experiencing music through the interface of software. Emphasizing the influence of the spatial representation of music, the arrange window intensifies the powerful feeling of transcending musical time by transposing the common trait of navigating digital environments into the world of music. This navigation creates a new form of multimodal composition and performance where producers can spatially remix their compositions in real time. Nonetheless, all these complex visuals can be viewed as a detriment to the creation of music, distracting the producers, visually polluting their composition process and changing their perception of music. While often a useful method for manipulating, arranging and performing a composition, the arrange window must not be understood as the sole way of visually representing music. Revealing the various biases and spatial influences inserted into a producer's process by the arrange window is a highly important undertaking, as this cross-domain mapping has been normalized by several generations of producers whose main conception of music is mediated by what is shown on the computer screen.

Next, I will continue my examination of the spatial representation of sound, zooming-in for a closer view and investigating the producer's manipulation of the attacks and decays of percussion hits in the creation of danceable rhythms.

Chapter Five: "Fish Bone": Attack and Decay in the Creation of Drum Grooves.

> Your groove is driven by the interplay between your kick, snare and hi-hat. Call them the holy trinity of groove and worship them. Pay attention to how they interact and adjust the timing and balance until your groove pops just right. (van Dyk 2014)

> How do you create a groove? This simply needs to be discussed. I see alota producers hindering their growth from stickin to the grid. (Appendix C)

> So I know when I'm happy with my drums because they look like a nice fishbone. When they look just skeletal as fuck in front of me … I know they'll sound good. –Burial (Clark 2006)

Working entirely with waveforms in the grid-less, mid-1990s sound editing software *Sound Forge*, Burial's process is highly idiosyncratic, resulting in slightly loose rhythms that sound markedly different from his peers (Clark 2006).[91] To him, the visuals displayed on the computer screen are essential in the creation and recognition of a good drum groove.[92] While most producers do not utilize a fish-based template for creating danceable rhythms, I contend the graphics displayed on the computer screen have no less impact over how their grooves are created and conceptualized within the DAW.

Continuing from the previous chapter, I will illustrate various issues, concepts and ways of operating that are introduced into the creation of groove by the GUI's spatial representation of time. Through transcription, waveform visualization and rhythmic measurement, I will examine

[91] Alongside the lack of temporal grid, *Sound Forge* also restricts the user to manipulating two tracks of audio at a time. To create multitrack compositions, Burial must irreparably combine each new audio track onto one channel before he can load and begin working on a new layer of sound.

[92] There are many definitions for the word groove. However, for the purposes of this chapter, groove will entail a continuously repeating rhythmic pattern that strives to encourage dancing.

various ways that producers manipulate, sculpt and microrhythmically deviate the beginnings and the endings of their drum hits,[93] foregrounding how groove is spatially conceptualized and constructed through the influence of the computer screen. Expounding on these results, I will speculate on the possible function of these techniques and the effects they might have on the listener, in terms of anticipating, humanizing and widening the pulse in order to get people up and dancing.

To begin, I will study the manipulation of percussive attacks, focusing on the techniques of performance, placement and sampling utilized by many producers in the creation of grooves. In this instance, by outlining the commonly held correlation between going off the grid and more human sounding grooves, I hope to highlight how microrhythmic deviations form an important part of a producer's process. Next, through an analysis of one of Burial's fish bone grooves, I hope to show the interesting ways that his rhythms deviate from the rhythmic ideal visualized in the DAW. Further deliberating on Burial's process, I will then explore the 'head nod effect', asserting that, alongside the eyes and ears, the rest of the body is an integral part of the producer's recognition of a good groove. Then, I will study several commercial sample libraries, portraying how millisecond delays in certain proffered drum hits might serve to secretly add groove to a producer's rhythms. Displaying the intersection between the space of the computer screen and the body, I will also speculate on some of the effects these microrhythmic deviations might have on the listener, drawing on several scholarly viewpoints on the experience of groove.

[93] For a scholar writing about popular electronic music there is a challenge to describing its instrumentation. While EDM and hip-hop drum patterns are highly indebted to funk, rock and disco drum set rhythms, the traditional sounds of snare drum, kick drum and hi-hat are often replaced by a multitude of different sonorities. These sounds, although functioning in a musical context as a drum kit (grounding and embellishing the pulse of a composition), do not sound like traditional drums. Jeff Greenwald calls these sonic substitutions, "replacement sonorities," where sounds are replaced "sonically not functionally" (Greenwald 2002, 263). Therefore, throughout this chapter I will apply traditional drum set names to describe the panoply of replacement sonorities used in their stead.

Moving on, I will focus on decays, investigating various methods that producers utilize to shape and deftly arrange the tails of percussive notes in four-on-the-floor rhythms, creating anticipations that serve to draw the dancers into the beat. Then through an examination of sidechain compression, I will show how many producers prefer detailed visuals when crafting the anticipatory pumping effect that is the hallmark of EDM. Next, I will examine the negative space created by these sculpted decays, demonstrating that perfect decays beget perfect silences that can also function as rhythmic participants in a groove. Finally, I will end with an analysis of the rapid fire hi-hats created in trap hip-hop, unpacking many producers' belief that *FL Studio* is the best DAW for these stylistic flourishes and foregrounding my belief that these hi-hat patterns can function as anticipations, drawing the listener into important temporal locations.

In his monograph *Groove: A Phenomenology of Rhythmic Nuance*, Tiger Roholt problematizes the effectiveness of measuring "slight variations within a repetitive rhythm" (what he calls rhythmic nuances) as a way of comprehending grooves (Roholt 2014, 10). He writes that many theorists

> … apparently believe that by becoming more and more specific about nuances— by measuring nuances with scientific precision— we increasingly clarify the phenomenon. This view is what I am calling the analytical approach … (Notice that a measurement of timing nuances says nothing about their effects, nor how they are related to their effects.) An effective indirect description will have to reflect the importance of nuance objectives. (ibid., 26; 32)

While the measurement of timing nuances might not reveal much about a groove's effects on the listener, utilizing this analytical approach with DAW-created grooves does provide insight into many producers' processes as visual measurement is an important part of their workflow. Producers may not be perpetrating an empirical investigation of their rhythms, measuring and notating the millisecond deviations they incur when composing; however, when moving

individual hits slightly off time, many are definitely zooming in and visually measuring their grooves in relation to the grid. Nonetheless, like Roholt, I am also interested in the objectives of these rhythmic nuances, fascinated by the ways the effects of these microrhythmic deviations are conceived of by producers when filtered through the particular visualizations of the DAW. Thus, in this chapter, I will do both, measuring the microrhythmic deviations present in computer-created drum grooves, citing some online conceptions on the effects of these rhythmic nuances, and then, drawing from the groove-based literature to speculate on their particular effects on the listener.

Performance, Placement and Sampling

Many analyses of groove are focused on performing musicians. As Charles Keil asserts, groove is found in "the little discrepancies between hands and feet within a jazz drummer's beat, between bass and drums, between rhythm section and soloist" (Keil 2005, 98). To Keil, a groove is created by the participatory discrepancies in a performance, the intended and unintended temporal shifts incurred when a body is in motion playing an instrument. These participatory discrepancies do not occur during the process of DAW producers placing rhythms into their projects with a keyboard and mouse. Yet, many producers do profess to performing their rhythms with a MIDI controller to insert some of these discrepancies into their grooves. As one Redditor claims, performing rhythms creates "those tiny micro-errors that real live musicians make" (Appendix C8). These slight timing errors and off-grid notes create a more human and less robotic feel, and according to many, "will automatically sound better than drawing stuff in on some sort of grid" (Appendix C12). With this method, the manipulation and editing tools of the DAW come into play when selecting the perfect loop. Redditor *Racoonie* writes,

> … lower the tempo dramatically when recording drums (or anything for that matter), down to 60 or even 50 bpm. This helps a lot in getting a good groove and you won't have to quantize as much. practice and then record a lot of bars and then cut and use the good ones. It usually takes a while to get into the groove, so don't expect to hit record and record amazing 4 bars on the first try. do not simply layer samples on one pad, split them across different pads and then hit then with some extra sloppiness. This makes your snares sound much more lively … (Appendix R1)

With this method, producers can listen back to their recording session and choose their favourite sloppy loop, rife with participatory discrepancies. However, the producer is most likely performing with a metronome, and while individual hits might slightly wander from the grid those that stray too far are often captured and quantized.

While the performance of drum rhythms is a fairly popular method for DAW producers (particularly in certain styles of hip-hop which often value a looser feel), there are many other ways of creating grooves that are less indebted to performance and reveal the influence of the computer screen. For instance, online, groove is usually understood as the placement of the sound object in relation to the grid. While I have previously asserted that working with the DAW can be viewed as a form of performance, I believe Keil's concept of participatory discrepancies does not address some of the issues present in the producer's process of moving, navigating and tweaking sounds on the fly as a composition is being played. Speaking of how the recording studio problematizes Keil's term, Zagorski-Thomas claims,

> I find that the nature of the participation involved in Keil's participatory discrepancies is not altogether clear when we come to study recorded performance. Can we participate with a click track in the process of musical production? Were Stevie Wonder and Mike Oldfield participating with themselves when they recorded Innervisions and Tubular Bells? Does participation have to happen in real time or can the editing process on a computer constitute participation? If the discrepancies from 'strict' time are normalized through programming on a computer, the 'groove quantize' on a sequencer or the use of a sampled loop of

> ‘live’ performance do they cease to be discrepancies? (Zagorski-Thomas 2007, 328)

Therefore, for the rest of this chapter, instead of participatory discrepancies, I will be utilizing the terms microrhythmic deviations. Kvifte discusses the utilization of this term in performance:

> The basic premise for research into microrhythmic phenomena is the belief that we do not play any rhythm exactly as it is, or could be, written in standard notation. Further, deviations from the mathematically simple and exact values of notation fall into two categories, namely random variations due to imperfections on the part of the performers or the equipment, and systematic variations that are important as part of the style, and/or important for the rhythmic feeling…One hesitates to use terms such as "deviation" or "variation" to describe these patterns as the patterns that are described are not perceived as necessarily deviating from a norm. (Kvifte 2007, 65)

While it might not be a suitable term for the performing musician, categorizing these subtle rhythmic nuances as microrhythmic deviations captures the influence of the visual representation of the DAW when discussing the ways producers construct grooves. For many performers, these rhythmic nuances are not considered deviations, they are the norm. Strict musical time that conforms to the limited subdivisions of common musical notation is the deviation. Conversely, quantizing notes into the precise visuals of the grid is the norm for many producers; anything that goes off the grid is a deviation.

In the producer community, creating these microrhythmic deviations by placing sounds off the grid is often considered as a method to create a more human feel. As one Redditor mentions, “try to misplace some notes or hits outside of the grid … so everything doesn't hit simultaneously. This makes it more humanized…” (Appendix R2). However, these humanized

rhythms are still conceptualized in relation to the grid. Even when avoiding the grid, producers use it as a reference. It is the dominating spatial referent when creating grooves. Kvifte observes,

> … software has extensive possibilities for the manipulation of micro-timing, but, with very few exceptions, micro-timing is always seen in relation to a regular or mechanical grid of metric subdivisions. (Kvifte 2010, 214)

When speaking of grooves, performing musicians also utilize a spatial metaphor for musical time. Common in jazz and popular music, musicians often speak of playing "before the beat, after the beat, or on the beat" (Friberg; Sundströöm 2002, 334). Cox maintains that in spatial metaphors of music where "times are conceptualized as locations … anticipated events become located 'ahead', present events become located 'here', and remembered events become located 'behind" (Cox 1999, 199; 7). Furthermore, this spatial orientation occurs in the "imagination of the embodied listener in the conceptualization of musical experience" (ibid., 8). This embodied spatial metaphor is utilized by Redditor *psychedellosaurus*:

> If they're sounding really robotic, sometimes I will put the snare/clap slightly ahead of or behind the 2 and 4 … And if I have multiple snares or claps I'll leave one maybe on the 2 and 4, and move the other slightly ahead to give kind of like a "Flam" feel to it. (appendix R3)

Here, we see moving sounds ahead or behind the beat as a method to make a groove sound more human and less robotic. This metaphor is also frequently changed so that the grid lines—the DAW's visual representation of the beat—are used instead as the reference point. In these instances, we see the embodied ahead and behind metaphor is replaced with the orientation of left and right:

> You don't need to shift things far - a couple tiny milimeters to the right or left of a grid line should do the trick. Play around with it until it sounds right. (Appendix R4)

> Put your kick, snare, and hi hats on separate tracks … Now grab all your hats at one time and bump them to the right, grab all the snares and bump them to the left … Adjust until you get the right swing you want, move them more for a looser feel. (Appendix R5)

Thus, the embodied spatial metaphor common in performed music is replaced by the spatial relationship conceived in the DAW; in this instance, vision holds sway over bodily sensation.[94] Not all DAW created grooves are tightly quantized. Moving notes around the grid is an integral part of the process of creating tracks but the grid is so dominant in the producer's process that they are often seen as deviations. As one of Duignan's informants observes,

> the grid is exactly divided, but to get a good groove you often need to move certain elements of the track slightly ahead or behind of the beat. I achieve that either by getting it right beforehand in the sequencer, or I will use the nudge function in Pro Tools. (Duignan 2008, 219)

Nonetheless, by utilizing the groove templates feature provided by many DAWs,[95] producers do not have to manually move their beats on or off the grid because they are provided with the ability to sample other grooves. Groove templates are algorithms that serve to analyze the temporal placement of notes in a phrase or loop, extracting the distance the notes deviate from the quantized norm and allowing producers to apply those timing deviations to their own rhythms. Moreover, most DAWs provide premade groove templates. For instance, some grooves in the *Ableton Live* library are sampled from old digital samplers from the 1980s and 90s. One of the most popular groove templates is from the Akai MPC line of samplers, as many producers

[94] Online, many producers will use one form of orientation (left, right or ahead, behind), while others seem to use these terms interchangeably. One instance could be in instructing how to create a groove (conceptualizing it in terms of the DAW—left and right) versus describing a groove (conceptualizing it in terms of the listener—ahead and behind). Yet, this is not always the case.

[95] Called "groove templates," "Groove files," "DigiGroove templates" or "Groove quantize presets," in various DAWs (Apple 2013, 330; Ableton 2015, 178; Avid Technology 2015, 615; Bachmann et al. 2015, 241).

consider them to be the "the best around when it comes to groove and timing" (Scarth; Linn 2013). Created by Roger Linn, the MPC samplers allow producers to swing their straight rhythms, creating a triplet subdivision for their entire composition or selectively applying degrees of swing to different patterns. According to Linn,

> my implementation of swing has always been very simple: I merely delay the second 16th note within each 8th note. In other words, I delay all the even-numbered 16th notes within the beat (2, 4, 6, 8, etc.) In my products I describe the swing amount in terms of the ratio of time duration between the first and second 16th notes within each 8th note. For example, 50% is no swing, meaning that both 16th notes within each 8th note are given equal timing. And 66% means perfect triplet swing, meaning that the first 16th note of each pair gets 2/3 of the time, and the second 16th note gets 1/3, so the second 16th note falls on a perfect 8th note triplet. The fun comes in the in-between settings. For example, a 90 BPM swing groove will feel looser at 62% than at a perfect swing setting of 66%. And for straight 16th-note beats (no swing), a swing setting of 54% will loosen up the feel without it sounding like swing. Between 50% and around 70% are lots of wonderful little settings that, for a particular beat and tempo, can change a rigid beat into something that makes people move. (Scarth; Linn 2013)

This usage of percentages to control the amount of swing is also the method adopted for use with groove templates in various DAWs (Apple 2013, 336; Ableton 2015, 179; Bachmann et. al 2015, 238; Avid Technology 2015, 619; Dambrin et al. 2015). Producers can control the amount of rhythmic deviation applied to their track through a percentage scale. One effect of this process is that for many producers, swing is understood not as a triplet subdivision, but as a percentage or as a method of placing notes off the grid to create a human feel. The following Reddit discussion details this particular conception:

> NyoZa: What does swing do again?
>
> MIDI_Hendrix: In music terms, the word "swing" refers to a bouncing groove that can be created in the rhythm of music. This can be achieved with any instrument but usually happens in the bass and drum parts of a music arrangement. A primary example of this sound

> would be the swing style of jazz music that was popular in the 1930s.
>
> NyoZa: Wait, so swing incorporates swing? This is really cool.
>
> MIDI_Hendrix: Yes, there is(?)/was a whole genre called "swing music". In today's eyes, swing is just what the groove is called. In hip hop production, swing is basically unquantizing your programming so it gives your drums/bass a more "human-esque" feel/groove...IMO you should add some swing to your drums and bass on all of your tracks. It just feels more natural that way. I tend to add 9-21 percent on all of my tracks. Sometimes I vary from my norm, but I tend to stick with that range. It really just depends on what I feel is right. (Appendix R6)

Often producers will avoid groove templates and perform a visual analysis of other grooves themselves. Similar to the method of utilizing commercial songs as templates discussed in the previous chapter, these producers will put a commercially released groove into their DAW and then visually line up the attacks of their own rhythms with those of the imported groove. A Redditor details this process where popular grooves can be learned by their sounds and by the patterns they trace on the screen:

> Whatever it is you're trying to do, find examples of it and copy it, drum for drum. After you do this for a few beats /songs you should start picking up on patterns. Different styles are defined by different rhythmic patterns and ideas but [you'll] be able to pick up on them if you're paying attention. (Appendix R7)

Once again, visual and sonic modalities combine to create a situation of analysis and learning.

Many producers believe that overly relying on quantization stifles the learning process as producers cannot develop their own unique sense of groove:

> … challenge yourself in this way: don't quantize ANYTHING on your next beat. or how about, not even on any of the next beats you make for the next few weeks. just leave quantization out ENTIRELY. see what happens. I predict at least 2 things will happen. First, you'll be forced to develop a better sense of rhythm without relying on crutches. Second, you'll realize what YOUR sense of rhythm actually is.

