12-12-2022 2:15 PM

Sound Judgements: Music Education Framework for Guiding Digital Mixing Practice

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A thesis submitted in partial fulfillment of the requirements for the Doctor of Philosophy degree in Music

Abstract

Mixing is an intermediary process within audio production wherein the aesthetic and technical qualities of musical compositions are further enhanced and refined. Most music perceived via audio-playback devices is mixed to sound a certain way. By understanding why recordings 'sound' how they do, musicians, music educators, and novice mixers can acquire a greater appreciation for mixing while considering how this process might affect their own performance practices (Hodgson 2019; Fisher, 1998). Knowing how and what to listen for when mixing is highly subjective, as people experience and describe sounds differently. Indeed, mixing is illusory as listeners are presented with an apparent single acoustic phenomenon (the mix) with all the sounds blended to complement one another to sound aesthetically pleasing.

This study introduces readers to a flexible music education learning framework involving principles, guidelines, and strategies which students and music educators of secondary and post-secondary levels may refer to when learning to mix. Such a framework outlines ways of listening, evaluating, and mixing sounds through reiterative decision-making processes. The researcher's purpose of this study was to engage firsthand in mixing practice through autoethnography to experience, explore, and document the craft's musical potentialities. One of the researcher's primary goals as a novice mixer was thus to make musical arrangements 'sound better.' It is what constitutes 'better' that makes studying mixing practice mysterious and highly subjective, although mixing processes also involve objective, numerical, and scientific values (i.e., Hertz frequencies, decibels, etc.).

Among the significant findings of the study were important insights into the elusive mixing goals of improving the 'musicality' of arrangements and exploring the skills and competencies necessary for students to learn how to mix with a technical and aesthetic mindset.

Cultivating a sense of musicality within mixes is difficult, enigmatic, and an utmost mixing goal due to the lack of ‘one-size-fits-all’ solutions and the accessibility of mixing tools. Beginners might be overwhelmed if not provided with a learning framework for mixing that includes helpful guidelines and possible strategies to make sense of what they see, hear, and can do musically.

Keywords: Music education, mixing practice, audio production, autoethnography, record production, DAWs, Ableton Live, music technology, sound fidelity.

Summary for Lay Audiences

The music recording studio with its tools for crafting, curating, and refining records was long an isolated practice and the province of recording engineers. With advances in technology and growing accessibility, however, anyone with a personal computer, audio production hardware interface, and software (also known as digital audio workstations [DAWs]) can now record, arrange, edit, mix, and master their own audio recordings and music. Otherwise known as music mixing, this process of digital music making is increasingly found in school music programs as students seek to craft their own music via digital technologies. Yet music mixing remains a relatively recent interest among music education researchers (Bromham, 2017).

The researcher's purpose of this study was to engage firsthand in mixing practice through autoethnography to experience and document the craft's responsibilities and musical potentialities. As illuminated in the study, mixers critically listen, evaluate various sounds' musical and sonic relationships, and ideally shape them to make musical arrangements sound technically and aesthetically better than they were. What makes the craft difficult and enigmatic is the lack of 'one-size-fits-all' solutions to technical or aesthetic ideas. The mixer's goal is to make musical arrangements 'sound better.' It is what constitutes 'better' that makes studying mixing practice mysterious and highly subjective, although the processes available use objective, numerical, and scientific values.

To explore mixing, the researcher used, experimented, and documented his actions with various mixing processes while attempting to improve musical arrangements. One of the significant outcomes was the generation of a music education learning framework outlining principles and guidelines for students' mixing practice. Such a framework is flexible, as rigid

parameters and guidelines allow little room for creative ingenuity, a vital trait for artistic mixing practices.

Mixing may provide students and music educators with a means which they can better appreciate recorded musical communication. Mixing is also an intermediary audio production process shaping how sounds are balanced against one another and are ultimately rendered to be heard as a single acoustic phenomenon, formally known as the mix. This process is both highly technical and artistic.

Acknowledgements

First and foremost, I would like to thank my supervisor Dr. Paul Woodford for his patience, guidance, and support throughout my doctoral and master's studies. I am extremely grateful for your time and effort spent in assisting me while I completed the dissertation.

To my second reader, Dr. Jay Hodgson, thank you for your support, research advice, and introducing me to the world of audio production. This research would not have been possible had I not taken an introduction to audio production course during my master's studies.

Thank you to my parents, siblings, and friends for keeping me in good spirits.

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CHAPTER I

INTRODUCTION

Probably most people are familiar with the general purpose and function of the recording studio and have doubtless heard the descriptor ‘mixing’ applied to sound engineers. Many listeners, however, may not be aware or particularly knowledgeable of sound engineering principles employed therein because the work done by these ‘mixing engineers’ is both highly technical and at times meant to be undetectable in creating the illusion that the recording artist(s) is the sole creator of the music heard. But what exactly is mixing and what is it that mixers do? In its simplest terms with respect to the recording studio, mixing is the process through which sound engineers curate musical sounds that were previously recorded with the intent of refining and enhancing them (Horning, 2004). With the proliferation of electronic dance music genres in recent decades, however, this definition of mixing has been expanded to describe it as a compositional and creative process, which collapses the traditional view of mixing perceived as a rigid and technical stage of music production (Devine & Hodgson, 2017).

In the recording process, there is a great deal of work between the music recorded in its early stages and the final product that is communicated to listeners, and much of that work takes place in the intermediary recording practice known as the mixing process. Whereas, in its traditional form, mixing took place behind large analog consoles that were handled only by professional sound engineering personnel and specialists (Kealy, 1979), those processes are now possible with a personal computer and appropriate software referred to as digital audio workstations (DAWs). With these and other digital tools, mixing is increasingly available and accessible to children and youth, affording them greater educational opportunities than ever before to create, modify, and generally learn about how music works (Byrne, 2012).

Thus far, however, much of what secondary and post-secondary students learn about music mixing in the home or school is acquired informally, with minimal (if any) teacher guidance. Among the reasons for this relative lack of teacher direction and guidance with respect to this mode of music praxis in schools is that mixing practice remains in its infancy in general music education curricula and traditional higher music education (Gall, 2013; Bromham, 2017). It is only fitting given the diversity of popular music practices, in which audio production is a key player, that music educators learn from and expand their own pedagogical approaches to include said musics and associated recording practices. Although there is a rich literature pertaining to popular music's theoretical frameworks, the discourse and research on audio production processes in the classroom is largely absent (Tobias, 2013, pp. 213-214). Moreover, according to Mantie (2017), music educators and students must be active agents and should go beyond simply including music technology for its own sake to use digital recording and audio production tools musically while continuously evaluating and refining their actions, thereby encouraging and facilitating active learning about recording technologies and their musical potentialities.

It is not the purpose of this dissertation to prescribe a universal mixing pedagogy, however, as this practice is closely linked to personal values and experiences. This study instead draws on autoethnography to identify pedagogical principles while recommending guidelines that may help music teachers and novice mixers better understand the mixing process and its musical challenges and rewards. As is explained, music mixing has great potential for enlarging and enriching music education programs in schools by, among many other things, developing critical listening skills that differ from or otherwise enhance those involved in traditional ensembles or composition programs. Moreover, mixing is itself a form of artistry involving the

development and exercise of musical decision-making and communication arguably on a par with performance and other modes of music making. It is worth noting here that musical communication occurs in many ways and is not limited to instrumentation choice and selection, lyrics, emotional character, musical expressions facilitated by pitches and rhythms, or the socio-cultural, historical, and political contexts which potentially influenced the artist's musical decision making (Woodford, 2012, p. 47).

Music Mixing as Recorded Musical Communication

A key question then for understanding music mixing as recorded musical communication is, "What acoustic phenomena are relevant for mixing practice?" Music educators typically attend to the traditional musical elements of melody, harmony, rhythm, duration, timbre, volume, texture, pitch, balance, and blend in their instruction, but these are only *some* of the factors that are rooted in conventional cultural, social, and historical structural schemas (Dawson, 2018, p. 10; Broomhead, 2018, p. 17). Other elements that are involved in the mixing process but that have traditionally been viewed as non-musical or technical, such as the treatment of varying sound frequencies or the positioning of the foreground or background sonic elements, are fundamental ideas in the recording and mixing processes yet are not beholden to Western music theory. For example, a lyrical delivery within a song and representing literary and melodic information can be made more prominent and/or colored to a certain degree by using audio production tools such as filters, compression, and equalization to highlight or accompany meanings embedded in the text. Also addressed is how one might approach and treat stylistic conventions of particular musical genres in the mixing process. These and other factors that enhance musical arranging within mixing practice are explored herein.

The study is primarily inspired by Hodgson's (2010; 2019) groundwork scholarship in recording practice, which emphasizes the importance of musicologists and educators understanding what it is they are actually listening to in musical communication mediated by recording practice. For example, the apparent single acoustic phenomenon listeners consider a song or track (the mix) is for most people only an illusion. The mind processes a multitude of individual acoustic phenomena, such as percussive elements and sounds, a piano, guitar, voice, or an entire symphony orchestra of instruments, but is heard as a single acoustic phenomenon (p. 3). The mixing engineer manipulates all the relevant recorded elements of sound with the intent of refining, enhancing, and shaping the sound sources to better complement each other with the overall goal of crafting a coherent and artistic whole or, as it is said in the trade, a mix.

Hodgson's theory of record production considers that recorded musical communication is the result of perceiving auditory representations of sound instead of acoustic information (2010; 2014; 2017). This is an important distinction because a music recording does not replicate a variety of sounds that an individual hears and understands (e.g., drums, piano, guitars, vocal, etc.). Rather, it is a single auditory representation of those sounds. Another word for this blend of sounds is the mix. Once the mix is satisfactory according to the mixer's or client's standards, it then enters the mastering stage where the collection of sounds as a whole is modified and, as such, is referred to as a master.[1] Rather than affirming notions of sound fidelity, this study instead attempts to problematize the concept, as doing so helps listeners to listen critically from a recording practice perspective. By knowing how sounds were produced or mixed to make a recording in its unique format, listeners may gain an appreciation for recording practice as they

[1] Although mastering is outside the scope of this study, one can refer to Shelvock's (2012) *Audio Mastering as Musical Practice* for an extensive overview of mastering as an artform and facilitation of musical communication in recording practice.

understand what they are hearing (Fisher, 1998). Deconstructing and critically examining recorded performances can allow musicians, music educators, and novice recordists/mixers to gain a clearer understanding of how certain sounds were recorded, produced, and mixed in ways only replicable using audio production technologies.

This type of work requires a discerning ear that can distinguish the subtle nuances among sound sources, a capacity to exercise aesthetic judgment suitable for musical genre and style conventions, and appropriate musical technical expertise as mixers use the tools at their disposal to refine the artistic visions that are inspired by, shared, or handed to them by recording artists. As described and explained below in more detail, music mixing is a mode of critical listening dedicated to the pursuit of sound fidelity, a concept further elaborated on in chapter two, as individuals attempt to realize what they regard as ideal musical values. The proposed study of mixing can help music teachers and their students better understand how recorded music is mediated and curated prior to consumption, knowledge of which is essential to the development of pedagogical principles and guidelines related to music mixing.

Statement of the Problem

As already suggested above, music recording practice today is largely conceived as a mode of communication. Yet this medium is still not a tradition within which music educators tend to be comfortable, or that is accessible to them and to those in general education training opting to teach music. Mixing and other recording practice techniques remain largely novel areas of knowledge within the field of music education, as can be seen in the academic literature, in which those practices receive only cursory attention (Bromham, 2017, pp. 246-247; Zagorski-Thomas et al., 2020, p. 2). There remains among many music education academics and teachers a lack of interest in and therefore also reluctance to delve deeper into the various recording

practice tools and techniques that can potentially enrich music teaching and learning. This lack of interest in and understanding of the musical potentialities of recording practice techniques and tools is exacerbated when strictly limited to reading articles and books, as words and visual images cannot fully convey how sound is manipulated and may lead to confusion as to how people subjectively perceive and identify sounds.

Within the various interdisciplinary fields that make up sound studies, problems compound when respective scholarly disciplines utilize their own forms of jargon when observing what are otherwise identical forms of auditory phenomena, especially given the fact that books and academic papers can reproduce visual images but not sounds. Because people perceive and interpret acoustic phenomena subjectively, there is no universal vocabulary which reliably describes sound qualities in musical or sonic terms (Bromham, 2017, p. 254). One set of ears could perceive and interpret sound's quality as "warm" when the same term could mean "muddiness" for another auditor. Therefore, a higher premium should be placed on language and terminology that are closely inter-related with acoustic phenomena and psychoacoustics than with vision (Bijesterfeld & Pinch, 2004; Porcello, 2004).