> Fans can tell a Dilla beat from a Madlib beat from a Pete Rock beat or a Preem [DJ Premiere] beat based on certain characteristics they had as producers. You need to hone YOUR characteristics…once you have good rhythm and know what your sense of rhythm is like, THEN you'll know when to apply some quantization and when to let that rhythm out of the cage. key concept is BALANCE! (Appendix R8)

Thus, to the above Redditor, producers can develop their own recognizable time feel by not letting the software do too much of the quantization work. Where producers place their drum hits can be an identifying feature in their music. According to Iyer,

> in groove-based contexts, even as the tempo remains constant, fine-scale rhythmic delivery becomes just as important a parameter as, say, tone, pitch, or loudness. All these musical quantities combine dynamically and holistically to form what some would call a musician's "feel." Individual players have their own feel, that is, their own ways of relating to an isochronous pulse. (Iyer 2002, 398)

For many producers, fine-scale rhythmic delivery is replaced by fine-scale visual placement, as quite often a producer's 'feel' is defined by where they place their drum hits in relation to the grid.

One producer who definitely has his own time feel, independent of the grid, is Burial. In his song "Raver," Burial's approach to creating a common four-on-the-floor dance groove—in which the kick drum hits on every quarter note, the snare on two and four and the hi-hat on the "and" of every beat—reveals the slightly loose and un-quantized style of his drum rhythms (Burial 2007). Mark J. Butler writes that four-on-the-floor

> … comes from rock, in which a performer playing a drum set would need to depress the foot pedal on the bass drum (the "kick" drum) four times per measure in order to play a four-quarter-note pattern. (Butler 2006, 78)

As I am discussing the influence of the DAW's visuals in the creation of grooves, I thought it a fruitful exercise to place one of Burial's grooves in the DAW to measure his

microrhythmic style. In this way, I hope to reveal the ways Burial's self-proclaimed visual style of groove deviates from the omnipresent grid of the DAW.[96]

Beatport, the online "principal source of music for DJs," has the tempo for "Raver" listed as 124 bpm (Beatport 2015). One indication that Burial does not utilize the grid is that the 4-on-the-floor drum loop for his track is actually 7 ms short of 124 bpm.[97] Due to that 7 ms deviation, the track quickly drifts from the listed tempo, a possibly confounding experience for a DJ attempting a transition from "Raver" to another track at 124 bpm.

Even more interesting, Burial's groove has fluctuations that do not follow the usually quantized character of 4-on-the-floor percussion. To portray these fluctuations, I measured the spaces between the attacks of successive kick drums and hi-hats, what London calls their interonset intervals (IOIs) (London 2004, 4). In a perfectly quantized 4-on-the-floor groove at 124 bpm, the IOI is an equidistant 484 ms (a quarter note) between each kick drum on the downbeat as well as each hi-hat attack on the 'ands'. In contrast, in "Raver," the IOI between the kick drums on beat one and two is 12 and 13 ms shorter than the IOIs of the following two kick attacks on beat three and four. More dramatically, the IOI between the kick on beat four and the loop's return to beat one is 23 and 24 ms shorter the IOIs between beat 2 and 3 as well as 3 and 4 (See Figure 5.1). This means, in comparison to the quantized ideal, each kick attack's IOI (in order) is 6 ms shorter, 7 ms larger, 8 ms larger and 16 ms shorter than a quarter note at 124 bpm. When looped, the first and the second kick hits of the "Raver" drum groove are rushed in

[96] Utilizing *Logic*, I measured the attacks between drum hits in the opening section of "Raver," where the drums play by themselves for four bars. These measurements were consistent for all four of the bars. As I could not discern the exact location of the snare that hits in concert with the kick drum on beats 2 and 4, I have omitted it from my transcription; nonetheless, I believe this does not effect this particular analysis of Burial's groove.
[97] A bar of 124 bpm is 1,936 ms in length, burial's bar long drum loop is 1,929 ms.

comparison to the kicks on beats 3 and 4, creating a slightly lopsided pattern that subtly slows down in its back end before rushing the return to beat one.

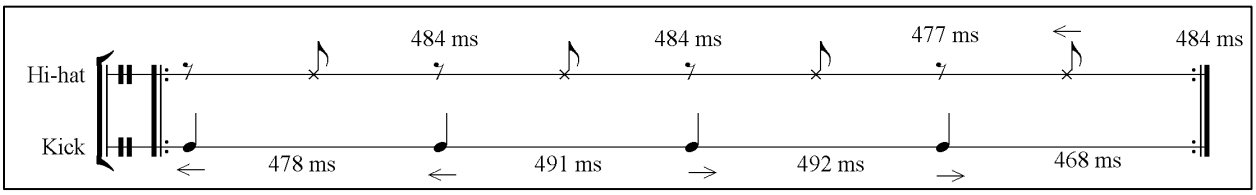

Figure 5.1: The IOIs in Burial's "Raver" groove
Left arrows denote rushed attacks, right arrows delayed attacks.

This lopsidedness is accentuated by the hi-hats, which have IOIs that correspond exactly with a four-on-the-floor groove at 124 bpm (484 ms), except for the IOI between the 'and' of three and the 'and' of four, which is 477 ms. By placing the hi-hat on the 'and' of 4 consistently ahead of its three earlier counterparts, Burial is providing a slightly rushed counterpoint to the delayed kick drum on beat 4. The rhythmic irregularities of this loop could be the result of Burial placing each kick and hi-hat sample individually by hand, without the guidelines of the grid. Yet, the equidistant nature of the first three hi-hats seem to point to the fact that Burial is aware of the visual location of a perfectly quantized 4-on-the-floor groove and is intentionally playing off of it.

Whether the rhythmic idiosyncrasies of this groove are intentional or not, they are definitely not emblematic of the music created by the majority of my informants within the DAW. First off, the lopsided nature of Burial's loop, with an abbreviated IOI between beat four and the return to beat one is not easily afforded by the equidistant grid lines of the DAW. This loop would visually run afoul of the grid after a few repeats, making the arrangement of an entire composition, cutting and pasting and arranging modular parts, a challenge. Moreover, while online many producers do discuss moving percussion hits off the grid, with a 4-on-the-floor groove, the kick drum (as marker of the pulse) is deemed to be the one voice that should be

quantized (Appendix R17). With this track, Burial seems to be creating a slightly loose version of the perfectly quantized pulsations emanating from countless nightclubs. Even Burial admits his inability to create conventional dance tunes: "one day I want to make a tune people can have a dance to, I've tried" (Clark 2006). I believe the nature of Burial's grooves are a result of his unique rhythmic style just as much as his gridless tools. Yet, examining his grooves does provide some insight into the creative process of a producer who is not beholden to many of the dominant visual dictates of the DAW.

While Burial's groove does have an un-quantized feel, it does stick fairly close to the consistent rhythms demanded of most commercial dance music. I can speculate on several reasons for this consistency. Perhaps Burial's visual cue of a groove as a "nice fish bone" is highly detailed and provides a fair amount of spatial consistency when building a groove (Clark 2006).[98] In my mind, a more likely scenario is a multimodal combination of hearing and vision. His eyes confirm the fishbone shape but what the groove sounds like also holds high priority. Burial states that his drums are

> … definitely not necessarily in time. When I try and do drums that are too regimented, they lose something. But the moment I put drums where I think they sound good, rather than in time, they seem to have that roll, the swing of the jungle and garage tunes I love. (Clark 2006)

Placing drums where he thinks they sound good seems to be a combination of visual and sonic modalities. The placement and the shape of the groove is visual, which is then confirmed by his ears.

[98] Also, he could be exaggerating the amount he relies on visuals in his process; however, as I have no further information, I am proceeding as if he is telling the truth. I contend there is an unique, organic character to his grooves that distinguishes him from many of his peers.

A third element possibly deployed by Burial in recognizing a good groove is his body. Many producers discuss the head nod (or bob) factor when listening to grooves (Appendix S). As one producer claims, "don't forget about the groove - if you can't bob your head to your track it needs work" (Appendix S1). Parkinson believes that this type of embodied listening

> … lets us consider how all of these 'superfluous' or non-musical actions that make up our musical experiences, whether they be the strange plethora of facial expressions coming from some jazz drummer, the head-nodding of an otherwise static laptop performer, or the wild hand gestures of a passionate vocalist can be seen as essential to the processes of listening and playing, and the lived totality of the music as it is experienced by an embodied mind. (Parkinson 2013, 164)

Many producers assume a similar posture when composing, hands on the mouse and keyboard, bobbing their head in time to the music while still keeping their eyes on the screen.[99] This is an incredibly common stance that can be seen in countless online videos of producers working on *YouTube*.[100] When creating a good groove, the body has to confirm the findings of the eyes and ears. Roholt writes,

> … we come to understand a groove through an activity of the body. The activity I have in mind is, at a minimum, moving some part of one's body to the music's pulse. This is the kind of movement musicians and listeners regularly display…foot-tapping to the pulse, head-bobbing, swaying, finger-snapping, and so on. Notice that, on my view, the role of body movement is very different from the way these movements are often characterized, where a movement is considered to be an effect caused by the music. (Roholt 2014, 106)

Roholt's conception of a groove as having to be understood by the body resonates with producers working with the DAW. The head nod is the body recognizing a groove and if producers are not automatically driven to nod their head to their track, it needs more work. While

[99] I assume for many, their feet are tapping as well; however, in the many videos I have viewed on *YouTube* none have deigned to show the producer's feet.
[100] The *YouTube* series "Rhythm Roulette" provides an excellent sampling of popular producers and their various styles of head nods (Mass Appeal Records 2006).

he does not mention it, I believe Burial's body serves a role in confirming the success of one of his fishbone grooves. According to Roholt,

> to "get" a groove (to understand it) is not to apprehend it intellectually, in terms of a set of propositions or concepts; rather, to understand a groove just is to feel it … feeling a groove, and understanding it, does not occur in thought, nor in listening alone, but through the body. (ibid., 2)

The rhythmic nuances of Burial's "Raver" loop are extremely slight when compared to the quantized ideal; nonetheless, he maintains his rhythms are not danceable. This could very well be because the microrhythmic fluctuations in his grooves are not understood intellectually, but are grasped by the body and found wanting by dancers encultured to traditional EDM grooves.[101]

Libraries

Another instance of this type of microrhythmic variation crops up in the drum samples provided by commercial sample libraries. Alongside loops, many companies sell vast collections of perfectly edited waveforms of instrument samples and drum hits. Many producers utilize these packs to construct and perform their own rhythms utilizing professionally created sounds. While there is the occasional comment on Reddit voicing contempt for producers who utilize these libraries instead of synthesizing or sampling their own sounds; many believe composing with premade sounds is a negligible shortcut to creating excellent tracks:

> It depends on the style I'm going for but I use samples sometimes. Aaaaand if someone can be #1 on Beatport using samples and you can't, you can't say shit. Sorry. (Appendix U4)

[101] There are many producers and listeners who do grasp and enjoy Burial's microrhythmic style. There is even a Burial subreddit where producers and enthusiasts can discuss his music (Reddit 2017c).

Often, producers will utilize virtual samplers,[102] bundled with the DAW or purchased separately, to organize these audio samples within the MIDI environment. With these samplers, the producer can insert waveform samples into a MIDI track for performance with a keyboard or construction within the piano roll. For instance, when creating a drum kit, producers can link each key on the keyboard to a different drum sound from their sample library (Middle C is the kick drum, D is the snare, and so forth) and the results are visually represented with MIDI notation in the piano roll. This tidies up the visuals of a producer's process, allowing them to work with the clean lines of MIDI notation instead of the more visually complex waveforms in the creation of a drum groove. When constructing a drum kit, producers could easily drag audio files from a commercial sample library into their sampler and perform or build a groove without viewing any waveform representations. Interestingly, through this process, I believe creators of sample libraries can covertly provide microrhythmic deviations for their users. For example, when examining three sample libraries (the Vengeance EDM sample pack, as well as two created by popular producers Lex Luger and Deadmau5), I found several instances of hi-hat hits that had brief silences inserted at their onsets, creating a delay before the hi-hat sound is triggered (Luger 2015; Deadmau5; Duda 2008; Efx 2017). Three of the most delayed hi-hat samples had spaces from 22 to 61 milliseconds before the hi-hat hit sounded[103] and there were others that were delayed 2-10 milliseconds (See Figure 5.2). This means that if a producer places one of these

[102] These bundled samplers are called "Structure Free" in *Pro Tools* (Digidesign 2008); "EXS24 sampler" in *Logic* (Apple 2015, 165), The "Channel Sampler" in *FL Studio* (Dambrin et al. 2015); or the "Simpler," "Sampler" and "Drum Rack" in *Ableton Live* (Ableton 2016, 482; 456; 272).

[103]Delayed hi-hats were not an extensive phenomenon in the libraries analyzed, 4 out of 26 hi-hats in the Lex Luger sample pack were delayed, 44 out of 316 in the Deadmau5 pack and 50 out of 991 in the Vengeance library (See figure 5.2. for a visualization of a few of these delays). Yet, I believe, the fair amount of detail that goes into the editing, sculpting and labelling of the sounds in these libraries means that these delayed hi-hats were placed purposely and were not a result of sloppy editing. One delayed hi-hat could be seen as a mistake, forty or fifty, not so much. An intensive examination of more sample libraries, cataloging the positioning of other instrument hits would be a task for another scholarly analysis.

delayed hi-hat samples into their sampler and aligns its MIDI notation perfectly with the grid, the hi-hat will still consistently trigger with a double digit millisecond delay. In this case, the visuals are misrepresenting the sounds coming out of the speakers as the waveform delays present in these hi-hat samples are hidden from view behind the monochromatic shell of midi notation. I believe these short delays have an affect on perception of the groove and in many cases can be sensed by the body. The producer might not intellectually know why they prefer this delayed sample over others, but they can feel it. An informant of Duignan applies this method to his own samples when composing, stating, "to make things feel sloppy and loose on snares and stuff I'll always leave a little bit of air on any of my samples so it leaves things late" (Duignan 2008, 218). Or as one Redditor writes,

> I quantize everything for the sake of perfect mixes, but because my drum samples aren't store bought and perfectly cut by a soulless algorithm, I can get the unquantized feel by leaving a bit of space before they start in the sound file itself. (Appendix R9)

It seems many soulless store bought drum samples seem to utilize this method as well. Furthermore, instead of having a silence inserted at their onset, certain hi-hat samples had a gradual sloping of their attacks, creating a crescendo into a more perceptible hit located further away from the grid.[104] These hi-hat with sloping attacks might have some connection to the sounds created by a performing drummer, playing with a slightly open hi-hat, which causes a slightly washy cymbal sound, blunting the sharpness of the initial attack and creating a wider decay. Also, the different kinds of delayed hi-hat hits could be utilized to avoid having the kick drum and the hi-hat hitting at the same time. As one online instructional article advises, "when

[104] External drum machines and drum machine emulators within various DAWs all have an attack knob, that allows the producer to delay the main attack of any drum sample, creating sloping hits just like the ones viewed in these sample packs.

multiple similar elements hit at exactly the same time…try nudging one of them slightly forward using channel delay to give a more exciting and natural sound" (Computer Music 2009). Another reason for placing the hi-hats behind could be to create a wider downbeat in the drums. Speaking of producers over-quantizing recordings, producer Joe Barresi states,

> imagine this is a piece of tape and here's the kick drum in the middle. The bass is going to be a little bit behind, over here, and the guitar player will be a bit ahead, over to the right of the down beat, and essentially your entire downbeat will sound huge! The moment you start looking at music you start lining things up and your down beat is small again. There's none of that push and pull that makes music come alive. (Phillips 2010, 271)

To some extent, I believe this problem of over-quantization is being thwarted by sample library creators covertly selling slightly off-time percussion hits. The producer does not have to worry about moving graphics on and off the grid as the sample library has done it for them. Referencing the microrhythmic variations in various parts of a James Brown funk groove, Danielsen writes, "the correct location—the core of the beat—becomes more a center of gravity or concentration of energy than a fixed point in a metrical framework" (Danielsen 2006, 79). Perhaps these delayed hi-hats are a way of creating a more expansive downbeat, fashioning a larger center of gravity by microrhythmically delaying off the main pulse.

In fact, in her analysis of Michael Jackson's "Don't Stop 'til You Get Enough," Danielsen provides an excellent example of a stylistic microrhythmic deviation that, I believe, correlates to these delayed hi-hats:

> As in previous funk-related black music, the first beat, or "One," exerts a gravitational pull upon the slower and lower-frequency layers of the groove. This pull is enhanced by the specific design of the sounding gesture that occupies this structural position—it attacks slightly early relative to the "center" of the One in an example of a "downbeat in anticipation" …A "downbeat in anticipation" is a gesture with a typically snappy attack: it feels slightly syncopated, as if it is both

> early and too short at the same time. This attack "anticipates" the downbeat, that is, the part of the beat where the energy is centered. It is a crucial stylistic feature of funk and a gesture that is extremely movement inducing, largely because the early attack hits the body unawares. (Danielsen 2012, 156)

Thus, by deviating from normal temporal rhythm and putting the downbeat earlier, the Michael Jackson track is anticipating the beat one, creating a crucial stylistic feature that induces dancing. Nonetheless, when creating loops in the DAW, placing an instrumental hit slightly ahead of 'beat One' can be done, but it greatly complicates the looping process. In a one bar loop, an early hit on beat one is actually a late hit after beat four. If the kick drum hit on beat one starts early, the producer will have to move the hit to the end of the loop, making it trigger in the few milliseconds before the loop returns to its beginning. This also means that without intervention by the producer, the first iteration of the loop will have a kick drum that does not sound, as the first kick hit is located at the end of the loop. When creating drum loops, this situation can be remedied by conceiving of the kick as perfectly on time (right on the grid line) and moving everything else back. Thus, in relation to the other elements in the loop, the kick is ahead, while still locking perfectly with the grid. This is echoed by a Redditor, who claims when creating grooves, the "hi hats should hit just behind the right timing" (Appendix R10).

Sample libraries cannot provide a drum hit that sounds before the beat, they can only provide microrhythmic deviations by delaying their samples. A delayed hi-hat sample triggered with a kick drum will consistently place the kick a few milliseconds ahead, in an anticipatory location, creating a stylistic drive that can be recognized by a dancing body and a head nodding

producer. Moreover, the fact that the majority of the kick samples in the examined libraries fall precisely on the downbeat, seems to prove this thesis.[105]

Speculating about the neurological connection to groove in drum performance, Iyer cites a study by Fraisse asserting that when participants were asked to finger tap or foot tap with a consistent beat, the hands would anticipate the sound by 30 milliseconds and the foot would anticipate by even more. Thus, neurologically we have a tendency to put our foot ahead of our hands when synchronizing with an external rhythm. Iyer states that this

> … seems to predict that a regularly alternating stomp-clap pattern would contain a microscopic asymmetry similar to that found in the modern backbeat. Given that the bass drum both references and is played by the foot, and similarly the snare drum both points to and involves the hand, it is possible that this resultant delay structure was transferred to the drumset. (Iyer 2002, 407)

In line with Iyer's assertion, there were a sprinkling of delayed snare drums throughout the examined sample libraries.[106] However, he does not discuss whether the drummer's other hand, playing the hi-hat, is susceptible to this same delay. Butterfield refutes Iyer, suggesting that

> … backbeat delay is not an inevitable consequence of our physical makeup, as Iyer proposes, but a preferred timing pattern actually chosen for its expressive influence on anacrusis produced at the syntactical level. Each groove pattern has a particular syntactical shape, and this shape directs energy toward closure with greater or lesser force.
>
> The groove pattern also induces certain tendencies in backbeat timing, however, which can either enhance or temper the effects of syntactical shape. Some grooves seem to call for backbeat delay, and others backbeat push…Backbeat timing can then be varied for strategic purposes. Pushing the backbeats to the top of the beat can add energy at crucial moments in a performance without rushing the tempo;

[105] With kick drum samples, 4 out of 30 were delayed in the Lex Luger library, 5 out of 894 were delayed in the Vengeance sample pack and 0 out of 420 in the Deadmau5 library. The delays were no larger than 5 ms.
[106] For snares, 99 out of 824 were delayed for the Vengeance sample pack, 62 out of 155 for Deadmau5 and 1 out of 17 for Lex Luger.

> conversely, laying back on them can dissolve some of that energy as the need arises. (Butterfield 2006, 255)

Many of the delays provided in the sample libraries could be examples of stylistic conventions. The libraries that cater to EDM, where the kick drum is the rhythmic foundation for the dancers, had the fewest kick drum delays (including zero delays for the Deadmau5 library). Moreover, with the four-on-the-floor rhythm in EDM, the kick and the snare hit at the same time on the 2 and the 4. Producers often think that moving "… the snare hits a little late, can get you a little extra groove" (Appendix R11). This is reflected in the Deadmau5 sample library where all the snare delays were about 5 milliseconds in length. This means that the snare hit will trigger just after the sharp attack of the kick drum, preventing the attacks of the kick and snare from clashing. It is quite possible that the delays in these sample packs are not accidental, the creators of sample libraries are aware that microrhythmic variation is part of the stylistic conventions of various genres and, in certain cases, are clandestinely adding these variations whether the producer wants them there or not.

Another type of delayed hit is present in the sample libraries' clap hits. In this instance the majority of the clap hits are slightly delayed with multiple different claps hitting at different times (See Figure 5.3). These samples mimic the messy procedure of multiple people clapping along with a track. In certain packs, the Vengeance sample library even measures these participatory discrepancies for the producer by putting the amount of millisecond delays in each sample's title (Refx 2017). When placed on top of the snare on two and four, the backbeat becomes larger as the claps create a rapid flam behind the snare hit.

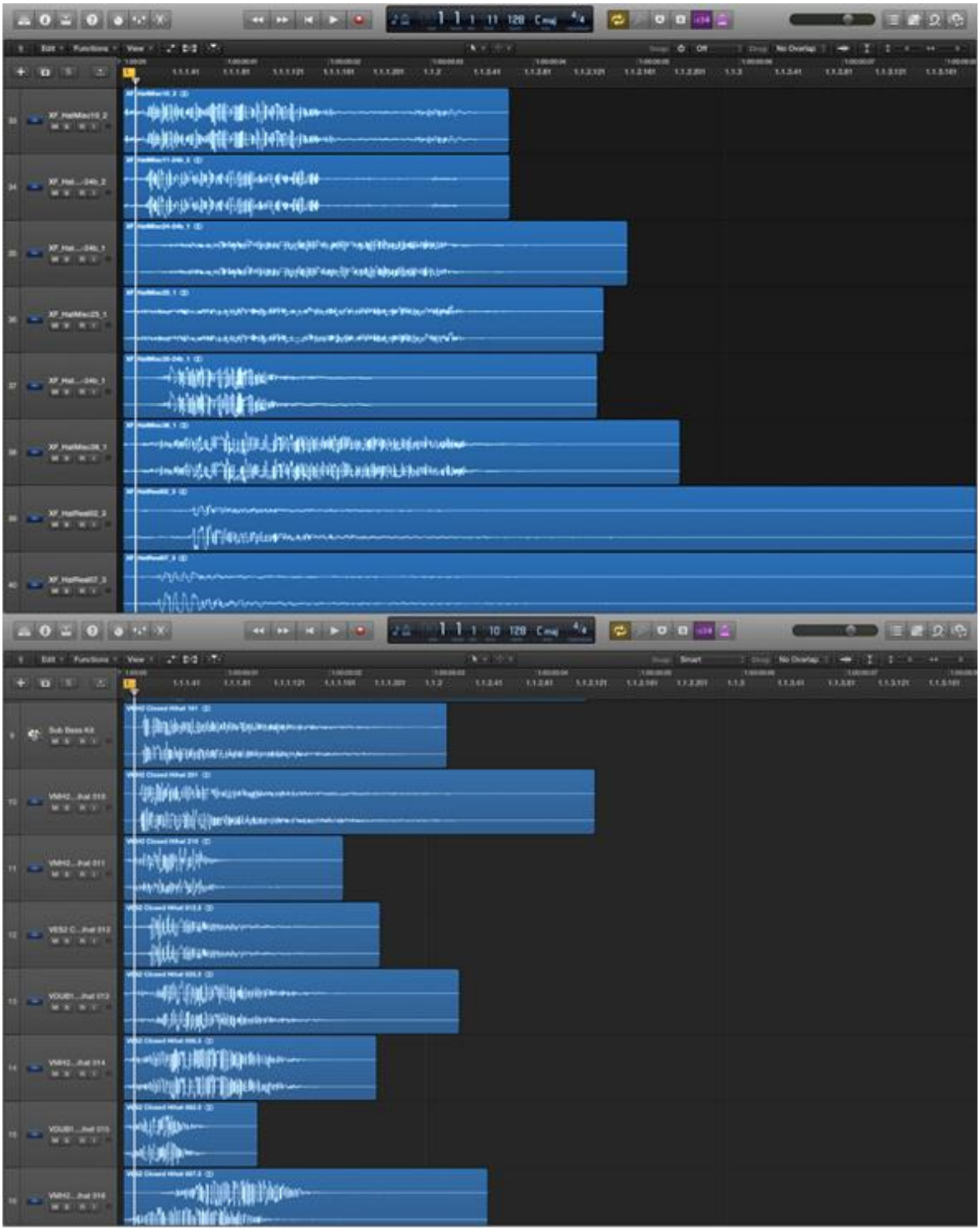

Figure 5.2: Hi-hat delays in Deadmau5 sample pack (Top), Vengeance sample pack (bottom).

The highlighted section and the playhead denotes 5 ms.

Here, this process is described by a Redditor:

> I've been recording a sample pack with claps and snaps. The thing you really want with this sounds is the flam effect, that is for two sounds to sound really close, but not at the same time, so you hear a snappy sound twice, not a hard hitting impact, but sort of like a "tra" sound. (Appendix R12)

Danielsen discusses a similar phenomenon in the percussion of Michael Jackson's "Don't Stop 'til You Get Enough":

> … these percussion sounds never fall exactly on these four beats but always precede them slightly, attacking about ten to thirty milliseconds early…This means that all the pulse beats are extended, destabilized, or simply made more dynamic by way of percussive sounds that are placed very close to, but not entirely on the beats.
>
> This aspect of the groove is on beats 2 and 4, audible as "flames[107]"—that is, the percussion sound and the snare drum are very close but still far enough apart (twenty to thirty milliseconds) to hear that the combined sound consists of two separate sounds. These make up the typical "wet" sound associated with the backbeat of a disco groove (which usually derives from clustering the snare drum with handclaps or another percussive sound). (Danielsen 2012, 157-158)

Once again, we see the limitations of the sample libraries. While providing flammed hits, they cannot provide hits that are ahead of the beat, the producer must manually move them ahead to create these anticipatory rhythms. As one producer attests,

> … I typically get a snare sample then two clap samples and space them apart ever so slightly. What i mean is that I may put the snare on the beat, while one clap is slightly before the beat and the other clap is slightly after the beat. You'll know when you do it right because it feels like the sound is one, except it sounds larger. It makes it sound more organic as well. (Appendix R13)[108]

[107] I am not sure of this terminology, as a drummer I have always utilized the term as "flams," so I will call them such.

[108] Figure 5.4 shows a screenshot of Mr. Bill's arrange window displaying this flam effect on the backbeat (See Figure 5).

For a researcher of grooves, it is a challenge to analyze commercially released tracks, where multiple sounds hitting at once tend to obscure the onsets of percussive notes. I believe sample libraries, filled with individual loops and hits geared towards particular styles of electronic music, are an untapped area of research that can reveal many more microrhythmic secrets to the interested scholar.

Whether purchased, performed, placed or sampled, microrhythmic deviations are an important aspect of creating a danceable, humanized groove within the DAW. In these instances, visual, auditory, as well as bodily perceptions, combine in the comprehension and recognition of good groove. While in this section I have focused on note onsets, another highly important element in the visually influenced creation of drum grooves is present in note decays.

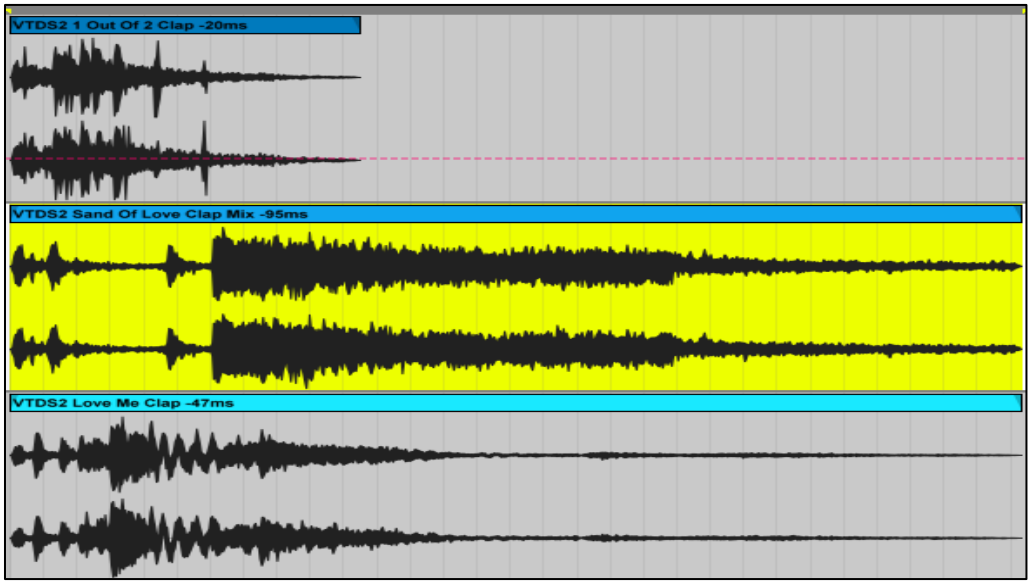

Figure 5.3: Messy claps from the Vengeance sample pack.

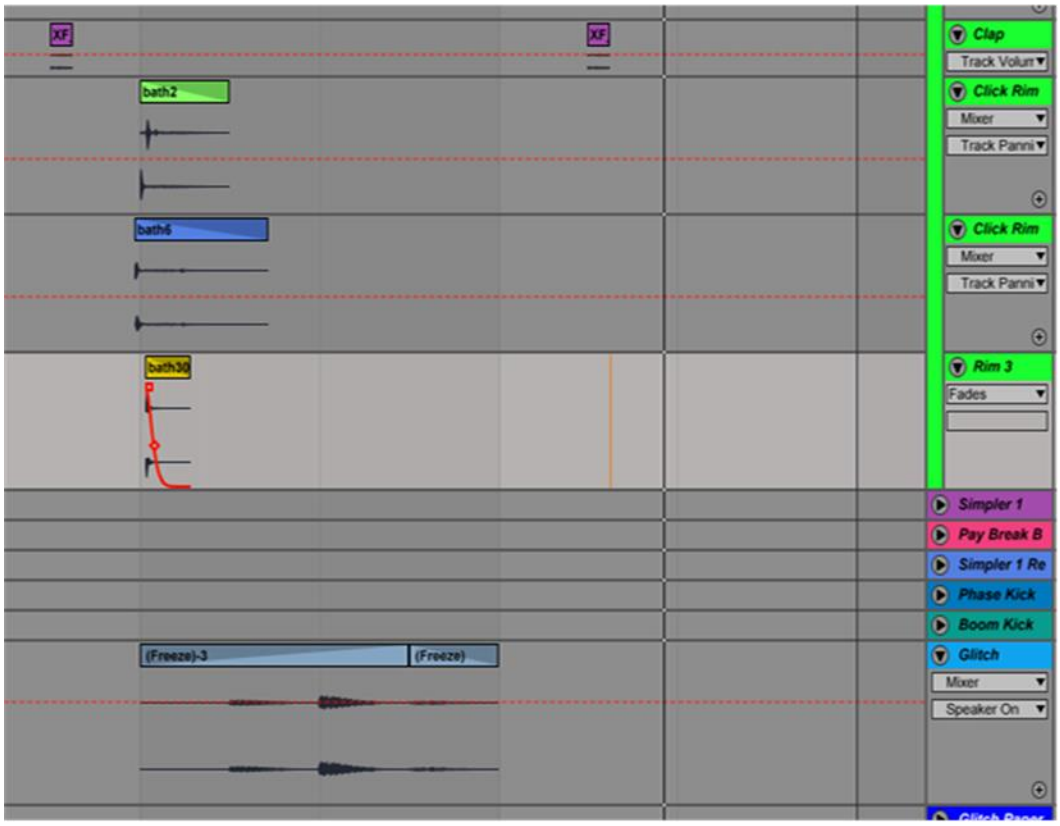

Figure 5.4: Mr. Bill "Router" percussion flammed ahead and behind the beat (Mr Bill 2012).

Decays

> According to Carl Schacter,
>
> … the accent occurs on the boundary between two time spans, an old one and a new one. If only because of its novelty, the beginning of the new span attracts more attention than the end of the old one. (Schachter 1987, 6)

Despite Schachter's assertion, for many DAW producers, the ends of notes attract attention and are considered a very important aspect of groove. As EDM artist Timothy Allan mentions, "[drum] note length is one of the big things in House music or any Dance music" (Allan 2009a, 4:37). In this section, I will focus on these percussive note lengths, highlighting various methods

by which they are manipulated as well as elucidating how on-screen representations influence and greatly aid this process. By discussing, visualizing and transcribing four-on-the-floor, as well as trap hip-hop grooves, I will explicate how these percussive decays are utilized to anticipate the pulse, creating rhythms that serve to draw the dancers into the groove. Moreover, I will analyze the silences generated by these precise drum decays and the implications they have on rhythmic composition.

The precise control over the decay of percussion instruments is a unique phenomenon in sample-based music. With the DAW, percussion does not have to be subject to the laws of physics and acoustics; a single drum hit can be elongated for bars or truncated to a thirty-second-note. This durational elasticity adds a whole new dimension to the creation of percussive and drum set rhythms within the DAW. In contrast, playing a drum set is an acoustically messy endeavour. Unlike instruments which can hold a consistent tone for a desired length, once a drum or cymbal is struck, the performer has little to no control over when the instruments will stop producing a sound.[109] Each component of the drum set—from the low booming kick drum, to the high resonant cymbals—has its own highly variable and imprecise rate of decay. Moreover, as the drum kit has no method to sustain an attack over a length of time, attempting to create a legato articulation between individual drum hits would be a challenge.[110] Contrarily, in the realm of the DAW, this durational limitation is removed. To discuss the implications of this percussive precision, I will first examine the durational creativity present in four-on-the-floor grooves.

[109] There are techniques for muffling drums and muting cymbals with the hand; however, they are not consistently used in most drumming situations, as they require the drummer to relinquish a stick to perform these actions.
[110] The hi-hat is the only instrument that allows the drummer regular control over decay, as the resonance of the two cymbals can be arrested by bringing them together with the use of a foot pedal.

One important reason producers regulate drum durations is in order to avoid clashes between the tail of one drum hit and the attack of another. By articulating drum durations in time with the music so that they never overlap, drum sounds are more emphasized and defined, not masked behind the chaotic decays of a live drum set. EDM artist Sharooz advises, "keep percussion hits neat and tidy by adjusting the decay of the samples according to the groove of your track … Too long a decay and the kick will interfere with the bassline and too short a decay will not yield enough punch" (Sharooz 2010). Allan warns, "as we start piling on more sounds, it even gets trickier, because you've got to make sure that the tail of one note isn't interfering with the attack of another note or vice versa. It does make a big difference" (Allan 2009a, 4:37). Needless to say, being able to visualize these decays serves to make this process much easier (See figure 5.5 for the precise decays in Mr. Bill's arrange window).

The avoidance of sonic conflicts between drum hits is only one facet of this durational precision. Interesting grooves can also be formed by lengthening drum durations, in effect creating legato percussion articulations. Many producers utilize this technique extensively in hi-hat rhythms. In live performance when an open hi-hat is struck, it creates a distinctive sizzling timbre that abruptly ends with a slight metallic sound as the two cymbals are closed. By utilizing this open sonority in combination with the muted character of a closed hi-hat, producers are able to synthesize the hi-hat's action to create interesting rhythmic effects. There is a plethora of EDM compositions which make use of hi-hat durational variations, alternating between open and closed hi-hat sonorities to create different articulations between pulses. EDM-enculturated dancers recognize that open hi-hat durations hitting on the 'ands' of each pulse will normally fall into the downbeat. A textbook example of the EDM open hi-hat anticipation is present in Daft Punk's composition "Around the World" (Daft Punk 1997). Daft Punk's drum rhythm is

identical to the generic four-on-the-floor groove, except, in this track, the open hi-hat anticipations are placed on the 'and' of each beat, sustaining until the kick sound hits on the downbeat. These sustained drum sounds—creating legato articulations by connecting with the subsequent beat—function as rhythmic anticipations, keeping the dancers moving by presaging the main pulse.[111] As we have seen, the four-on-the-floor rhythm is regular and consistent in its emphasis of the quarter-note pulse of each bar. This consistency is integral to dance music, as the dancers must be able to easily predict the occurrence of the next pulse in order to synchronize their motions with the music. According to David Burrows,

> ... predictability induces trust. The reliability of an isochronic flow of beats means that within the focus area, music, participants are close to perceptual equilibrium, with no fringe of anxiety about the metrical future. (Burrows 2007, 102)

This perceptual equilibrium allows the dancers to stay in the present without worrying that the constant pulsation of the groove will change. In certain contexts, sustained drum hits further reduce listener uncertainty over the metrical future by functioning as anticipations, foreshadowing the main pulse. David Huron analyzes the use of anticipation in a V-I cadence, asserting that "Western-enculturated listeners tend to expect the dominant chord to be followed by a tonic chord" (Huron 2006, 246). Huron professes that there is always uncertainty as to *when* the resolution might occur. Anticipatory notes arriving previous to the resolution provide the listener with clues as to when the I chord will sound. He claims, an anticipation "significantly reduces the uncertainty" as to when a musical event will occur (ibid., 246).