Statement of Purpose

This study investigates music mixing processes by means of autoethnography to reveal and explore common pitfalls in this audio production practice, the necessary listening and software use competencies, and the overall character of working in this craft while highlighting its various subtle nuances of discerning and treating sounds in their musical and sonic relationships. As already mentioned, but that I explain next, music recording practice is concerned with facilitating a recording's perceived representation of sound qualities. Listeners make many value judgements while they are perceiving a recording according to their subjective

standards of ideal sound quality, otherwise known as sound fidelity (or lack thereof). Mixing is one of the means for shaping the sounds by using various signal processing tools and processes which affect listeners' perceptions of a recording's sound fidelity. With respect to recording practice, fidelity is "never an intrinsic sonic quality. Rather, it is a qualitative standard that is limited by and contingent upon the technologies and cultural circumstances of the historical period it circulates in" (Coverdale, 2010, p. 19). Aside from matters related to audio recording, fidelity can also be investigated from the angle of performance practice which is not limited to "high" or "low" art. Glenn Gould's peculiar interpretations of baroque and classical music or Jimi Hendrix's (1968) psychedelic rock version of Bob Dylan's original folk tune *All Along the Watchtower* (1968) are only a couple of examples that demonstrate how fidelity is not set in stone *per se*. The musical ideas of the twentieth century would have lacked variety if individuals refused to challenge fidelity within performance practice. Thus understood, fidelity is an interpretive standard and constantly changes owing to evolutions in audio production technologies and performance practices, shaping consumers' expectations of sound quality. Fidelity is explained in greater detail within chapter two due to its involvement in recording and mixing decisions.

To interpret mixing processes from a music education perspective, the study draws on theoretical ideas and philosophies from Belland's (1991) and Eisner's (1985; 2017) connoisseurship models of education, Benjamin's (1969) *The work of art in the age of mechanical reproduction*, and Dewey's concept of transactional experiences from *Art as Experience* (1934; 1958), all of which are explained in further detail in chapter two. Belland (1991) argued that one must go beyond traditional research paradigms, since learning experiences are complex and personal. Influenced by Eisner's (1985) ideas on connoisseurship in

education literature, individuals must sense the aesthetic details and affective characteristics that instructional mediums or systems will evoke in learners (Parrish, 2012). If mixing practice shapes how listeners experience the aesthetic character of music, one must adopt a research paradigm broad enough to capture the various complexities needed to make a mix sound "good." For these reasons, I selected autoethnography as a methodological tool to investigate mixing practice.

Dewey's ideas offer a perspective to analyze how individuals interact and learn from one another when analyzing mixing practice in music education. Many experiences are transactional since people interact and learn from one another, thus influencing future experiences with others (1925/2000). Mixers vary according to their experience levels, subjective preferences, and personalized workflow techniques. These traits also carry over to music educators and their students who are learning to mix while allowing room to learn from one another.

As just suggested but that begs repetition, the aim of the study is to guide readers through mixing processes and the tools necessary to complete them, illustrate common pitfalls that occur in mixing practice, describe, and explain some of the competencies required for mixing practice. This is all with a view to developing theoretical and pedagogical frameworks with guidelines that can assist students and teachers when venturing into this audio production process. The intent is to bring music education closer to decades/years of experiences and knowledge rooted in recording practice paradigms, a field that has traditionally been outside of formal music education.

Fidelity and Mixing Practice

Benjamin's (1969) theme of artistic reproduction underscores the theme of fidelity or lack thereof in audio production, especially since mixing might provide impressions of

believable recordings or amplify the sonic possibilities available through signal processing tools. In the latter instance, the "echoed" signal processing and tape effects used in records, such as Pink Floyd's *Dark Side of the Moon* (1973), are illustrative of the creative options available. Mixing practice complicates matters dealing with aesthetic authority, especially if calling fidelity into question. During instances in which listeners are seeking proficient and musical performances, mixed recordings may be deceptive since the final product one hears differs from the original recordings. In other cases, artists and engineers manipulate recordings while mixing, as this is part of the creative process available to them.

Judging recorded performances for their sonic fidelity in resembling live performances yields few benefits to those wanting to know more about recording practice as a technical endeavor and art form. Listeners might sense a loss in fidelity between original performances and their audio-reproduced copies, particularly when comparing studio-recorded performances with their original performances. In fact, this definition resembles the original definition of fidelity — the quality of being faithful or loyal between persons, parties, or bonds (Oxford English Dictionary Online, 2022).

Sound production since its inception in recording practice is a studio art and bound to the social relations of those involved in its curation; behind the finished song, track, or album, were the collected "social relations among people, machines, practices, and sounds" (Sterne, 2003, p. 219). Initially, recording was a practice exclusive to sound engineers, or individuals with an intuition for troubleshooting and maintaining audio production equipment, and it became accessible as technologies grew increasingly affordable and powerful. While maintaining fidelity might have been the objective of early recordists attempting to capture the musical performances of their time and experimenting with novel audio production technologies, recording studios with

their collections of analog and digital tools since the twentieth century served as extensions of musical composition and arranging (Bell, 2018; Sterne, 2003). Recording processes have also been used to recreate illusory depictions of performances claiming fidelity to live musical performances.

Artists and mixing engineers might attempt to craft recordings stylistically in one of three ways: high-fidelity, studio art albums, or a combination of the two. High-fidelity recordings resemble performances that are replicable in live settings without the aid of extensive audio production tools and techniques while maintaining transparency. Artists, producers, and mixing engineers crafted studio art album recordings with the intention of expressing minimal or dramatic sonic visions with audio production tools and techniques (Turino, 2008). Although stylistic classifications may be helpful to readers wanting to know more about recording practice styles, they could also be illusory. Artists and engineers may craft ostensibly high-fidelity recordings as emulations of 'live performances.' For example, producers and engineers working with soul music artists Aretha Franklin and Solomon Burke of the 1960s often recorded the people involved in the studio as they were imitating audience sounds and noises thought to be indicative of live performance (Turino, 2008). In a rock/pop example of the Beatles, when asked to overdub a note on a record, Paul McCartney considered it to be cheating, although the practice was common in popular music recording (Martin, 1979). By understanding how recording processes are used to facilitate musical communication, both in technical and aesthetic ways, novice mixers can acquire a better understanding of sounds moulded to express musicality via recording practice techniques.

Dissertation structure.

Following this brief introduction, chapter two commences with a theoretical overview and short history of mixing as a craft, describing how early recordists and sound engineers worked in recording practice through much of the twentieth century and continuing to the present. This historical context precedes a brief music education literature review addressing its lacunae in mixing and recording practice techniques by referencing audio production literature and reviewing its practical and theoretical challenges. The chapter concludes with an introductory and thus necessarily brief methodological overview of autoethnography, explaining the basic rationale for its implementation as a research tool and means of navigating mixing practice as the researcher seeks to address a set of research questions.