[111] However, this technique is not limited to hi-hat sounds; lengthened durations are also applied to other drum hits. Starting at 0:30, the Stephan Bodzin track "Valentine" provides an interesting use of percussion decays in the snare drum as well as the hi-hats (Bodzin 2006).

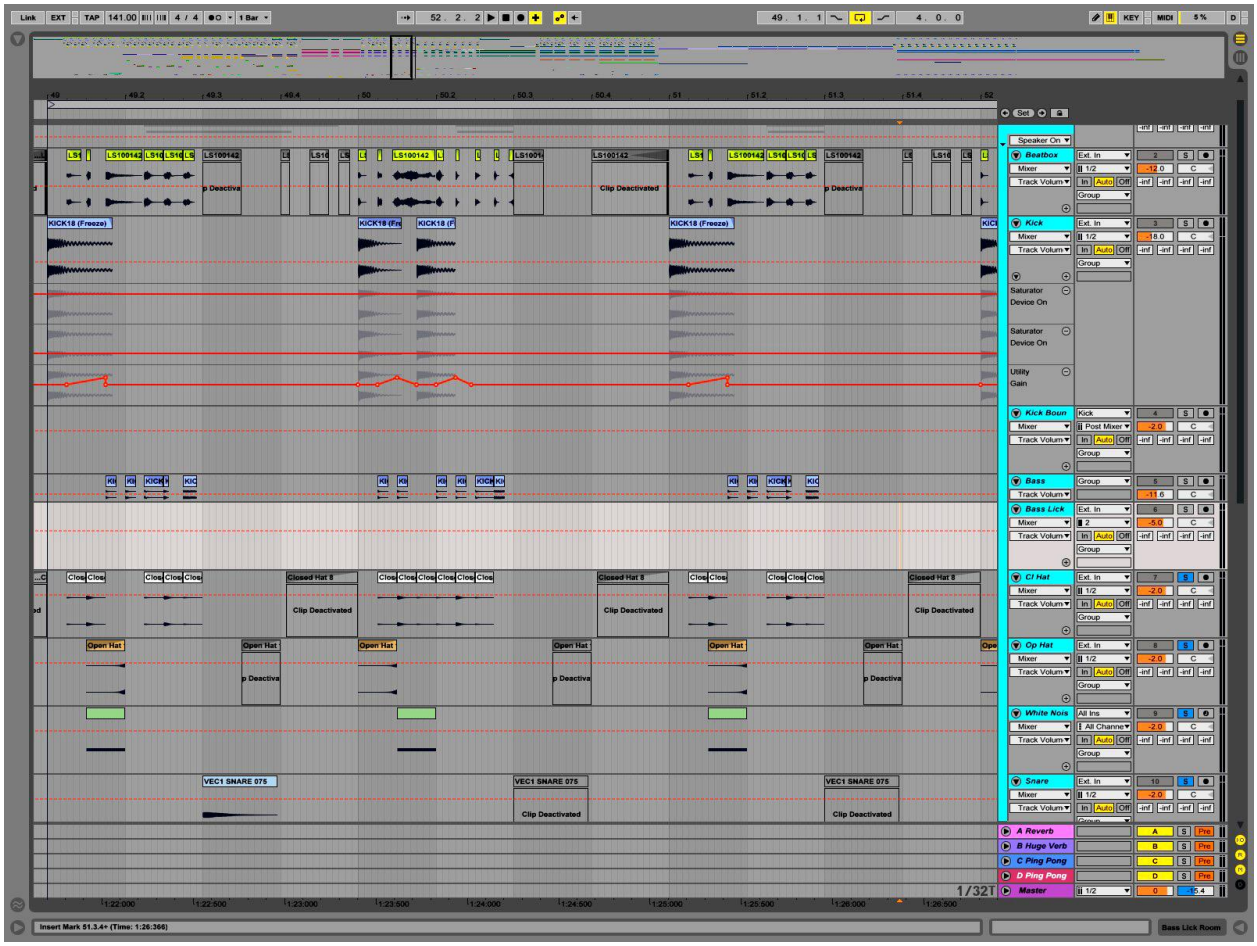

Figure 5.5: The precise decays of Mr. Bill's arrange window (Mr. Bill 2012).

Hi-hat anticipations in a four-on-the-floor groove function in a similar manner; however, instead of reducing uncertainty, hi-hat anticipations function to instil confidence. Dancers know that the constant flow of pulses will most likely continue unabated; yet, hi-hat anticipations make the dancer more certain of what will occur from moment to moment. The propelling effect of the open hi-hat is highlighted in the Daft Punk track when they oscillate between sections of closed and open hi-hat grooves. In my mind, the string of open hi-hats surging into the main pulse creates a more driving feel.

Timothy Allan discusses the use of a sustained hi-hat sound to connect beat four to the next bar's beat one, stating, "[it] almost sucks you into the kick [on beat 1]. That's a great way of getting a bit more groove into your drums" (Allan 2009b, 2:21). Allan's hi-hat anticipation reinforces the dancer's notions of future events by pointing them to the next pulse, sucking the dancer into the next downbeat. The Redditor *Silentaugust* attests,

> sounds that help anticipate the beat are immensely useful. Things like an open hihat playing on the "and" of the beat (e.g. 1 & 2 & 3 & 4 &), provide for a "stabilization" of the beat. A reverse clap that leads into a clap of a different timbre can work extremely well. Ghost notes that accent and augment any kind of rhythm adds timbre and velocity variations that create a wave of change that help the ear. (Appendix R14)

This knowledge of future musical events evokes a feeling of joy in the dancers. Huron states that when "ensuing events unfold as predicted, the listener will" become elated (Huron 2006, 246). Moreover, the open hi-hat, by drawing the dancer into the next downbeat, creates a feeling of forward motion by heightening the dancer's expectation of the coming pulse. According to Huron, "the feelings that precede highly expected events are quite distinctive. The [emotions] might be characterized as tending, urging, cleaving, leaning, driving, propelling, pushing, or craving" (ibid., 306). In this instance, these anticipations and resolutions happen very rapidly, lasting usually no more than an eighth-note; as a result, I doubt dancers are entirely cognisant of this mechanism of anticipation and resolution. Nevertheless, as Huron states, "we don't simply think about future possibilities; we feel future possibilities" (ibid., 8). I maintain, these open hi-hats increase the feeling of drive and forward motion in a groove, sucking the dancers into an unrelenting flow of anticipation and resolution that is not intellectualized, but felt in their bodies. These anticipations make a song more appealing to the dancers, laying out a perfect interlocking

set of rhythms that are cleverly hinting at, as well as propelling, the dancer towards the next beat, making them confident and excited about what's coming next.

While the Daft Punk example could be performed by a live drummer (and has been in countless disco songs). Deadmau5's remix of Daft Punk's, "Harder, Better, Faster, Stronger" provides a more intricate example of a hi-hat groove (Deadmau5 2007). With Deadmau5's four-on-the-floor groove, he creates a bar length hi-hat rhythm, consisting of an abrupt thirty-second-note long hi-hat—on the onset of the "and" of 1 as well as the "and" of 3—and a sustained eighth-note open hi-hat—on the "and" of 2 as well as the "and" of 4 (See Figure 5.6). This creates a constant alternation between closed hi-hat and open hi-hat, the closed hi-hat always preceding a snare hit on 2 and 4, and the open hi-hat sustaining into the following kick note, sucking the dancers into beat 1 and 3. Moreover, in the hi-hat, the alternation between quiet staccato and louder legato articulations forms an accent pattern of weak and strong, another interesting rhythmical counterpoint to the main groove. Conversely, the staccato nature of the closed hi-hat creates an identical dotted sixteenth-note silence before each snare hit. This contrast between silence and sound greatly emphasizes the snare's attack. Snoman affirms that

> … long drum sounds cover the gaps between each of the drum hits and this lessens the impact of the rhythm. Jumping from silence to sound then back again to silence will have a much more dramatic impact than sounds occurring directly one after the other. (Snoman 2008, 160)

The two hi-hat durations, emphasizing the kick through legato articulation and the snare through staccato articulation, clearly illustrate how the duration of one note can have interesting effects on the note that comes after.

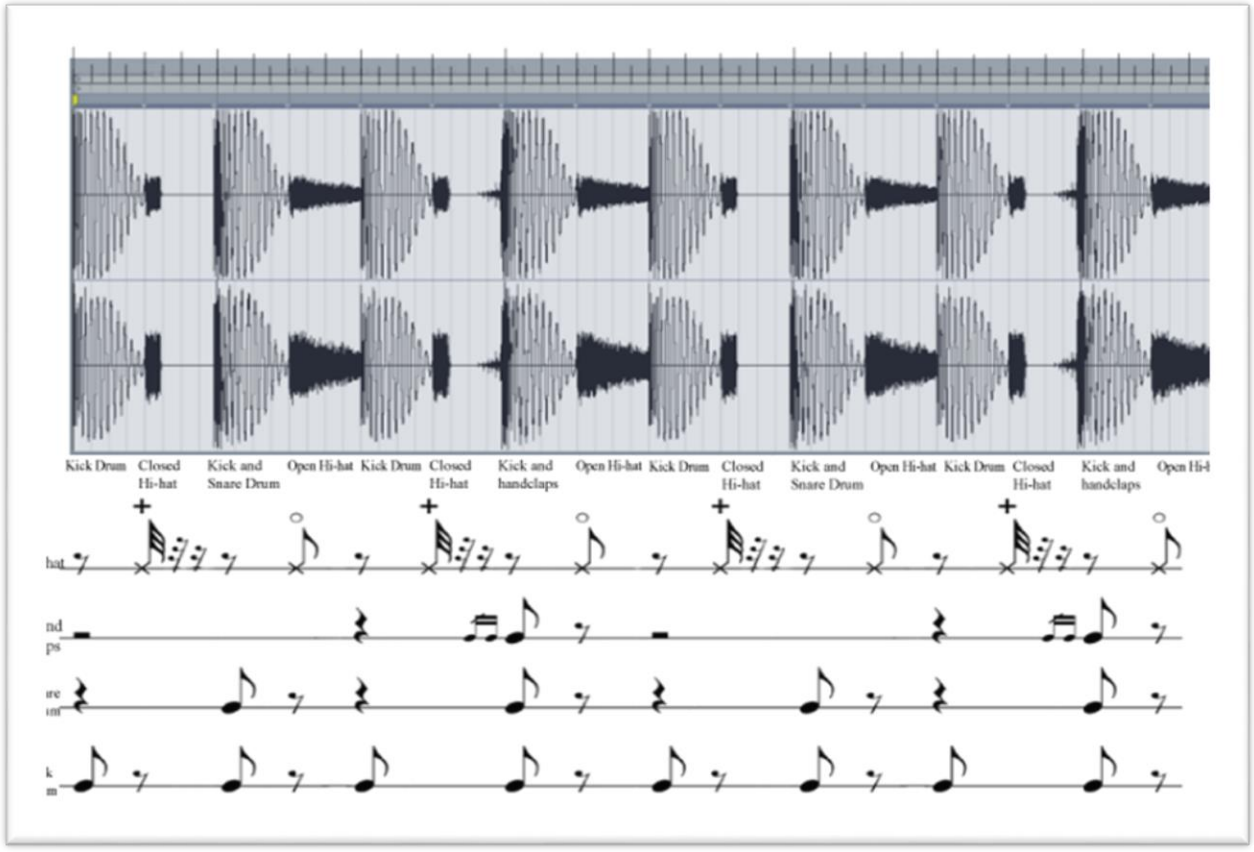

Figure 5.6: Hi-hats from Deadmau5's remix of "Harder, Better, Faster, Stronger" Daft Punk (Deadmau5 2007)

Sidechain Compression

Another way producers can create these anticipations in a four-on-the-floor groove is by utilizing sidechain compression. With this type of compression, a signal from one track can be fed through a compressor placed on a second track, lowering the volume of the second track whenever the first track produces a signal. For instance, sidechaining the entire mix to the kick drum means that all the other instruments in the composition lower in volume whenever the kick drum triggers. [112] While also used regularly in other genres, this technique is frequently utilized

[112] In many styles of electronic music, this technique is also utilized on any long sustained sounds, such as bass lines.

in four-on-the-floor grooves as it makes the main pulse (represented by the kick drum) stand out dramatically from the rest of the composition. As Snoman contends, with this type of sidechaining, "the all powerful kick … appears to punch a hole in all the rest of the mix every time it strikes" (Snoman 2008, 111).[113] Nonetheless, once the track lowers in volume in conjunction with the kick attack, it has to rise back up to its original volume. If the timing of this rise is matched to the tempo of the composition, the sidechained track creates a smooth crescendo between the downbeat and the upbeat 'ands' of each quarter-note. Similar to an open hi-hat or a reversed sound in a four-on-the-floor groove, a rhythmically sidechained track fills in the space between the kick attacks and the hi-hat upbeats, rising and falling in volume, creating an undulating wave of sound that consistently anticipates the kick downbeat (See Figure 5.9, for various shapes of this sidechain wave). This greatly accentuates the feeling of being drawn into the groove. Achieving a sidechained crescendo that synchronizes perfectly with the pulse of the track requires some work with the compressor's release time knob, which determines how quickly the compressor returns the track to its normal volume (Owsinski 2014). Snoman calls this type of sidechaining gain pumping:

> Finally, experiment with the release time of the compressor and note how as the release is lengthened, the pumping appears to be less dramatic. Similarly, note that as a release time is shortened, the gain pumping becomes more evident … The key element to this effect lies with the timing of the release parameter, and this depends on the tempo of the drum loop. It must obviously be short enough for the compressor to recover before the next kick but also long enough for the effect to sound natural so experimentation and careful listening are crucial. (Snoman 2008, 125)

[113] An extreme usage of this technique can be heard on the track "I Love the Bloody Beetroots" by The Bloody Beetroots.

Producers who do not want to experiment with the virtual knobs of a compressor (which are emulations of pre-DAW outboard gear) can utilize volume automation, which provides a more detailed and spatially mapped way of working. In all DAWs, volume automation is visually represented as a line stretching across the arrange window, usually superimposed on top or in a pop-up lane adjacent to each individual track (Ableton 2015, 653; Apple 2013, 189; Avid Technology 2015, 978; Bachmann 2015, 313; Dambrin et al. 2015). In this automation lane, the volume fader is visually stretched in time across the screen, the X-axis represents time and the Y-axis represents the volume level (high on the axis is an increase in volume, low is a decrease). In this way, the volume automation of a particular instrument (or the entire track) can be drawn in by hand, simulating the volume pumping achieved through sidechained compression (See Figure 5.8).[114] Thus, instead of twiddling knobs and relying on their ears to create the fluctuating sidechained wave that connects to downbeats and upbeats, volume automation allows producers to visually shape the wave to an exacting precision. As one Redditor claims,

> … I actually think it's easier to be more accurate … with side chaining when you actually automate the volume envelope of a loop or clip, rather than using actual side chain compression. (Appendix T1)

Moreover, there are external tools, such as Xfer Records *LFO Tool* or Cable Guys *Volume Shaper* that also allow the producer to visually shape the sidechained response (Xfer 2016; Cable Guys 2017; See Figure 5.8 for the *LFO Tool* interface). Online, many also prefer the increased visual detail of these external plug-ins to the less visually detailed knobs. According to

[114] Using various tools, the producer can also smooth out and shape these automation lines, creating precisely sculpted volume fade-ins and fade-outs (Ableton 2015, 288; Apple 2013, 537; Avid Technology 2015, 1005; Bachmann 2015, 579; Dambrin et al. 2015).

one Redditor, “it's great to be able to visualize exactly what you're doing” (Appendix T2).

Similarly, *sparkeemusic* thinks

> the reason plugins like LFO Tool, Volume Shaper, or manual automation are different than using a compressor to sidechain is because you have more control over the actual shape of the automation curve. With a compressor, you can't completely control the curve. You can tweak the various settings of a compressor, sure, but you can't control the shape of the "automation" curve in the same way you can with those other tools. (Appendix T3)

Once again, detailed visualizations spatially mapped out in the DAW are preferred over knobs emulating earlier outboard recording gear.

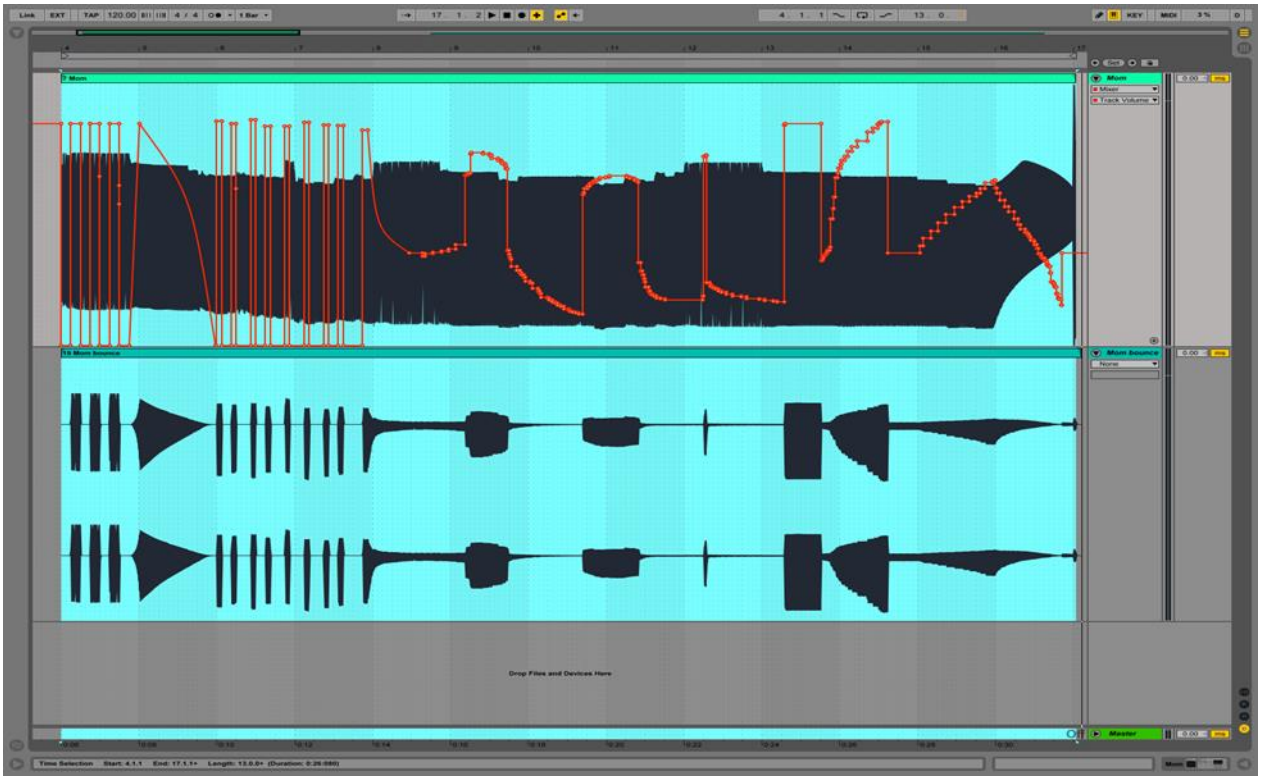

Figure 5.7: Various shapes of volume automation in *Ableton Live*
Original shapes (top track) and the Rendered results (Bottom track).

Figure 5.8: Preset sidechain shape in LFO Tools
(Xfer Records 2016).

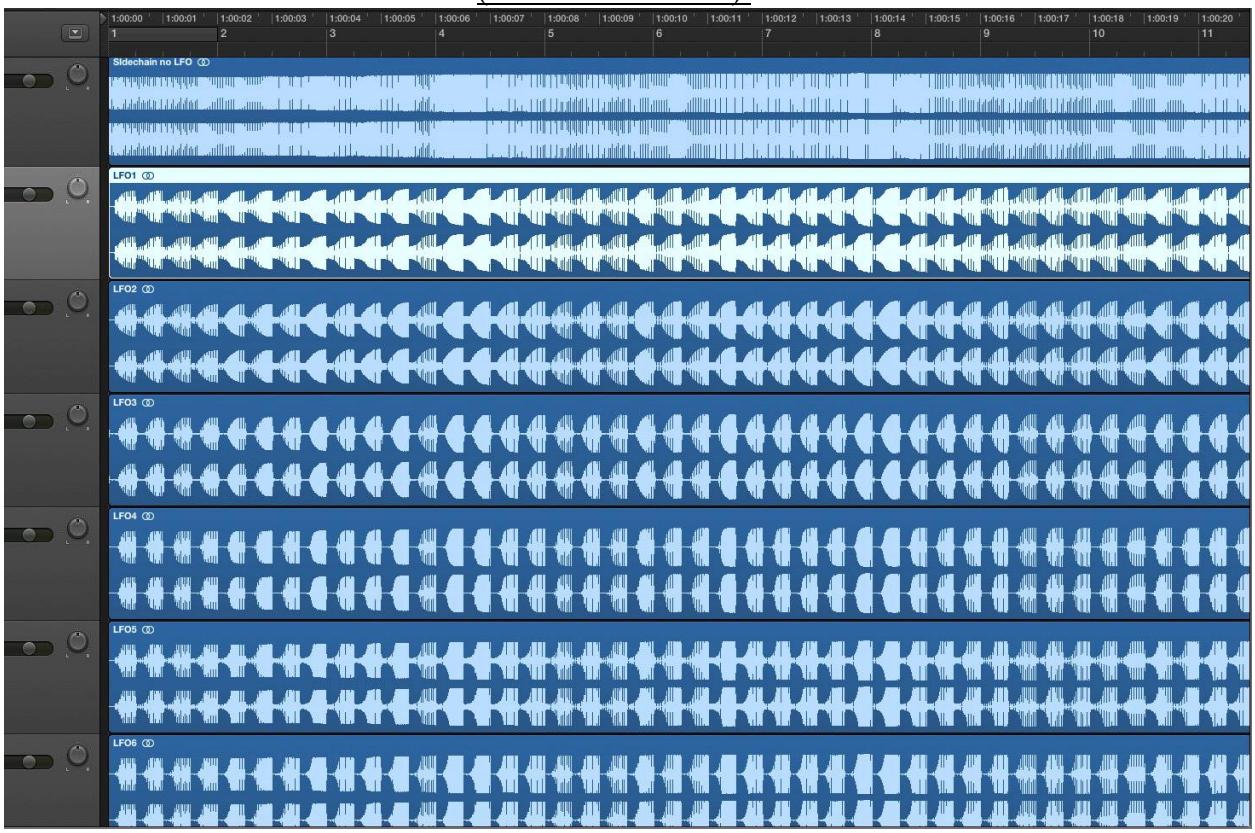

Figure 5.9: Sidechained waves with the presets in LFO Tools
Top track is-un-sidechained synth line, below are sidechain waves created from that track

No matter the method, sidechain compression comprises another way of anticipating the downbeat in a four-on-the-floor rhythm, drawing the dancer further into the groove. One Redditor speculates on the bodily effects of four-on-the-floor sidechaining:

> The main takeaway is that the pumping effect of most 4x4 "EDM" tracks nowadays is there to 1) make room for the kick 2) give you the urge to groove and jump with the song.
> If you notice, when you jump to the beat of a song your hearing kind of cuts out whenever you hit the ground? My little theory is that the side chain effect is conducive to jumping, which is why it became so essential in modern dance music. Feel the bass when you hit the ground, hear [the] music when you're in the air. (Appendix T4)

Thus the anticipatory wave of sidechaining accentuates the up and down of the four-on-the-floor groove and the low pitched kick drum and the high pitched hi-hat are mapped to the bodily registers of low and high when dancing. By creating an anticipation that rises in dynamics to the hi-hat and then falls back down to the low kick drum, this dancing motion is greatly heightened by the four-on-the-floor sidechained wave. Elevated to an almost sculptural art form by the visuals on the computer screen, the open hi-hats and sidechain compression are integral elements in the four-on-the-floor dance rhythm, serving to anticipate the pulse and create an irresistible groove.

Silences

There is another less tangible effect of all this control over precise durations: precise silences. For an excellent example of the impact of silence, I want to return to Deadmau5's remix of Daft Punk's "Harder, Better, Faster, Stronger." In this track, each kick and snare duration lasts exactly an eighth-note, in turn, leaving an eighth-note of silence between each beat—except for beat four, where the hand claps break up the silence with a brief appoggiatura (See Figure

5.10.). The equidistant and constantly re-occurring nature of these silences make them a rhythmic participant in the groove. In this case, an alternating eighth-note rhythmic pattern is formed between the drum samples (on the beat) and the silences (on the "ands"). Joan R. Erdman (taking her impetus from Indian rhythmic theory) calls this phenomenon the *empty beat*. She states,

> … the silence, which is interrupted by beats in an even pulse, becomes rhythmical with the introduction of an empty beat, but only when the empty beat is regular in its occurrence ... Empty beats determined by whim or caprice are not signs, merely absences. But regular empty beats require a beginning and an end of time to make their placement in time identical. That is, the placement of the empty beat must replicate itself in a time period, in order to be recognizable as an empty beat rather than an arbitrary absence. (Erdman 1982, 33-34)

As compared to performed percussion, where decays are imprecise, the empty beat is made all the more tangible by Deadmau5's identical note lengths. The precise quality of the EDM drum hits—and their exact, silent brethren—make this phenomenon more evident. Erdman also affirms that "logically [an empty beat] exists, but rationally it cannot be documented without reference to what would be there if it were heard" (Erdman 1982, 33). Normally in EDM, the upbeat is filled with a hi-hat sample, and a listener familiar with the genre would expect its presence. Huron states that a listener can become "enculturated into specific auditory environments where some events or patterns are more predictable than others" (Huron 2006, 36). The listener, conditioned by EDM's traditional dialogue between kick drum and hi-hat, is encultured to recognize the empty beat as a rhythmical participant. In this case, "context can transform an acoustic silence into a perceived silence that is filled with imagined music" (Margulis 2007, 487).

Sample libraries also provide exquisitely shaped kick drums that match up with a composition's tempo, providing perfect rhythmic silences. Many kick drums from the Vengeance sample pack are shaped for specific tempos and their decays fit into the grid perfectly (See Figure 5.11). For producers who want to create their own kick decays, the same methods used for visually sidechaining (volume shaping with automation or external tools such as the LFO tool or volume shaper) can also be deployed to shape precise kick drums.

In fact, aside from kick shaping and sidechaining, volume automation and external tools can also be used to sculpt interesting rhythmic decays into sustained sounds. This is a particularly visual process, where rhythms are created by subtraction. As opposed to drawing in rhythmic pattern, where the sounded note is inserted into the composition, it is the silences that are drawn into a sustained sound and the remainder is what is heard.

Basically, the producer is chopping holes in the sound and what remains is the rhythmic design. For instance, turning the volume automation line of a sustained sound into a castle turret shape creates rhythms with sharp attacks and decays. Moreover, the right angles of the turret shape can be curved, softening the attack or lengthening the decay of the sounding note, providing a large amount of visual precision in the creation of flowing rhythms, of which downbeat sidechaining is just one variety (See Figure 5.7).

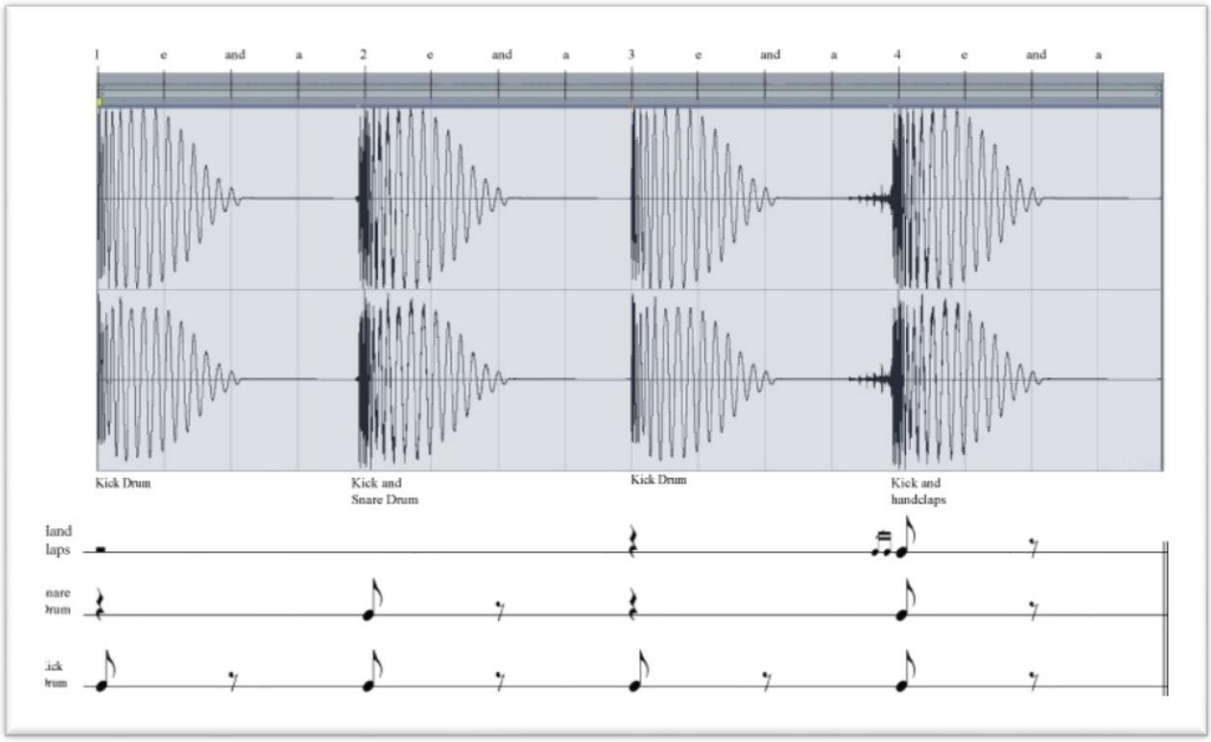

Figure 5.10: The perfect silences in Deadmau5's remix of "Harder, Better, Faster, Stronger" (Deadmau5).

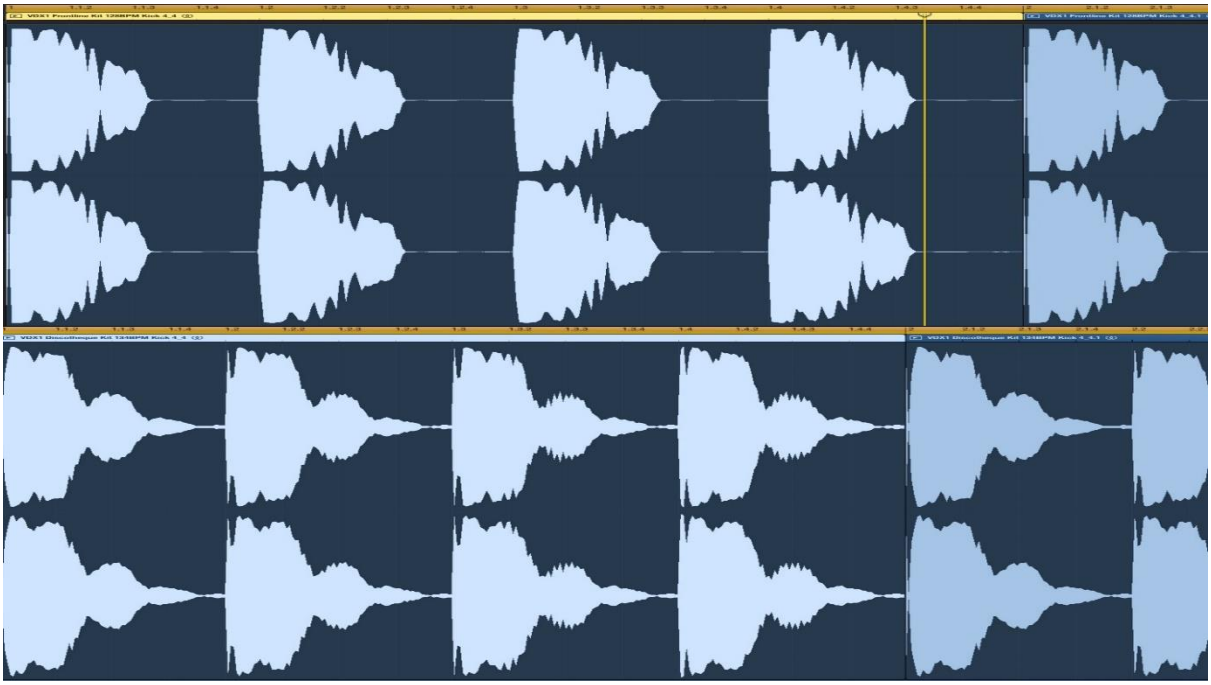

Figure 5.11: Shaped kick drums from the Vengeance Sample Pack (Refx 2017).

Within the seemingly mundane four-on-the-floor drum groove, there are fascinating topics for analysis, such as anticipations, expectations and perfect silences all created through the precise visual control of percussion decays. Utilizing sidechain compression and hi-hat decays to anticipate the downbeat and create rhythmic tension is a highly important factor in creating a danceable four-on-the-floor groove. Moreover, many of these durational techniques used by EDM artists augment certainty, making the dancer more confident as well as excited about what happens next in a composition. However, anticipations are also created in visually interesting ways in other genres of DAW-based music.

Trap Anticipations

Another way of creating anticipations which draw the listener into various important temporal locations is with the creation of rapid rolls. This is especially prevalent in the style of hip-hop music called trap. Originating in the southern United States, trap music is often characterized by quantized Roland 808 drum machine sounds with rapid fire hi-hat rolls that dance between various permutations of triplets, 16th and 32nd notes.[115] I believe these hi-hat rolls serve as another form of downbeat anticipation, drawing the listener into various important rhythmic locations and increasing the groove of the track. While the individual notes of these rolls can be discerned, perceptually they are grouped together by the listener, forming a rhythmic gestalt that creates the same urge towards a downbeat as the sustained tones of an open hi-hat or a reversed percussion sound. Often these rapid hi-hat rolls fall into important temporal locations such as the downbeat on one or three. For instance, the track "Bars," produced by *Zaytoven* for the rap group Migos, utilizes some extremely rapid hi-hat rolls that alternate between 16th and

[115] This is often a confusing stylistic term, as trap is also a style of EDM music which holds some similar characteristics; yet, has no rapping (Drake 2012). For this chapter I am examining the hip-hop style of trap.

32nd notes, as well as 8th, 16th and 32nd note triplets (Migos 2016; See Figure 5.12). In this track's 8-bar long drum loop, each of the longer hi-hat rolls either lead into beat one or the clap backbeat on beat three.[116] The most striking of these anticipations are the two instances of a long roll that extends over three beats while morphing between 16th and 32nd note triplets. I contend these rolls form extended anticipations that are positioned to cleave towards the two most important locations in the groove, the downbeat and the backbeat on 3. Moreover, I believe the roll's increase in rhythmic density serves to create a stronger tension leading to the release on the resulting downbeat.