Chapter three introduces the music education framework for guiding mixing practice. Included are competencies necessary for mixing practice which are re-examined in chapter six, where the researcher's firsthand experiences are cross-referenced against audio production and music education literature which teaches beginners general audio production theory and principles. Although guides and reference manuals may provide novice mixers with an introduction to mixing, participation in the craft allows greater learning experiences. Also included are John Dewey's ideas relating to evaluating experiences and Elliot Eisner's ideas on connoisseurship. Their ideas form the theoretical basis of this study and influences how mixing practice requires practitioners to examine how they are engaging with aesthetic ideas while communicating, learning, and providing feedback to and from their peers and educators. Schön's reflective-in-action method (1983) is also a pragmatic component of the framework, as it encourages novice mixers to engage in introspective questioning about complex tasks. The second half of the chapter describes and explains techniques and concepts frequently employed in music mixing.

Chapter four revisits and elaborates on the study design, research questions, and other methodological considerations as it further develops the rationale for implementing autoethnography. Autoethnography fit the criteria as an appropriate methodological tool since mixing is a craft typically practiced by individuals and is strongly phenomenological in nature. This is because mixers directly perceive and consequently judiciously treat sounds with reference to cultural and genre norms and according to their subjective expectations of what is aesthetically pleasing or not, which is also a notion inherent to fidelity. Autoethnography requires researchers to place themselves directly into the phenomena or culture which they are studying. By doing so, researchers gain a first-hand perspective of whatever it is they are studying while also understanding how their actions, thoughts, personal characteristics, and positioning in culture relate to the phenomena under investigation. As such, this chapter also describes the researcher's musical experiences and personal background. This information is foundational to the study framework, as autoethnography requires that researchers participate in the practice under study while investigating and questioning their roles therein.

The rich descriptions and organization of various mixing events which occurred throughout the study are to be found in chapter five. Collecting and organizing data requires a level of analysis since the researcher has to decide what events in the mixing process were similar, different, or significant. This study places data collection and analysis in the same chapter because of their interdependent relationship in autoethnography. Themes and sub-themes emerged from the organization of the data. After data were analyzed and categorized into themes, they were interpreted and explored from a music education standpoint. Various competencies, and information specific to mixing practice are explored in greater detail according to these themes. Data collection and analysis overlap and are not separate phases in the

study, although the researcher extensively analyzed the collected events and themes further in the last chapter.

The sixth and final chapter of the study further elaborates on the aforementioned themes and events by analyzing them against relevant music education literature and concepts introduced in the literature review. I explain what competencies were necessary during the various tasks required in mixing practice, problems that arose in mixing practice, and provide a framework which positions mixing and audio production techniques and practice within music education literature and traditional Western music practice. Regarding my own results with mixing practice in the study, I also include what I learned, what mixing scenarios were difficult and why, and what guiding principles were helpful in various contexts. These results will be framed against my background as a musician and educator with both classical and popular music training, so readers could then compare or contrast their backgrounds with mine. The chapter then concludes with implications for future research in music education.

CHAPTER II

A BRIEF HISTORY OF MIXING IN RECORDING PRACTICE AND ITS RELATION TO MUSIC EDUCATION

History of the Theory and Practice of Music Mixing as a Craft

Although mixing and audio-engineering are distinct processes, the histories of the two share common roots and interrelate today. Early recordists, who typically learned their crafts through trial and error, had to be well versed in mechanical, acoustical, and chemical elements involved in the recording and distribution processes (Horning, 2004, pp. 706-708). Perhaps one of their most important skills was the placement of the recording bell (now microphone placement), as it dictated the overall recorded sound via the stylus cutting the grooves onto the disk. For many performers at the advent of commercial recording studios, the process of recording was somewhat of an "ordeal," an unnatural practice by modern standards. Musicians had to position themselves directly in front of the recording horn when performing in order to capture their performances at maximum amplitude. The recording horn transferred this acoustic energy to the diaphragm which then moved the stylus, that finally cut the record's grooves (Williams, 2006, p. 40). As seen in the image below, some of these musicians had to sit closely together while performing with modified "Stroh" violins containing metallic resonators and horns to further project sound into the recording horn.

Figure 2.1: Conductor Rosario Bourdon and the Victor Orchestra of the Victor Talking Machine Company performing before a recording horn in Camden, New Jersey 1924 (Huffman, 2020).

The formal terms “audio engineers” or “sound mixers” can be traced back to 1948, when music industry personnel recognized audio production as a separate profession or craft (McProud, 1968, p. 28). This collective awareness of sound engineering was initially sparked by the actions of unions, which would initially stabilize the livelihoods of performing musicians. For example, prior to the 1942-1944 recording ban initiated by the American Federation of Musicians, many musicians made their livelihoods in temporary arrangements, such as travelling with ensembles during the big band era. As with many other businesses, restaurant and bar owners who traditionally hosted live musical performances in the 1930s felt the need for cost cutting. Recorded music played by jukeboxes was an attractive alternative to live music as it was cheaper and more efficient than hiring musicians, and so began a war between the American Federation of Musicians led by its union boss James Caesar Petrillo and the recording industry

(Anderson, 2004, p. 237). After successful union negotiations, a compromise was reached and session musicians could then earn their livings exclusively from recording studio contracts and royalties (Williams, 2006, p. 146). In later years came union regulations restricting musicians, composers, and record company personnel from being directly involved with recording and mixing equipment in studio settings (Kealy, 1979, p. 10). Henceforth, and until the advent of affordable and accessible computer and recording technologies around the late 1990s, mixing engineers and producers dominated the hierarchy within control rooms, while musicians resided in the lower tier of the performing space (Williams, 2006, pp. 147-148; DeArcangelis, 2017). It is also worth mentioning that the hierarchical structure also had much to do with the divided competencies between musicians and mixing engineers. Musicians would not have known how to operate recording machinery while simultaneously performing music.

Aside from hierarchical positions within the recording studio came craft union regulations in the 1950s. From this point on, recording studios belonging to larger corporations hired administrative supervisors whose duties included "expediated compliance with the contractual provisions of the collaborators, coordinating their work, keeping the studio sessions within budget and on schedule, and selecting and arranging music to suit the company's intended audience" (Kealy, 1979, p. 10). Presumably, these limitations would curb the artistic direction of musicians desiring greater agency at the recording and mixing console. Artistic agency and control over recording and mixing decisions would not change until the mid-1960s, when rock musicians would form their own writing, arranging, and performing groups (Kealy, 1979, pp. 16-17). The transition to greater artistic control and agency behind the mixing console inspired by these 1960s rock musicians was also beneficial in terms of financial considerations (Marrington, 2017, p. 203).