With its rapid, perfectly quantized patterns, trap music production is more conducive to manual insertion of notes as opposed to performing the rhythms with a MIDI controller. Most producers utilize their DAW's MIDI piano roll to create their drum grooves, as it would be incredibly time consuming to fashion rapid hi-hat rolls by placing individual waveforms in the arrange window. Online, many producers claim that *FL Studio* is the best DAW for creating these rapid hi-hat rhythms because of its fluid workflow.[117] Speaking of trap music, one Redditor declares, "*FL Studio* provides you the most straightforward ways to do a lot of the signature tricks of the genre" (Appendix T5). One way *FL Studio* is helpful when creating rapid hi-hat rolls is with its quick chop feature (Dambrin et al. 2015). With this feature, the producer can create one long note in the piano roll, select it and then with the keyboard shortcut Ctrl+U, the program will automatically slice the long note into smaller subdivisions of the producer's choosing. Thus a long roll with a considerable amount of notes can be created through a minimal

[116] In order to legibly display the rapid hi-hat notes, I transcribed this track in half-time, so the backbeats fall on beat three of every bar instead of beat two and four of each bar. Many producers also profess to creating their trap tracks in this manner, working at a bpm that is twice as fast as their intended tempo, so that 16th notes become 8th notes and the backbeat hits on beat three of every bar (Appendix O). See Chapter 4 for a discussion of this topic.

[117] As the FL Studio Manual asserts, "FL Studio's Piano roll has the well deserved reputation as the best Piano roll in the business (with good reason)" (Dambrin et al. 2015).

amount of clicking and keystrokes, versus other DAWs where the user would have to insert each note by hand. By enabling the producer to automatically chop-up one long MIDI note into a rapid-fire roll, *FL Studio*'s quick slice feature seems to visually emphasize the roll's membership in a larger group that cleaves towards various downbeats.

Conclusion

In this chapter, I have presented various ways that the DAW's spatial representation of time influences the creation of groove. Whether placed, performed, purchased or sampled, truncated, sculpted or sliced, I believe the various ways producers manipulate the attacks and decays of percussion hits reveals much about the visual influence of the DAW. These spatial ways of operating add many new elements to the creation of rhythms that drive people to the dance floor, such as precise drum hits, perfect silences, covertly commodified grooves and perfectly sculpted anticipations. Examining the methods that producers utilize to make their rhythms danceable can be an informative exercise, not just for the scholar of electronic music, but for all academic examinations of groove. Many accomplished DAW-based producers are also accomplished scholars of groove, who (unconsciously or not) understand many of the microrhythmic techniques utilized by several generations of rock, disco and funk drummers, as their rhythms inform much of EDM and hip-hop. Not having to worry about performing, producers can observe their grooves from a far, visually and sonically learning which hits need to be placed ahead or behind the grid and which pulses need to be anticipated, all the while, nodding their heads and endlessly listening to their grooves on repeat.

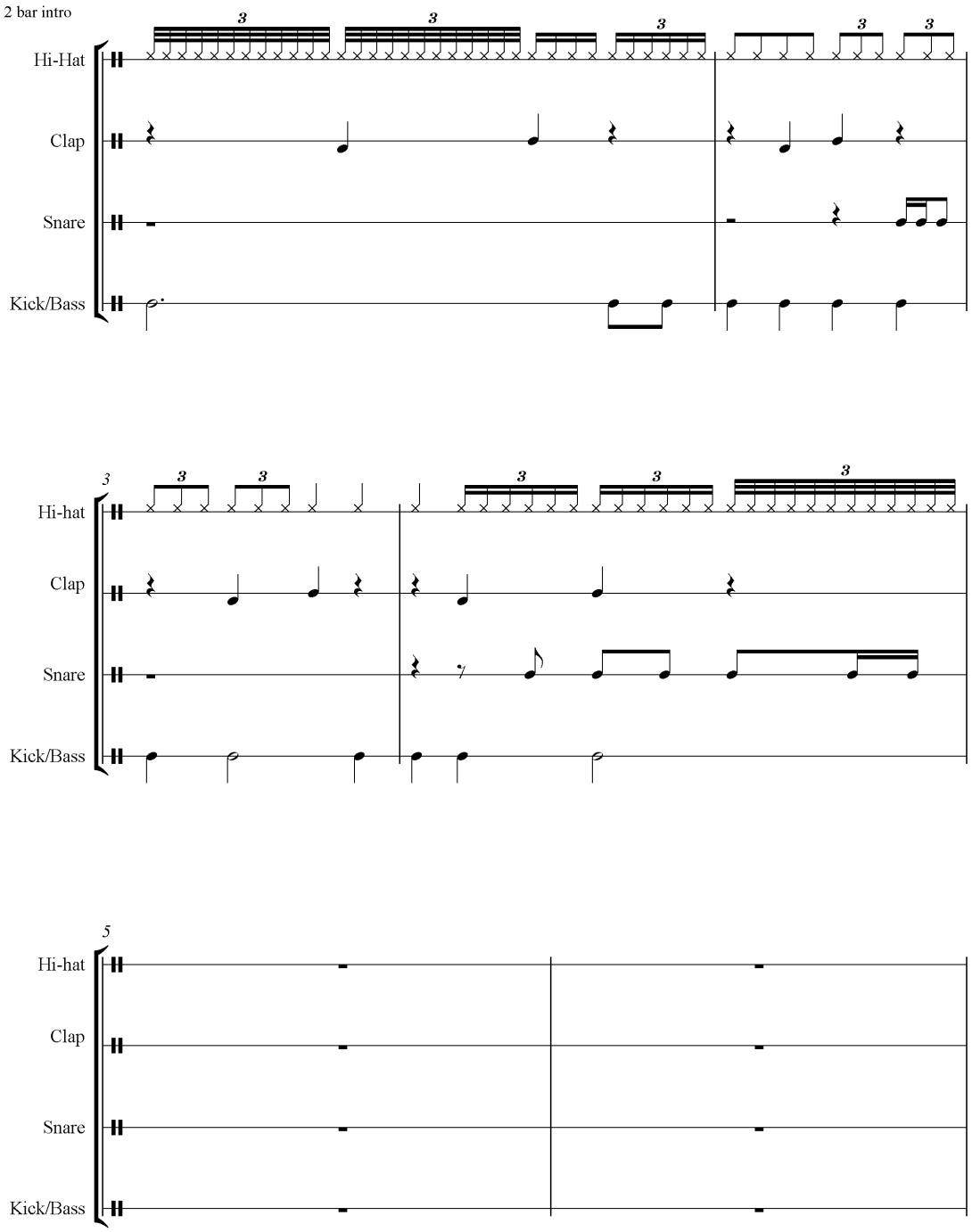

Figure 5.12: Transcription of “Bars” Migos produced by Zaytoven.

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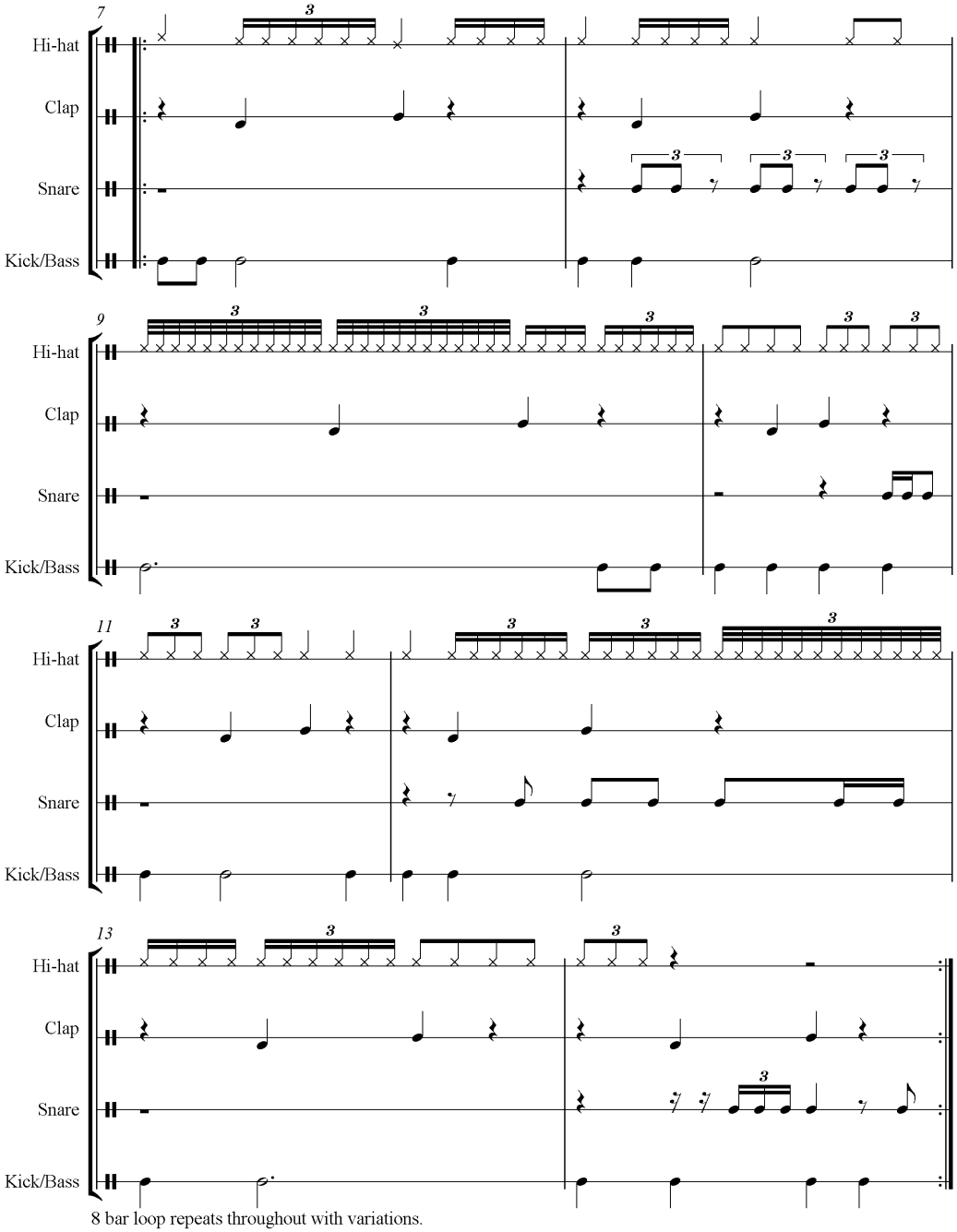

8 bar loop repeats throughout with variations.

Chapter Six: Conclusion

> The field of sound is time, that of sight is space. To multiply sounds heard at one time, or to develop colours one after the other, is to change their economy, to substitute the eye for the ear, and the ear for the eye. – Jean-Jacques Rousseau *(cited in Mattis 2005, 215)*

With the DAW, the economy of the senses has changed; however, the eye has not been substituted for the ear, the two senses have in fact combined into a new multimodal form of composition, analysis and performance that is visualized on the computer screen. Whether playfully interacting with the waveform, navigating, spatially analyzing and labelling compositions or microrhythmically moving percussion off the grid, I contend (for better or worse) the visuals of the DAW exert an influence over the processes of producers. Many facets of this visual representation are guided by the visual structures and interactional dictates of the Graphical User Interface. Bodker discusses the "taken-for-grantedness" of the GUI and the desktop metaphor, maintaining that many of her first-year students do not question the graphic icons and windows they are constantly shown on the screen, asserting, "that is just how things are—what is strange about that?" (Bodker 2007, 49). With this dissertation, I have attempted to combat the "taken-for-grantedness" that seems to befall many applications that fall under the GUI's purview, pointing out the ways things are and how they effect the compositions of hip-hop and EDM producers.

I believe the critique of the visual representations of the GUI is an area of study that needs to be greatly expanded in the coming years. Unpacking these on-screen visualizations and portraying the ways they influence a user's workflow and comprehension of a particular task is a

highly necessary undertaking in all disciplines that utilize software. More specifically, in the fine arts, music's status as a sonic art form that is visualized by the computer screen adds a unique view point to the influence of the GUI that is lacking in other visual art forms (such as film, photography and animation). I contend the transformation of sound into interactive graphics makes this visual influence more readily apparent than other artistic software packages that work entirely in the visual realm. It needs to be noted that the visual representations of the GUI are just one way in which digital tools have impacted the processes of musicians. Computer processor speeds, online sharing, the non-rivalrous nature of digital files, as well as the popular conception of digital information as free of context all serve to put forth a particular conception of music that needs to be studied for its processual impacts.

Through my examinations of the Reddit producer communities of *Making hip-hop* and *EDM Production*, as well as magazine reviews, YouTube tutorials and technical manuals, I hope to have enumerated various visual influences that pop up in the processes of producers. While the methods I have illuminated are in no way the only ways the DAW is utilized and there are a multitude of other musical, stylistic and cultural influences brought to bear on the music that is exported out of the DAW, I hope to have isolated certain ways the graphics on the screen guide and transform the music making process.

In Chapter two, I focused on the history of the DAW and the ways it affords the looping act. Stressing the Western musical biases of the on-screen visuals and their connection to repetitive, evenly delineated musical time, I demonstrated ways the DAW foregrounds the loop-based processes enacted by the majority of my Reddit informants. I assessed the strength of these affordances across several DAW software packages, enumerating the features that assisted the recording of groups of musicians as well as the designing of loops. Finally, I provided a history

of looping, stressing four areas of interest that highlighted the processual, perceptual and commercial issues raised by the looping act: the concretization of musical time into space, recorded repetition as a process of sonic analysis, the automated process of looping and the rise of loops as modular digital commodities, demonstrating how these areas of interest changed with the evolution of recording technology as well as showing how the technological transgression of the looping act was normalized into the visual structures of the DAW.

In Chapter three, I examined the cause and effect of direct manipulation, hypothesizing that for many producers, a detailed visual response to manipulations inspired a sense of control, agency and fun. Utilizing the video game studies frame work, 'the space of possibility,' I maintained the detail of the visual feedback and the structuring of these visuals (almost always in view) pushed many producers into a playful and experimental workflow. Moreover, I argued that the detailed waveform representation was often prized over the sparse nature of MIDI notation, driving producers to render everything to the waveform (including effects and glitches), in order to visualize what they heard through their speakers. Finally, I speculated that this inspiration to manipulate influenced aesthetic considerations of many online producers who often considered the degree of manipulatory participation they could perceive when listening to another producer's track.

In Chapter four, I framed the synoptic representation of the arrange window as a spatial analysis of musical time and examined its influence on the producer's process of arranging, analyzing and performing a track. I maintained the representation of a composition along a temporally demarcated, zoom-able timeline highlights a modular form of arrangement that often has to be overcome through the use of transitions. Moreover, I argued, through the act of labelling and organizing their arrange windows, as well as commercial compositions, producers

placed analysis alongside performance and composition as an integral act of DAW musical creation. I also classified the spatial navigation of the arrange window as a novel form of multimodal musical performance unique to the DAW. Proposing the timeline metaphor as software's normalized representation of musical time, I then highlighted several producer commentaries, revealing how the arrange window has become the expected representation for music and enumerating the ways the perceptual patterns of the DAW's spatial representation affects many producer's conception of a musical composition. Finally, I ended the chapter with several producers' appeals to turn off the screen, utilizing studies on computer usage and attention to speculate on ways the visuals could affect audition.

In Chapter five, I turned to musical analysis, investigating the spatialization of groove in the DAW and demonstrating how the slight rhythmic deviations in musical performance could be algorithmically sampled, performed with MIDI controllers as well as visually conceptualized in relation to the grid. Dividing the chapter into two sections, covering attacks and decays, I utilized transcriptions and waveform visualizations to reveal the musical results of the spatialization of groove. First, I compared Burial's gridless mode of composition to the unforgiving lines of the grid, examining the temporal looseness of his four-on-the-floor rhythms and speculating on the influence of the body in recognizing good grooves. Then I assessed the contents of three sample libraries, examining the microrhythmic deviations inserted into several hi-hat, snare and clap samples, proposing them as stylistic deviations that connected to performed funk and dance drumming. Next, I outlined the producers' precise manipulation of drum decays, examining their use as anticipations in four-on-the-floor dance rhythms, creating grooves that consistently anticipate the main downbeat. I also examined dance anticipations in the use of sidechain compression and the ways external tools such as Xfer Records *LFO Tool*,

provided visual precision in creating the sidechained wave that anticipates the pulse in a large portion of EDM music. Then through a transcription and visualization of a Deadmau5 track, I demonstrated how precise drum editing created perfect silences that could be a rhythmic participant in the groove. Finally, I ended with an examination of the rapid-fire hi-hats of trap hip-hop, unpacking the online assertion that *FL Studio* was the best DAW for creating these flourishes and foregrounding their use as anticipations through a transcription of a Zaytoven production.

Future Work

The obvious next step would be one-on-one interviews, video analysis of producers in process (showing the producer and the computer screen), as well as other visual and processual recording techniques, such as keystroke loggers and even eye tracking data—to see where the eyes are looking at all times during the creation process (Atterer et al. 2006 discusses this in regards to website navigation). These interviews and analyses would allow me to go beyond general concerns, elaborating on assertions I've made during this dissertation and honing in on particular producers' idiosyncratic approaches to the visualizations of the DAW. Moreover, other interview techniques, such as surveys questioning DAW-based producers about how they compare their music creation process in regard to their work with other GUI software (such as *Adobe Photoshop* and *Microsoft Word*, for example) would be highly informative.

Another future area of research would be exploring different aspects of the Reddit community, investigating the visual influence over the manipulation of timbre, as well as melodic and harmonic concerns. For example, producers often separate the designing of a sound (the crafting of the perfect kick drum utilizing equalization, compression and distortion, for

example[118]) with its deployment in a composition (utilizing said kick drum in a drum groove). The fact that many producers distinguish between composing a track and composing the sounds to be utilized in the track, as well as their reverence for visual analyses of sound in the design process (such as the spectrum analyzers included in many equalization plug-ins), adds an interesting facet to the tripartite framework of performance, composition and analysis I set up in Chapter four.

Another fascinating topic would be a deeper examination of the Reddit feedback threads (where users critique each others' compositions), focusing on the particular descriptive language utilized, as well as the musical characteristics users choose to highlight in their critiques. As an offshoot to my discussion of producers analyzing and labelling commercial compositions in their arrange window, a general assessment of the ways producers utilize the visual structures of the DAW to learn various production skills would also be a rewarding exercise. As Slater asserts, in DAW production, "there may be no clear distinction between carrying out the creative activity and learning how to carry it out: they can be one and the same" (Slater 2016, 12). By providing methods to overcome the more pernicious influences of the computer screen, my findings could greatly assist in the creation of a pedagogy for DAW composition, foregrounding the visual biases and processual tendencies inserted into the creative process by the visualizations of the GUI.