The 1960s witnessed a generation of rock musicians who would reject the notion of having people typically involved in record company contracts oversee artists' work in the studio, such as artist and repertoire (A&R) men. Creating independent record studios kept costs down, since fewer people were hired and involved in the recording process (Kealy, 1979, p. 17). This schism would prove beneficial for this "rock revolution," as it would lay the foundations of independent or "indie" music scenes, evident by the growing split between artists who challenged the hegemony of major record companies and those who followed the obligations of their contracts. Musicians could now demonstrate greater artistry and agency in the recording studio, since they could create music in the manner they intended, and not be swayed by the commercial goals and regulations of record companies (p. 17). With recording company regulations, musicians were either forbidden or discouraged from making any decisions in front of the mixing console. Now that artists and bands with independent record labels had free reign over both the recording and mixing processes, there were greater sonic opportunities available for the creative process. The mixing console afforded greater artistic agency and was made more available to artists and groups, which will be depicted in varying accounts in later chapters.

Sound engineers have traditionally been expected to troubleshoot unpredictable technological issues in recording practice. In addition to being able to anticipate unintended problems and deal with them in a timely manner, skillful engineers also exercised patience with recording artists (Horning, 2004, p. 716). Perseverance was another trait shared among successful gramophone recording personnel when dealing with technology, as unexpected technological issues often arise in the recording studio which require spontaneous problem solving. Social intelligence is another important trait when working with recording artists or as a team of recording personnel, as engineers had to remain impartial while artists performed and

recorded the best possible sounds regardless of the surrounding conditions, often requiring considerable social coordination and tactfulness. Of chief importance to sound engineers, however, is to make the audio tracks in question "sound good" by whatever means necessary, which requires knowledge in a list that is inexhaustible but includes: computer knowledge and troubleshooting, music theory, acoustics, psychoacoustics, DAW workings, and recording techniques (such as microphone selection, set-up, and placement). Just as importantly, one should learn to listen like a mixing engineer, which is different from the listening practices of those with other musical crafts such as piano tuners, wind band conductors or music teachers (Constantinou, 2019). What once was a highly specialized craft reserved for recording studio technicians is now a quotidian musical practice with the advent of personal computers and the growing affordability of recording tools and software. The following section outlines mixing's position in music education by addressing the gaps and challenges for school children, youth, and teachers who might find this mode of musical communication overwhelming.

Mixing's Position in Music Education Literature

Frith & Zagorski-Thomas (2012) explain that record production holds an uncertain position within higher education as it is both relatively novel within academia while positions for study within recording studios have been declining in number. According to Thèberge (2000), one of the most important contributions higher education can make to the field of recording practice is to create a place where popular music can be practiced, rather than being treated as a subject of purely academic study. This is because, as with any musical instrument, skillful recording practice is dependent upon individuals' hands on learning experiences, whether formal, informal, or involving a combination of the two. For example, Anthony (2015) found that students studying music recording practice at the tertiary level of education excelled when

formal, teacher-led instructions demonstrated proper use of recording tools, techniques, and methods that mediated musical expression. Formal guidance in these tools, techniques, and methods of mixing practice prepares students to better navigate music recording practice. This is only possible if educators are comfortable with and understand recording practice techniques. However, a guide that can help prepare music educators and/or musicians unfamiliar with recording practice, and more specifically, mixing, is missing from the literature. This section of this chapter hereby situates mixing by reviewing the supporting or lacking music education literature as it relates to audio production practice.

In the music education literature relating to music mixing practice, the terms "mixing" and "remix" have been used to condense and sum up multiple digital audio workstation processes, when other terms such as "tracking/recording," and "arranging," are arguably more suitable. When performing search entries into mixing and music education, one quickly encounters examples of the following literature: *Re-Mixing Popular Music Marketing Education* (Sylvester & O'Reilly, 2017), *Digital Artistry and Mediation: (Re)mixing Music Education* (Väkeva, 2012), and *Remixing the Classroom: Toward an Open Philosophy of Music Education* (Allsup, 2016). Mixing and remix share few similarities, aside from the same root words and are often used as metaphors to catch readers' interests. Although the aforementioned references are substantial in terms of music education literature dealing with history, philosophy, and theory, one would be disappointed if attempting to find detailed and accurate depictions of mixing and other audio production processes on technical and pedagogical levels.

Studying mixing practice can be problematic when describing the mechanics and actions necessary for mediating sounds through words alone. Differing schools of thought have their own frameworks with which they analyze phenomena, especially when there is a premium

on language, hence the need for jargon. Musicologists have their own specialized language that will differ from musicians and recording studio engineers, and social studies teachers. This problem is not limited to music education but is also present in interdisciplinary fields such as sound and cultural studies. From a recording practice perspective, Bromham (2017) states that it is necessary to interrogate and understand how and why we use these technologies without question, as "(t)he pathway to knowledge is through understanding how we arrive at a finished mix and we should be asking, what makes something sound like a record?" (p. 255).

There is a multitude of reasons as to why particular music technologies are still not fully embraced by music educators and this idea itself is a subject of continued study. Aside from economic factors, reasons why music technologies are not prevalent in today's classrooms include teacher unfamiliarity with tools/software; anxiety due to unexpected technical issues that require immediate troubleshooting, hence the hesitation for implementing particular music technologies (Gall, 2013, p. 19), and issues with re-conceptualizing previous pedagogies while integrating novel technologies into music classrooms (Gall & Breeze, 2007, p. 53). As just suggested, two themes that arise out of the literature are anxiety associated with addressing unexpected troubleshooting of problems and difficulty in conceptualizing and possibly linking previous music education pedagogies with those that implement modern music technologies.

State of Mixing in Music Education

Educators typically complain about a lack of agency and legitimacy when attempting to branch out to novel methods in music education because by definition this involves explorations beyond established norms and conventions (Allsup & Benedict, 2008). Many music teachers seek legitimacy, comfort, and professional security by subscribing, for example, to the wind band tradition and its repertory owing to its longstanding historical roots in North American

education systems (pp. 160-161). The repertoire and methodology associated with wind band instruction ensures an established and thus predictable frame of reference for rehearsal times and instruction as teachers set goals necessary for fixing any technical issues, and in which the emphasis is on the final performance, or product, over the process of learning (p. 162). This teaching literature and methodology contrasts with the uncertain and unpredictable nature of mixing in which the focus is on learning the *means* of realizing ideal artistic visions, rather than on the quality of final products or performances alone.[2] Aside from dealing with obvious technical errors, mixing engineers are concerned with making recorded music "more musical" with the mixing tools and techniques available or known to them. This involves making inferences, educated guesses based on the provided evidence, or in this case, making decisions based on what mixers perceive. This requires that mixing neophytes not be passive learners waiting for instructions from their teachers and having no influence in how a musical performance is achieved. Mixers at all levels have to make their own judgements when shaping a mix to further enhance prior artistic visions. This is of great educational value because the onus is placed on students to take accountability for the part they play in making final mixing decisions, which contrasts from standard education practices of selecting or writing the best answer which will award them the most points on a test.

Mixing's place in existing curricular structures remains unclear especially when the matter of funding and other available resources enters the equation. In today's schools, including mixing and other computer-based musical practices in the classroom can be seen as risky for those teachers seeking change, and especially since traditional wind band and choral methods remain staples of curricular planning (Abramo, 2017). Institutions such as the Organization for

[2] The mixing tools and techniques are the *means* by which mixers achieve their artistic visions. Chapter 3 (p. 27) elaborates on what these tools are, and how mixers use them in DAWs.

Economic Co-operation and Development (OECD) employ resources to inform and shape public opinion of education, which often includes the oversimplified relationship between teacher effectiveness and economic competitiveness of various subject disciplines (Allsup, 2015, p. 6). In terms of the relationships between economic prosperity and subject disciplines, the arts and humanities have generally not been viewed favorably considering the emphasis at all levels of education on job readiness and wealth creation (Woodford, 2019, p. 14). These tacit expectations presumably require that educators adopt a defensive stance when advocating for their subject disciplines and how they benefit both their students and the economy in the end.

Music educators sense that their subject is perceived as having 'low educational status' when there is a lack of money available for equipment and technical support (Gall & Breeze, 2007, p. 53). There is also the matter that teachers are skeptical of improvisatory and exploratory engagements, which is to say, creative activity without a complete understanding of it, even if these practices might present students with novel learning opportunities that are not available in other formal learning environments (Resnick & Rosenbaum, 2013, p. 167). Other teachers worry that incorporating new technology into the curriculum would burden them because they lack appropriate experience, training, and expertise to do so. They fear they are ill-prepared to address technical issues and problems in the classroom, which causes hesitation in implementing mixing practices along with other technological practices, particularly among pre-service teachers who already feel overwhelmed by the expectations placed on music teachers in general (Gall, 2013, p. 19).

Digital music technologies' potential for providing students with creative learning opportunities in the classroom is diminished if teachers are compelled to include it for purely its own sake or mistakenly believe that students are falling behind through a lack of utilization

(Mantie, 2017, p. 19). In situations in which music educators do have the resources allowing them to teach with computers in the classroom, they might resort to teaching *about* music with technology, rather than teaching music *through* technology (Ruthmann, 2012, p. 180). For instance, music educators might include computers in classes to teach students music history or have them notate scales with proper key signatures via music notation software, rather than considering music technologies as means for musical performances that are representative of modes of digital musical practices today (i.e., sampling, composition, synthesis, etc.).

When working with audio production software, it is essential that teachers allow for experimentation and trial and error in the mixing process, as this allows one to select and sample what sounds or musical decisions fit within an arrangement. This approach is one of the fundamental principles and practices of successful mixing. However, some educators believe tinkering and experimentation are too random or unstructured and would lead to ill-defined parameters of success (Resnick & Rosenbaum, 2013, p. 167). "Experienced" tinkerers, however, realize that experimentation is not truly random if individuals conceive of a "problem" inductively, or bottom-up, and they work their way to the top of a preconceived problem (p. 167). According to Dewey (1933), achieving a balance between work and play is an ideal mental state because an absence of dogmatic routine grants the conditions for intellectual curiosity, thereby allowing individuals the freedom to solve a problem with whatever solutions they might find (pp. 284-286). Experimentation with the various tools available to the mixer is one of the primary ways of achieving aesthetic or technical solutions in the mix. The following chapter will elaborate more on Dewey's and Eisner's ideas and how they relate to mixing practice in education from a theoretical perspective.

One of the most challenging aspects of utilizing music technologies is to mold one's artistic visions, rather than having technologies' limitations constrain one's foresight (Kardos, 2017). The easier part of using DAWs is learning the skills necessary to navigate DAWs and other software, after which educators and students are challenged with one of the central tasks important to music, which is learning how to listen while ensuring that recording technologies serve appropriate aesthetic ends (Hein, 2017). While technology might present certain limitations to workflow arrangements, these limitations can also have other socio-cultural effects in their immediate surroundings. For example, novice users might become overwhelmed with the superficial yet essential aspects of mixing practice, such as an unfamiliar graphic interface or an unorganized DAW arrangement, which may hinder their aesthetic workflow. When listening for relationships between the sounds in the mix, a user's progress in navigating the mix may also be hindered by having to learn new software or unfamiliar computer commands and signal-processing tools. Nevertheless, if DAW users embrace and problem-solve these obstacles, they will become more proficient and experienced in mixing practice despite what are at first unwanted experiences.

In an attempt to both demystify and reveal mixing as a creative and musical practice, Anthony's (2018) study includes video and image footage of him describing the various tools and processes involved in the mixing process. Bell (2018) has also documented how musicians create and record music with DAWs while indicating that most recording practice techniques are learned through first-hand experiences. Neither researcher, however, indicates how particular techniques and tools are used (and why) over the course of mixing a series of audio tracks from start to finish. Scholarship which combines text, image, and video examples illustrates how the techniques and tools available to mixers allow them to enhance and refine a piece of music. To

reiterate, there is a dearth of music education literature that focuses on the mixing process in music production through first-hand experience and documentation. Nor is there much music education scholarship that addresses mixing pedagogy *per se*. Bell (2018) contends that prescribing such a pedagogy could be harmful to the field of recording practice because it is likely to promote homogeneity at the expense of personal creativity. It is not the intent of this proposed study, however, to create a universal pedagogy for mixing. Rather, this researcher seeks to illustrate how with recording practice tools one is capable of mediating a multitude of musical expressions, which can only be achieved by experimenting with a variety of sound configurations throughout the mixing process. Experimenting with a variety of creative possibilities during the mixing process is optimal if the foundations of recording practice tools and techniques are understood and, more importantly, experienced for oneself, which this study attempts to model for teachers and students seeking pedagogical and technical guidelines, or principals.

Summary

By this point, readers should see that music and music-making as recorded communication go beyond broad elements such as rhythm, melody, harmony, structure, form, meter, instrumental arrangement, tempo, lyrical contents, etc. The recorded musical performance itself represents a social-cultural context depicted by instrument choice, lyrics, and other recording decisions; timbre, which can be understood as either being physical according to frequency content and the loudness of their relations, or rhetorical, as sounds have conventional sound signatures, (e.g., string section, 808 drums, a saxophone); echo; ambience or reverberation; and texture (Zak, 2001). These variables extend the creative potential of musical compositions and performances as facilitated by recording practice. Throughout the twentieth

century, the recording studio and its tools have been a major influence in how people interact with music as a culture. DAWs replicate the functionalities and recording tools found in recording studios which has made these pieces of software commonplace among today's musicians, whether or not they are established and experienced in digital recording tools or newly entering this culture for the first time.