In the realm of groove, a further analysis of the instrumental hits in sample libraries, investigating microrhythmic deviations in other percussive as well as melodic samples and comparing them to performed music in funk, disco and rock music could prove fruitful. I believe,

[118] This technique is often called "Sound Design" on Reddit (Appendix U6; U7; U8).

connecting the stylistic deviations inserted in loop and sample libraries to the deviations of performed music is a productive area for understanding electronic, as well as performed grooves. Moreover, analyzing the bodily motions of producers during the music creation process could provide an interesting area in the exploration of groove. The rhythmic technique of "quintuplet swing," where producers move the second note of a shuffled triplet subdivision backwards so that it hits a quintuplet subdivision, is also an interesting example of the spatial representation of groove that I have recently discovered (Slynk 2016).

Finally, an exploration of other kinds of musical visualization would be an excellent area of study. With the rise of the iPad and iPhone (and their android equivalents) in the creation of music, there are many touch screen visualizations that do not heed to the familiar dictates of the DAW. Apps such as *Patterning* (a drum machine emulator that utilizes Euclidian representations of rhythm) or *Konkrete Performer* (a music control instrument that utilizes shapes instead of knobs to control MIDI) can be connected to the DAW, adding a different sort of visualization to the usual screen-based interactions (Konkrete Labs 2017; Olympia Noise Co. 2017).

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Appendices

Appendix A: Looping

(A1) I find that when I'm working on music, it's incredibly easy to fall into the mindset of the "loop", spend a ton of time adding all these tracks that sound great together, but still only having 10-20 seconds worth of unique audio. I usually love the loops or grooves I end up with, but they're far from completed songs, and I have a helluva time taking them to the "next level". It's especially frustrating because by the time I've got a loop to the point I'm happy with it, I've been listening to it over and over so many times, it's difficult to think of what can change or what can happen "next" in the context of a song. I use Ableton, but I imagine this crops up with any DAW

(A2) would say not to let your productions loop endlessly while you work on them. There's a time and place for looping but otherwise, start and stop the production manually as much as you can, do not let your work loop over and over in the background.

Looping your work makes you get used to what you've already made even though there may be additional tweaking that needs to be done. Any foundational changes you make may automatically sound bad to you because you'd gotten so used to what you were hearing before.

Not looping your work also helps keep your ears fresh and gives you a more unbiased perspective to work with seeing as how you haven't been listening to the same thing on end for hours in a row.

Edit: It also helps keep your work fresh and interesting to you. If you're bored of what you just made because you've heard it a billion times already, how are you supposed to continue the track with any kind of inspiration? Do yourself a favor and keep yourself interested in your work, it'll definitely show in the end result.

Appendix B: Visuals When Mixing

(B1) I don't trust my ears so I reference the analyzer all the time.

(B2) I understand that you are trying to make your tracks sound like a professional..but it is really bad practice to rely on visual feedback to make your music better.....really it should only be to correct problems. In the long run its better to train your ears.

(B3) People love to say that you should use your ears instead of your eyes. While I don't disagree that you should MOSTLY use your ears, it would be a disservice to discount entirely what your eyes and learning to read the spectrum can do for your mix. Especially if you have a poorly treated room, your ears could actually be doing you wrong.

For example, a few things instantly stand out to me in your mix:

Your 600-1.5k range looks pretty hot, I'd probably lower it by quite a few decibels.

Similarly, I'd lower that peak around 175.…Now take everything I said above with a grain of salt and question it all. Use your ears first when making those changes to decide if it sounds better before/after -- some of the advice I gave above might totally kill the energy of your track.

(B4) [Your] best tool for this would be a spectrum analyser, you wanna be getting a visual representation of everything going on in the frequency spectrum if you're finding it hard to just use your ears, you'll wanna be analysing things like where the drums are hitting and at what level, where other instruments are siting in the mix etc

Appendix C: Sound as a Modular Object Falling on the Grid

(C1) It really mostly boils down to preference. Think of patterns as lego pieces, what kind of lego pieces do you need most? Do you need a single kick drum that you're gonna paint over the playlist as you see fit, or will you write a 16 bar sequence that you end up looping for the rest of the song? It's easier for you to chop down your patters into parts that are reusable. If you have a drum pattern 1 with a drum fill and drum pattern 2 with some alternative hats or snare rhytms, why would you keep those in the same block when you could just split the sounds that both need and reuse the patterns you already made.

(C2) Not completely feeling the synth that comes in around 1:10 or so. I think you should tighten up the rhythm on that a little bit and adjust the delay on that so it falls more in line with where the triplets would land, right now it's kind of cluttering up some of the other notes.

(C3) Put the kick on 1 and 3. Snare on 2 and 4. Hats on eighth notes. That's the basics, and you can just add or subtract from there.

(C4) He's incredibly precise with his drum processing… Hihat and kick drum hits are falling slightly before and after the grid lines, creating a weird but alluring organic feel to his beats.

(C5) I start with major blocks of songs that represent different musical ideas I'd like to use…So after I have these major blocks down I start playing with the order of them. From here I start adding elements of transition to smear these individual blocks into something much more cohesive. I don't necessarily finish one section before moving onto the next.

Appendix D: Play

(D1) Everything I end up liking is as a result of happy accidents. In a way it's frustrating because I feel like whenever I happen to make fire it's just total fluke. But on the other hand it happens fairly consistently, so there must be some method to the madness. Bangers just materialise imho, for me it happens rarely and seemingly by accident. But as long as I occasionally shit out an absolute slammer I'm cool with it. Few things feel better.

(D2) Lol at the comments. He's right though. Even if you have "writers block", it's a case of trying a different workflow or fucking about with sounds until it sounds good or you get an idea. The /only/ way to overcome it is to make music.

(D3) Sometimes I just close my eyes and fuck with effect parameters until something happens.

(D4) Manuals for VSTs? You f00kin kidding me dude? Just load it up and turn some goddamn knobs.

Appendix E: Rendering MIDI to Waveform

(E1) I'm sure you're aware but the difference between the waveform and MIDI is with MIDI you're not seeing the sound you're seeing the notes.

(E2) Working with Audio is incredibly important…when you see it all in audio on the grid, and you start cutting parts out and pasting them elsewhere, taking little 1 beat section and make them repeat, reverse parts here and there, going to town making the tiniest little cuts and fadins/fade outs, wow... the track just exploded with life. Long story short, working with audio freed me from the restriction of midi and completely changed the way i looked at mixing.

(E3) In addition, I'm well-acquainted with the idea of MIDI but I really can't wrap my head around looking at 'audio' tracks on my screen and seeing little friggin' tetris blocks instead of the fuzzy wave forms that I'm familiar with. I guess I could quickly render midi to wav but then I'm not taking advantage of MIDI. Tips?

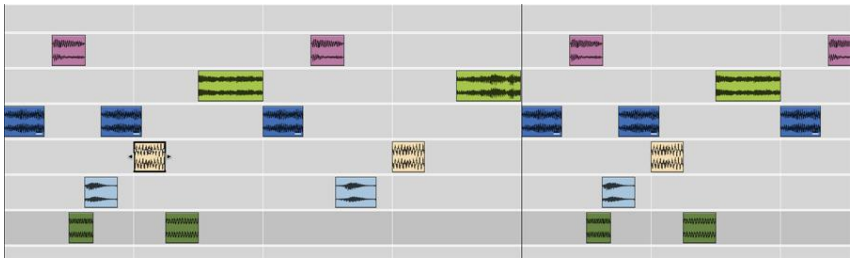
(E4) Plus MIDI tends to do whatever it likes (especially if they're supposed to be emulating analogue synths and the like) - you can't mix like that. Wav is static. So I do all my MIDI work in one DAW and when it's done, I export the wav to the other main DAW, where all the other live/non MIDI sounds are.

(E5) …much more stable; sometimes soft-synths will randomly change parameters or even completely reset the patch/initialize themselves for no reason. If you ever make a sound that you really like I would highly recommend resampling it just so you have the audio file stored on your drive even if you are still going to keep the sound in midi as well.

Appendix F: Dubstep Rendering

(F1) 1- open up your synth... which ever one you like and just write a simple bassline (simple, i said simple.)…
2 - once you have it written than do shit with the sounds…bounce it in place (record it to an audio track.). just make sure to keep the original.
3 - than go to the original midi track, ***alter the LFO, FM, what ever the fuck you want to change.*** bounce in place (record to audio track).
***than repeat step 3 until you have 20 audio tracks of your bass line, each of them slightly or immensely different. than chop them up, piece them together until you get what you want. and remember, there is no real skill to this, its all luck.

(F2) I have posted this image below in another thread already. What you see is a bassline edit / arrangement using different bass sounds that have been twisted and exported as audio files.



(F3) Anyway, resampling can be used when you have really complex basslines, the way they make it sound so different from one moment to the next is that they're actually 3-5 completely different synths-- maybe based off the same rough settings.

Because of effect tails, attack times and release times, it's easier to blend all the different leads/basslines/chords together by chopping them up and working with them on a per sample basis, then layering some kind of steady sound like a sub bass underneath it. Playing the same notes of course. It's a different way to work, and it yields more glitchy/IDM type of results if that's what you're looking for.

Appendix G: The Rendering of Effects

(G1) If the MIDI clips you're writing have reverb, delay, long release times or any number of other effects on them, they're probably leaking a bit of audio even after the clip ends. In most DAWs, this isn't represented visually, and so the result is that you've got extraneous sounds muddying up your mix that you're totally unaware of. Bouncing to audio lets you both see these tails and trim them.

(G2) Use reversed reverb tails. Just bounce a sound that is used in the next part (a synth or clap maybe?) but make sure it has a pretty big reverb on it. Now put that audio file back in your DAW and reverse it. You could do this with any sound, just use lots of reverb and reverse it. Also if your DAW has a fade tool between audio samples try and use a reverse and normal crash cymbal, but faded together so it flows better.

(G3) editing stutters, gating with different envelopes, reversing audio, looping audio, time stretching using different stretch algorithms, pitch shifting, reverse add a reverb or delay render and reverse again. It makes it more straightforward to cut and paste little edits here and there. Imagine a simple white noise riser from a synth, sure you could put different effects on it, but if you render to audio you can stretch it out, pitch it up or down, have the beginning or the end glitch out with some copy paste editing and changing the reverse stretch pitch envelope of the different slices. in this way you can achieve effects quickly that would be hard or impossible by trying to wrangle with a bunch of effects. with the added bonus that it's low on the CPU. Another thing is once you render something you can't go back and tweak your synth settings forever, which strange as it may seem is often a benefit because it forces you to move ahead.

(G4) It also makes your projects look more kewl.

Appendix H: The Rendering of Glitches

(H1) Working with rendered audio is how I glitch. You chop audio: it stops. No release, no FX send still hanging on at the tail. Know your envelopes. Work it destructively in a wav editer when you need to. You don't need to rely on glitch plugins or much plugins in general. Whatever you do, render as audio and tweak the render. Play different versions against each other. Effect the effected. Know how different kinds of fades respond and in different time scales. You won't get percussive definition with 32nd-64th notes unless you are chopping off the tails quick at the very ends. No fade and it's just a blur. Too long a fade, and short sounds turn to ugly sounding clicks. It's all details. There will be dramatic differences between sounds that cut eachother off wholly (choking) versus sounds fading into eachother.

(H2) the ability to see the waveform is a plus that u won't get from the sampler tho. working with visual audio is really nice

(H3) Plus I think you can do cooler things working with audio (Hlitches, reverse, consolidate a section of the drums and change another section's samples without duplicating or messing everything up in Live). Audio allows for greater control, and it's super easy to switch out samples in Live as your track comes out.

Appendix I: The Degree of Participation

(I1) Nowadays, it's all so accessible. any kid can download a demo version of fl studio, torrent a Marvin Gaye record, loop 4 measures of a random song, and overlay it with Funky Drummer. It's easy. and anyone can do it. If you want to be respected as a producer, you have to find other ways to stand out from the amateurs…

(I2) I think that technology limited what we could really do with sampling until recently, as did the total knowledge base of hip hop, as a single entity. Nowadays, there's no excuse for not flipping the hell out of a good loop, re-arranging it fifteen ways to sunday and then sampling 4 more songs for accents or using synths to round out the picture…there's no excuse for straight up looping something and calling it a day. A hot beat is a hot beat, but the solidity of your own work ethic will nag at you in the end.

(I3) The way you chop a sample, you can tell a premo beat by the way he chops his samples, madlib, dilla, pete, 9th etc. give em all the same sample they'd all chop it differently. There is an art in microchoppin and not just on the kick and snare. of course drums are a major role too and mixing and shit but choppin is not a small piece to the puzzle, your chops are your ear.

(I4) Focus on the small details. Samples will give you a pretty good base for a song, but don't underestimate the little things you can add. Think of all the beats you like. There's little things that give them they're signature essence, right? Focus on adding things to your samples that not only show off your personality as a producer, but also takes your beat to the next level.

TLDR: don't underestimate adding little details.

(I5) Let the downvotes pour on me, but I hate this kind of lazy shit. Looping a few bars you stole somewhere without chopping or adding anything and then slapping your artist name and a tracktitle on it is fucking wack.

Appendix J: Cheesy, Generic and Stock Compositions

(J1) Personally, I would loosen up the drums a bit, they seem really stiff and unnatural which kind of make's it sound like "stock/generic" music. add some feel, move shit off the grid a bit.

(J2) I'd recommend changing up your bass synth sound or pattern, because right now it seems a little generic. I like the bounce of the track, but after a few bars it got kinda boring; to make it even bouncier, I'd switch up your kick, place it differently to give it more swing. I would add a few ambient piano/organ chords to fade in and out later in the track, perhaps.

(J3) i think there are endless ways a beat can sound cheesy. the tempo in relation to other things like the sample or the use of drums. "stock" sounds. hollow sounds that need to be layered and aren't and make the beat feel empty.

(J4) For me its the subtle variations that do it. A slight change on the hi hat. A Rhodes lick that is embellished in just one bar. There's a huge amount of tiny changes that when on their own they don't seem like much but added up you get something special. Then again some of the greatest beats ever have been repetitive. There is a temptation to over complicate things when you gather lots of ideas you like. Think subtle, and tasteful.

Appendix K: Rendering Not Necessary

(K1) Maybe I'm being obtuse, but I've yet to run into a situation where I'm convinced I'd be better off bouncing a synth. I feel I have much more freedom being able to manipulate individual midi notes and automate cut offs and such wherever I see fit. I don't see any reason to bounce to audio so long as your computer can handle loads of tracks and many instances of the same VST. I'm genuinely curious: Am I really off base here?

(K2) I hear a lot of artists say that they get really creative sounds by bouncing their tracks and then going at them again.

Why does this enable you to get more interesting sounds? I don't have a bottleneck in processor power, so I could theoretically keep stacking effects on the channel without bouncing it. Does anyone on here use this technique frequently, and if so what do you do to the audio after you bounce it?

Appendix L: Waves Are More Fun.

(L1) maybe it's just me, but sometimes working in audio is more "fun". I sometimes find it more fun to drag around audio loops

(L2) I hate having MIDI in for some reason, haha. I bounce as much as humanly possible; audio manipulation is much more interesting and fun for me.

(L3) I suppose my passion has two branches, working with audio hands on (wave forms give me boners), and creating music with that audio.

Appendix M: Tempo Equals Space.

(M1) So, if you take a track that is 80 bpm, and change it to 160 bpm…and wanted it to sound the same, you would change all of the note lengths to double whatever they were at 80 bpm. The advantage of doing this is that your quarter note (Mne quarter note at 80bpm, one pulse of the beat) is now double its ordinary length at 160 bpm.

This makes it much easier to make fast fills than it would be at 80 bpm, because everything is twice its normal size on the grid. You can hypothetically make a fast, 128th note fill at 80 bpm, but those notes will be so damned small that it would be difficult to give them swing, create variations, etc. But if you wanted to do a fast, 128th note fill for a beat that, by all accounts, sounds to be in 80 bpm, that is programmed at 160 bpm, those 128th notes appear as 64th notes, which are easier to work with since they aren't so narrow.

(M2) I just prefer higher BPM because it gives you a little more space to create variation if you are using a step sequencer

(M3) This is how I look at it:

When you produce dubstep at 140 bpm, you have half of a bar to work with before your snare hits. This means more space / time for elements like percussion but also for wobbles.

You have a much broader spectrum of ratios to work with if you produce in 140 bpm. What I mean is that when you put your LFO at 1/12 in 140 bpm, it will go faster than it would in 70 bpm, which is logical but also means that to get the speed of 1/12 in 140bpm in 70bpm, you'd need a much higher ratio which is impractical.

Also a big point is that some DAW's and a lot of analog gear don't have a grid that goes below 32ths of a bar, which you would need if you want to produce dubstep in 70bpm. It all comes from the analog way of dubstep I believe, but don't quote me on that. There is virtually no difference, it's all just a matter of what you are used to.

Appendix N: Automation

(N1) If you want to make good music, you're probably going to be automating a lot of things to make every transition or phrase as smooth to your ears as possible. For example, bringing something into the foreground, you might gradually increase reverb predelay, low pass filter frequency, and dry volume settings; and gradually decrease the reverb wet, early reflection, and stereo width. Or raise the low-pass filter on some chords to build intensity. You have to be automating

(N2) So make them? Making risers is so easy it's insane

(N3) I automate everything. God damn everything.

(N4) Automation adds in an element of depth in your music that's unachievable otherwise. It creates a change over time.

Imagine performing a live show where you play every single note and key at the same volume. How boring and limiting is that?

I tried some stuff out but didn't really feel like it added more to my track.

100% bias. That's because you barely even tried. If you actually immersed yourself in the possibilities of automation and all the parameters you could use it on, you'll see just what it can do to your music.

Appendix O: Arrangement Templates

(O1) Pull a reference track into your DAW. Listen through and insert markers every 8 or 16 bars describing when things happen like:

"Drums come in"

"Start of breakdown"

"Chord progression changes"

Then, put aside the reference track, and just use the notes that you have made to construct your song. This will make it easier to structure songs and help you get an idea of how the pros do it, so eventually you can make structural and arrangement decisions intuitively. Good luck!

(O2) One thing that helped me a lot was dragging a song I liked in Ableton/DAW of choice, and taking notes on the structure of the drop. I'd get pretty detailed with the notes and it'd look something like this: - first 2 bars - 1/4 note bass hit - 1/8 note repeating bass that continues for 1.5 bars etc. etc. I'd try to make sure id organize it and group it in 16 bar groups, and then further sub categorize them into 8 bars, 4 bars, 2 bars and then everything that was in those 2 bars.

Seems tedious but after I did that with a few songs I really started to get a good understanding of what should come next when Im making my own drops, and I started to recognize certain patterns that many people would use.

When you start off, you're definitely not going to have anything close to a complete and satisfying song. You'll just have semi-independent loops or very short snippets that sound cool. Eventually, with enough producing, you'll work out how to build full songs out of them and layer them. Looking at reference tracks, and/or recreating them, can help you out with building a song structure.

(O3) Reference other songs and study their arrangement. That really is the trick.

What I do is drop a song into my DAW, then cut the track when a new song section comes in so I can visually see when things come in and out. I'll then model the overall song idea that I've already created to fit that arrangement scheme that I liked... You'll also get new ideas you had never thought of before by doing this. After awhile you'll be able to do lots of arrangement tricks on your own based on the arsenal of ideas that you've studied.

Also, layout the entire arrangement of the song before you even try writing full song sections. Have a full 6 minute long track laid out in front of you from the start. I typically do this with my drums to determine where the intro/outro, drops, and breakdowns are, and I add the rest of the sounds in on top of those song sections as I go. It's simple, but this makes it MUCH easier to finish, because

you've already got the arrangement finished, you're just building up from the foundation from there on.

Appendix P: Organization/Grouping

(P1) Hello r/edmp, lately I've been working on a track that I am really proud of so far. I've gotten to the point of the first drop section, and my mixing seems pretty damn good so far, but I decided to take a break because of how strangely tired I feel. I think it's because of the clutter of my track, how there are so many random waveforms of FX that are absolutely vital for "filling out" my track and keeping the breakdown interesting. This dependency on all these cluttered waveforms and automation clips as well makes my track seem like some shaky construction. Is there some way any of you deal with this feeling if you get it, a solution?

(P2) I find it helps to associate the sound in a loop with a certain color…This works like associative thinking... By that I mean, we associate warm with red, cold with blue. Here's some tips: Use similar colors for similar sounds, synths, OR sound TYPE (for example, it helps having all your percussion in the same color so you know that those particular audio files are percussion) …Use colors you can associate with a feeling or sound. For example, I use yellow for my leads cause to me, leads sound like bees. I use red for bass cause bass is warm, sub deep purple cause sub is deep, white for drums cause drum skins are white, blue for pads cause pads are cool/relaxing, etc. This makes it easy to spot the pattern youre looking for when you have a lot of patterns. For example, I know when I need to adjust my bass I know to look for the red patterns…You can color the channels, the tracks, and the patterns, depending on how much coloring helps you stay organized.

(P3) Sometimes spending time colouring and labeling things can really kill your flow once you get in that creative headspace, i usually make things more organized when i feel like im not doing anything productive or brick walling.

(P4) I group em' by frequency range mostly, excluding the drums which is divided by 2 groups (highs and lows). Works wonders for my mixdowns. In all I have 4 main busses excluding the premaster.

(P5) I have recently begun coloring tracks - Logic's default is blue for audio and green for MIDI, but grouping them based on type of instrument has been pretty useful.

(P6) Like was already said in one of the comments, bounce all your tracks that have crazy FX and automation into one audio track. Makes it much easier to work with. Alternately, go into the clips themselves, rename them, recolor them according to their function. Then group them all. That way you can still mess with them if you ever decide to go back.

Appendix Q Visualization as Distraction

(Q1) I could see the sense of editing with your eyes if you were planning on distributing screenshots of your music rather than sound files. The danger is that your eyes always overrule your ears - it's just how the human brain works. If you see the sound, your ears will lie to you to fit in with what your eyes tell your brain you should be hearing.

When the end product is sound, that's usually a bad place to be coming from. I guess I'm just struggling to tell what useful knowledge you'd garner from watching a waveform change shape.

(Q2) Watching levels, automation envelopes, midi patterns, etc. can affect how you hear the track…Along with being distracting, I think watching meters and all that can put ideas in your head. I usually close my eyes unless I have a reason to be watching the screen.

(Q3) Why would you want this? Compress with your ears...not your eyes.

(Q4) I never really thought that watching the window could change the way you listen but it makes tons of sense. By only listening you are forcing your ear to listen for the subtle changes without any exact timeline of what's going on.

This may be a way to get a better feel for the way a listener will interpret the track

(Q5) I often blank my monitor or hide my DAW app when I'm trying to make a critical listening decision.

Appendix R: Groove

(R1) Three things that I can recommend :

1. lower the tempo dramatically when recording drums (or anything for that matter), down to 60 or even 50 bpm. This helps a lot in getting a good groove and you won't have to quantize as much.

2. Practice and then record a lot of bars and then cut and use the good ones. It usually takes a while to get into the groove, so don't expect to hit record and record amazing 4 bars on the first try.

3. do not simply layer samples on one pad, split them across different pads and then hit then with some extra sloppiness. This makes your snares sound much more lively, I usually have at least 2 snare and 1 clap pad.

(R2) Try to misplace some notes or hits outside of the grid…so everything doesn't hit simultaneously. This makes it more humanized…

(R3) If they're sounding really robotic, sometimes I will put the snare/clap slightly ahead of or behind the 2 and 4…And if I have multiple snares or claps I'll leave one maybe on the 2 and 4, and move the other slightly ahead to give kind of like a "Flam" feel to it.

(R4) You don't need to shift things far - a couple tiny milimeters to the right or left of a grid line should do the trick. Play around with it until it sounds right.

(R5) Put your kick, snare, and hi hats on separate tracks…Now grab all your hats at one time and bump them to the right, grab all the snares and bump them to the left…Adjust until you get the right swing you want, move them more for a looser feel.

(R6) NyoZa:

What does swing do again?

MIDI_Hendrix:

In music terms, the word “swing” refers to a bouncing groove that can be created in the rhythm of music. This can be achieved with any instrument but usually happens in the bass and drum parts of a music arrangement. A primary example of this sound would be the swing style of jazz music that was popular in the 1930s.

NyoZa:

Wait, so swing incorporates swing? This is really cool.

MIDI_Hendrix:

Yes, there is(?)/was a whole genre called "swing music". In today's eyes, swing is just what the groove is called. In hip hop production, swing is basically unquantizng your programming so it gives your drums/bass a more "human-esque" feel/groove...IMO you should add some swing to your drums and bass on all of your tracks. It just feels more natural that way. I tend to add 9-21 percent on all of my tracks. Sometimes I vary from my norm, but I tend to stick with that range. It really just depends on what I feel is right. If it were trap I was making, the only thing I swing is my kicks and claps, but keep my snares, hats, and bass on a quantize.

(R7) Whatever it is you're trying to do, find examples of it and copy it, drum for drum. After you do this for a few beats /songs you should start picking up on patterns. Different styles are defined by different rhythmic patterns and ideas but you be able to pick up on them if you're paying attention.

(R8) challenge yourself in this way: don't quantize ANYTHING on your next beat. or how about, not even on any of the next beats you make for the next few weeks. just leave quantization out ENTIRELY. see what happens.

I predict at least 2 things will happen. First, you'll be forced to develop a better sense of rhythm without relying on crutches. Second, you'll realize what YOUR sense of rhythm actually is.

Fans can tell a Dilla beat from a Madlib beat from a Pete Rock beat or a Preem beat based on certain characteristics they had as producers. You need to hone YOUR characteristics.

edit: once you have good rhythm and know what your sense of rhythm is like, THEN you'll know when to apply some quantization and when to let that rhythm out of the cage. key concept is BALANCE!

(R9) I quantize everything for the sake of perfect mixes, but because my drum samples aren't store bought and perfectly cut by a soulless algorithm, I can get the unquantized feel by leaving a bit of space before they start in the sound file itself. I also make use of swing and I can program decent drums from time to time, when the moon is right.

(R10) very basically: your quarter note hi hats should hit just behind the right timing. this kind of swing is often credited to Jdilla. this video is real helpful in explaining this

(R11) I used to try to force use of it. But for the most part now I just play out my drums and naturally add swing/groove. Then adjust and slightly quantize certain hits. It can help if you know you have the tempo right but you can't get your drums to sit properly with a sample.

Also some time's just increasing the tempo by 1-2 bpm and adding some swing so the snare hits a little late, can get you a little extra groove. Or slow it down a little and add some inverted swing to make it hit sooner giving you a more snappy type groove (Hf that makes sense lol). Also good to use just applied to hi-hats and other percussion elements individually, bass is a good thing to try applying it to too.

Also try to look up articles of roger linn talk about it. A lot of it has to do with mathematics in a way, and different swing settings really come to life at different tempos.

(R12) I've been recording a sample pack with claps and snaps. The thing you really want with this sounds is the flam effect, that is for two sounds to sound really close, but not at the same time, so you hear a snappy sound twice, not a hard hitting impact, but sort of like a "tra" sound.

The other thing that will help is to pitch shift samples to a lower note, so it gets a fatter sound. You could have a copy of the unshifted sound and hipass it so you get the clarity of the snap while having the beefy-er sound of the pitch shifted one.

Other things include:

(R13) Pretty much, except I typically get a snare sample then two clap samples and space the apart ever so slightly. What i mean is that I may put the snare on the beat, while one clap is slightly before the beat and the other clap is slightly after the beat. You'll know when you do it right because it feels like the sound is one, except it sounds larger. It makes it sound more organic as well. Then once you do that, pan each clap slightly left or right and then add whatever effects you like. For me, I add a slight amount of reverb, ping pong delay, and sample delay to the claps. Sometime's I group the three audio channels together then I add a compressor and EQ to bring out the highs a little.

(R14) On the more micro side of things, what happens between kicks is just as important. Sounds that help anticipate the beat are immensely useful. Things like an open hihat playing on the "and" of the beat(e.g. 1 & 2 & 3 & 4 &), provide for a "stabilization" of the beat. A reverse clap that leads into a clap of a different timbre can work extremely well. Ghost notes that accent and augment any kind of rhythm adds timbre and velocity variations that create a wave of change that help the ear.

(R15) For me my kicks and snares are on the grid and the swing comes from the hats. Loops will usually be swung and are a good starting point. The difference was night and day when I first understood how to make use of swing. Look into triplet, quintuplet and septuplet swing for more funky/bouncy patterns. Varies from genre to genre what works.

Appendix S: Head Nod (Bob)

(S1) Don't forget about the groove - if you can't bob your head to your track it needs work”

(S2) I have always struggled to get my hi hats to really sound bouncy and pleasant. I usually apply groove that varies up the velocities and timing of each hit and I add a fairly dry phaser to keep them from being too robotic but they still lack that bounce that makes your head bob. What can I do to get my hi hats to get people grooving even when it's just a simple 1/8th note pattern? Is it a problem with compression?

(S3) Started working on this a bit yesterday after listening to "Mystic Stylez", some of my favorite 3 6 songs are on it. I made the beats, just going for a simple, bob your head type vybe, nothing crazy or groundbreaking, then decided to add some vocal samples.

(S4) You know why I think people love Dilla's music? It isn't really because of his skill, or his style, because those things alone would just make him another "ordinary" legend or master of the craft. What set people like him apart was his ability to bring forth a meaning and essence from a sample in a way that appeals to the head nod Hip Hop fans (because he wasn't the first to do this, believe that) In other words, he brought life to Hip Hop instrumentals; Made them stand on their own and say things on their own.

Appendix T: Sidechaining and Trap

(T1) That being said, I actually think it's easier to be more accurate (and to find interesting applications) with side chaining when you actually automate the volume envelope of a loop or clip, rather than using actual side chain compression. Using a volume envelope plugin, like Xfer's LFO Tool or Nicky Romero's Kick Start plugin, lets you avoid having to make ghost tracks and spend forever tweaking your compression settings (plus in Ableton it means you can freeze and flatten tracks).

(T2) It's great to be able to visualize exactly what you're doing, and it's great for discovering other cool things you can do with volume automation. For example, I use LFO Tool to make my hi hats sound more realistic without having to individually adjust the velocity on each one.

(T3) The reason plugins like LFOTool, Volume Shaper, or manual automation are different than using a compressor to sidechain is because you have more control over the actual shape of the automation curve. With a compressor, you can't completely control the curve. You can tweak the various settings of a compressor, sure, but you can't control the shape of the "automation" curve in the same way you can with those other tools. I'm not trying to be rude but either you completely missed the point or don't understand.

(T4) There aren't any rules per say, however there are basic mixing principles you should follow. In most EDM for example, the kick drum takes up a bunch of the sub 100hz frequency spectrum. Therefore, whenever the kick is hitting, you usually want to side chain the bass and sub bass so that it doesn't interfere with that kick drum and the kick drives through the mix. Obviously there are tons of exceptions to this for every type of genre and style; each has their own "rules" but most are made to be broken.

The main takeaway is that the pumping effect of most 4x4 "EDM" tracks nowadays is there to 1) make room for the kick 2) give you the urge to groove and jump with the song.

If you notice, when you jump to the beat of a song your hearing kind of cuts out whenever you hit the ground? My little theory is that the side chain effect is conducive to jumping, which is why it became so essential in modern dance music. Feel the bass when you hit the ground, hear it music when you're in the air. Just my 2 cents.

(T5) Yeah piano roll is pretty much excellent for sequencing drums, gross beat is great for trap, the troll reply gets upvoted, it doesn't really matter what DAW you're on as long as you can produce but for trap music FL studio provides you the most straightforward ways to do a lot of the signature tricks of the genre.

(T6) FL Studio is actually excellent for creating trap and dubstep music. Its workflow is designed to be mouse-and-keyboard-friendly. Let's face it -- when you're making trap music, you're not going to actually play-in those 64th-note snare rolls. You're going to click them in.

Appendix U: Miscellaneous

(U1) with the "Hot Swap" feature and now the Live 9 browser, it feels like I can try something almost as quickly as I can think of it.

(U2) Practice is the only way you're going to get there. I started out just messing around with simple things in Garageband to get the hang of it. Every time I made a change, I'd listen to it before and after to see if it sounded better or worse. Then I played around with every button and option, until I felt its limitations and upgraded to a more powerful DAW.

A big part of it is training your ear to figure out what meshes well, what two songs might have a similar key or beat or whatever. Think of the best mashups you've heard - what might the samples have in common? That sort of thing. Learn to pick out each individual instrument if you can.

See if there's a music college in your area; a lot of them will let you take classes without needing to formally enrol. I'm six months into a BA in composition & production, and I've progressed more in that time than in the two or three years prior. There are also some great tutorials on YouTube (and some so-so ones). Find someone who seems knowledgeable or whose videos are popular and see if they fit your learning style.

TL;DR - keep practicing, train your ear, learn from the masters, and find your own voice.

(U3) With notation you write and have it interpreted [sic] by a musician playing the piece. Electronic music composers don't have that luxury, every second has to be painstakingly described. Having learned notation then given up on it for being shit, every time I hear people talk about how good it is to know, or how it's better than automation and midi, it's all bs. Basically you could just do a complicated scribble on staff paper and say, here play this, some composers expiremented [sic] with that. That screenshot IS the music.

(U4) It depends on the style I'm going for but I use samples sometimes. Aaaaand if someone can be #1 on Beatport using samples and you can't, you can't say shit. Sorry.

(U5) I have a library of drum breaks and occasionally I'll look around in there and chop 1-2 beats of it and throw it in to my custom drum loop to give it flavor. I don't feel bad about it at all.

(U6) I see way too many posts on here along the lines of not knowing (or wanting to learn) how to write melodies or that your song sounds really boring since theres like 3 chords playing the whole time. Producing music is not just sound design etc it also involves..wait for it... writing the music! Writing music is an art, it takes time dedication and im sorry to say but also some talent. If your songs are

"boring" or you dont know how to write a beautiful melody then fucking work on it, research composition etc. Dont treat the actual content of your song as some abstract idea next to the sound design, the melodic progressions, chords etc ARE the song, But just asking on here "help i have no idea whats wrong with my song?!" When theres nothing interesting about the melody or chords is incredibly annoying because not only does it show a lack of actual commitment to the art of writing and composition it shows how fucking lazy youre being for not doing a little google search. Quit treating melodies and progressions like theyre just something you have to do in order to use this new synth you like but instead treat them how they should be seen, as the star and REASON for using that cool new synth. End rant.

(U7) In my personal experience, I spend too much time worrying about mixing and sound design when I should be worried more about the general musicianship of the track in the first place.

(U8) The other thing is you can get way too caught up in sound design you forget to actually make music that has personality to it. People who listen to your music, not producers, aren't gonna know if a kick drum isn't punching through the mix enough. It helps to have good sound design, but I believe a lot of people will overlook that if they can vibe with the music itself.

Appendix V: Music Theory

(V1) Whenever I try to learn about theory, my brain just stops functioning, I just can't seem to pick any of it up and retain it. I completely understand and acknowledge how important theory is but my brain just can't make the connection between theory itself and music and it makes me upset sitting down for hours and getting nothing out of theory lessons. I want to learn theory in order to use it and be an effective producer but I really have no interest in theory itself, I find it extremely boring, tedious, and I have a negative reaction to in-depth theory discussion because, well, it's simply boring and stuffy and there's no sort of engagement that you get from actually learning something tactile like playing the piano.

(V2) Learn it, but be careful. Don't let it restrict you into needing your music to make "theoretical sense" (if you will).

(V3) A bit of a controversial question from what I have seen, but I am curious as to how much music theory can benefit you if you are going to try and make your own music. Are there any famous examples of popular EDM producers who have little to no knowledge of such things?

Music theory is very important but you don't necessarily need to know much to be successful. I personally never wanted to be one of the producers who just bangs keys and wanders aimlessly until I come up with something good, I want to understand more than what I put into practice. Understanding the complexities of Beethoven or Bach seems like a no brainer to me since I plan to make music my entire life, even if I'm making something simple that has no relevance to classical music…Music theory does help tremendously with melodies, voicing, etc. but there are plenty of brilliant musicians and scholars at my school who can't compose.

People who don't understand theory are quick to say it's pointless, but in the end, it's good to *understand* what you're doing and know how to execute the ideas in your head. Knowledge is power, so knowing theory only puts you ahead. However, we're making electronic music so there are many other aspects of learning as well - such as mixing/mastering/etc.

Basic theory will get you by but I highly recommend learning piano to any producer, since it's the most applicable instrument to daws.

(V4) So ive been making beats for a few months and the seem almost trivial, like they are missing something and im wondering if i need to learn some music theory. Ive been watching some videos but im wondering how much of it is practical in a daw. Im looking for the most practical music theory possible. Any suggestions?

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