CHAPTER III

MUSIC EDUCATION FRAMEWORK FOR GUIDING MIXING PRACTICE

Introduction

According to Bell's (2018) admonishment in chapter two, the prescription of a rigid pedagogy for mixing practice is potentially harmful because doing so might encourage homogeneity and stifle authenticity and originality in mixes. Louth (2012) similarly warns educators of the codifying effects when teaching in formal settings by calling students' attention to the socially constructed nature of improvisational vocabulary in jazz performance. Students might otherwise accept certain improvisational characteristics as a set of permanent and abstract rules without question. With respect to musical practices and genres typically practiced outside of formal music education, which mixing is, Väkeva (2012) suggests that educators build their own philosophies "in ways that help us understand and appreciate such heretofore unrecognized and unacknowledged modes of learning, communicating, and enjoying music" (p. 105). Similarly, instructional approaches that prioritize modelling and step-by-step instructions are counterintuitive to the creative and experimental work found in computer mediated musical practices (Rudi & Pierroux, 2012). Instead of proposing a prescriptive pedagogy for mixing practice, this study instead suggests following a proposed framework that guides educators and students as they learn this craft. This framework is also compatible with other audio production practices outside of this study (e.g., tracking/recording; songwriting/arranging by digital means; mastering).

This chapter defines and describes the components of the proposed music mixing framework, as depicted below in Figure 3.1. The first component of this framework consists of four knowledge competencies necessary for mixing practice. These competencies are also

explained in greater detail in chapter six, where this researcher's firsthand experiences are also cross-referenced with theory and principles in audio production literature. After investigating the competencies necessary for mixing practice, connoisseurship is the next theme within the framework. Because one goal in mixing practice is to amplify the emotional and aesthetic character of recorded audio tracks, three connoisseurship guidelines (Belland, 1991) influenced by philosopher John Dewey (b. 1859-1952) and art education theorist Elliot Eisner (b.1933-2014) guide mixers through technical and aesthetic details. These are helpful guidelines for users as they navigate abstract and fixed concepts, indeterminate values, and hierarchical concepts within mixing practice. The chapter concludes with a few reasons explaining why constructivism is a valid approach for guiding mixing practices within educational settings, primarily because students and teachers will have to work collaboratively to create meanings out of their interactions within this audio production practice. As is also explained, Dewey's (1939) ideas of evaluating and valuing experiences in tandem with Schön's reflective-in-action method (1983) supports constructivism because mixing practice is reiterative. Mixers have to cycle between listening, shaping sonic materials, judging their decisions, and staying or moving on to other subjects of interest within musical arrangements. What follows are the competencies required for mixing practice.

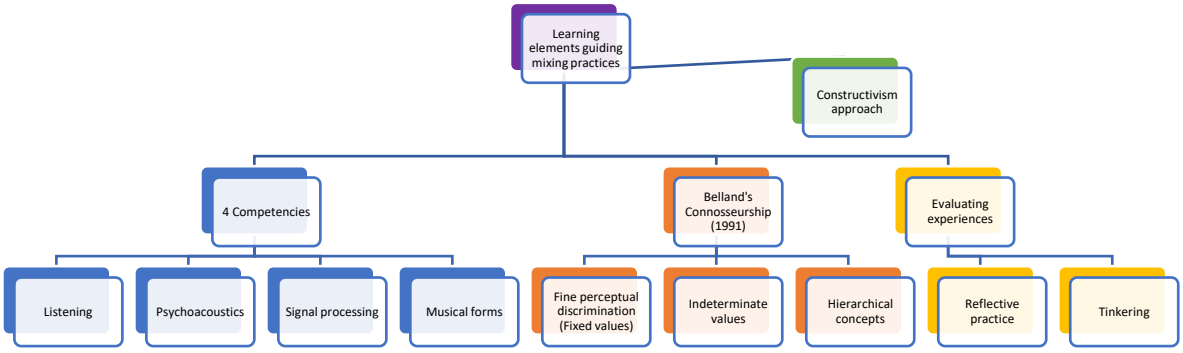

Figure 3.1: Competencies and conceptual elements of the learning framework guiding mixing practice.

Four Knowledge Competencies

According to Rudi & Pierroux (2012), the four knowledge competencies necessary for mediating digital audio production practices are (a) listening, (b) knowledge of psychoacoustics, (c) signal processing, and (d) musical forms. An overview of these competencies provides readers with a general idea of the primary skills necessary for mixing practice. To see these competencies expanded in greater detail regarding the researcher's experiences in mixing practice, refer to chapter six (p. 124).

1) Listening

Listening is one of the most important skills in mediating audio production practices, especially since identifying, describing, differentiating, and understanding what one is hearing is a prerequisite for the other competencies that follow. If one listens this very moment, it is possible to hear many sound frequencies and other sonic elements occurring simultaneously. This is an allusion to a Barthesian (1991) idea that hearing is an acoustical phenomenon, while listening is an action (Rudi & Pierroux, 2012). The surrounding environment, with its various objects and reflective and non-reflective surfaces, affects what one hears. The level of detail

required for listening in audio production is critical to mixing, because mixers are constantly assessing the sound qualities of every track in the mix and how they support, contrast, or conflict with one another. Writing every sound that permeates one's consciousness in a given moment is a good listening exercise demonstrating this form of critical listening. Examples could include the humming from a central heating fan, a low-pitched rumble from a passing motor vehicle further muffled and reflected by the physical objects standing in the way of those frequencies, to a fluorescent light's high pitched and monotonous, static buzz. What one listens to in recording practice can vary, as this depends on what is occurring at any moment in the mix besides whatever is catching the individual's attention. Similarly, the kinds of headphones or speakers used to play a mix will influence its overall sound quality owing to these technological devices' varying frequency response ranges.[3]

To reiterate a point made earlier in chapter one, what one listens to in recording practice is a single audio phenomenon, which is the mix (p. 4), and not a variety of sound sources. What one hears results from many tracks rendered through (bussed to) a stereo "master" channel once the mix arrangement is complete in its treatment and refinements. There is a caveat, as most recordings created intending to be distributed commercially are not only mixed but mastered as well, which further shapes their sound.[4] In sum, listening with this level of awareness is the first

[3] Frequency response ranges or profiles are the frequency limits and points of emphasis resembling or magnifying the human ear's capabilities, such as exaggerating 1-5 kHz frequencies and rejecting everything below 20 Hz and above 20 kHz. These frequencies ranges are particularly emphasized in consumer audio playback and recording technologies (Hodgson, 2010, p. 285).

[4] Once a musical arrangement has reached the stage where all the individual tracks have been worked with in a way to produce one satisfactory mix, it enters the mastering stage which involves manipulating the mix in the format of one recording rather than a series of separate recordings. Commonly known as a "quality assurance" phase of record production, mastering involves many technical and aesthetic skills while ensuring the music in question sounds optimally on commercial listening devices, such as stereo systems, digital listening platforms, mobile phones, etc. (Hodgson, 2019, p. 189).

competency necessary for mediating audio production practices, and is interdependent upon psychoacoustics.

2) Psychoacoustics

Perhaps the most important reason knowledge of psychoacoustics is a vital competency for mixing practice has to do with the fact that it encompasses how digital sounds exist because of our conscious awareness and understanding. Rudi & Pierroux (2012) define psychoacoustic interpretations as going "beyond our objective, acoustic reality, and [forming] important parts of the specifically human species response and adaptation to acoustic nature and culture" (p. 541). There are two ways in which we measure psychoacoustics, the first being threshold detection of auditory stimuli in the combined means of amplitude levels, frequencies, and timbral characteristics. The second means of measuring psychoacoustics is through discrimination, differentiation, or any subtle variations among multiple sounds (Bull et al., 2009). Although mixers make sense of auditory stimuli through mindful listening, they must also mediate visual graphic user interfaces (GUI), interact with audio plugins,[5] and other digital applications according to how DAWs and mixing consoles mediate psychoacoustic phenomena (Bromham, 2017, p. 250). Knowledge relating to psychoacoustic parameters such as frequencies, decibel levels, and the stereo spectrum is fundamental to navigating a mix session as users can navigate and resolve any issues they encounter. In sum, everything one can hear and perceive in a DAW is because of these psychoacoustic principles.

3) ***Signal processing and effects units***

[5] Plugins are software-based signal processors that are either built-into DAWs or purchased, downloaded, and installed from external software developers. In many cases, plugins eliminate the need for outboard processing and offer the capabilities of many signal processors and effects, including compressors, limiters, equalizers, reverb, etc. (Bell, 2018).

Embedded in psychoacoustics is signal processing, which is the analog and/or digital means through which recorded sounds ("signals") are manipulated ("processed") in recording practice. Within DAWs, signal processors and effects units are the digital tools used to affect, manipulate, and replace original sounds with newly altered ones. According to Rudi & Pierroux (2012), signal processing encompasses "[r]ecording, synthesizing, changing, and combining sounds in the digital domain" (p. 541). Within DAWs, users have various potentialities to place sounds side by side, stack them one on top of another, record traditional instruments with microphones, make analog connections, track digital MIDI instruments, create and synthesize sounds, or otherwise manipulate these previous elements employing several signal processing tools and effects.

Although Rudi & Perroux (2012) identify signal processing as one of the four competencies for audio production, their definition requires further elaboration. Various mixing tools fall into two categories depending on how they are used to treat audio signals, the first being signal processors, and the other effect units. Processors are devices, electronic circuits, or software codes that alter an original audio signal and replace it with a newly processed one (Izhaki, 2017, p. 112). Equalization, distortion, and compressors are only a few examples of signal processing. In contrast to processors where the audio signal is entirely modified, effect units add a new signal while keeping a prior one. For this reason, effects units have dry and wet parameters and allude to how saturated or unsaturated an audio signal is in relation to a particular variable. Dry parameters are the raw, unaffected sound, while wet parameters control the new signal created by the effect unit. These parameters work in parallel on a 50/50 knob where the user controls its setting from a 0 to 100 percentage value, with the lower the number representing how unaffected the signal sounds. Increasing the knob's setting determines the potency of the

applied effect. Or the effect unit might have two separate dry and wet parameter inputs showing how many decibels of each parameter are present at the end of the signal processing chain (Izhaki, 2017, p. 113). Examples of effect units include reverb, delay, pitch-shifting, and harmonization.

4) Knowledge of musical forms

Certain signal processors are commonplace in conventional or stylistic usage across musical genres. For example, within sub-genres in electronic dance music (EDM), mixers and musicians use sidechain compression. This is a compression technique that when used in tandem with a kick-drum signal creates a pulsing or pumping effect within an audio track that is characteristic of EDM stylistic conventions. Although the stylistic and nuanced genre conventions found within varying mixing practices may seem esoteric and possibly overwhelming, possession of some traditional musical knowledge is a useful competency because it may assist users in better understanding audio production concepts while also providing another perspective from which to comprehend the mix. If mixers can hear rhythmic inaccuracies or intonation errors within an audio track, they could resolve these issues through knowledge of audio production techniques, such as splicing and moving audio segments, so the rhythm of the track aligns with the overall musical arrangement, while tuning the audio file by modifying its Hertz values. Knowledge of meter, rhythm, tempo, intonation, key signatures, musical notation, and harmonic structure are only some of the many concepts embedded in the recorded audio tracks found within the mix. Musical form also includes the formal structural properties of a genre and how these characteristics developed over time, such as the format of a jazz performance or the rhythm behind a sub-genre of hip-hop beats.

Universal to all musical genres, one can describe and distinguish musical forms according to micro, meso, and macro levels of analyses. Mixers often focus on micro-detailed elements within musical arrangements, such as a glitch within an audio recording spanning a tenth of a second requiring an edit, or rhythmic misalignment within a drum track, where a kick drum's quarter note beats are a fraction of a second off the intended tempo or time signature of a musical arrangement. Meso-elements of the mix might include applying equalization to a guitar track, so it better compliments another audio track, or automating a signal processing or effect unit parameter, so an audio track possesses an evolving character as the mix progresses in real time. Macro elements might require the mixer to look at the overall proportions of the mix, such as questioning whether the audio tracks have complimentary musical relationships, or whether the climax of the arrangement achieves its aesthetic goal or not.

Because music occurs and develops dynamically in real time, it is difficult to write about its form without having a visual aid. Although the development of written musical notation made communicating and analyzing musical ideas more accessible, limitations arise when considering audio production principles, such as describing the use of certain signal processing tools and effects within musical arrangements. How would one musically notate or describe the psychoacoustic parameters within a musical arrangement as they become more reverberant or expansive over the course of thirty seconds, or if a particular audio track becomes more gritty owing to distortion? The soundbox can be a useful conceptual tool and guide for anyone taking part in audio production practices as it outlines where to position sound sources within a recording three-dimensionally and what treatments they have received. These four previous knowledge domains used in combination with the soundbox are helpful if users lack a starting point in recording practice.

The Soundbox

Like objects portrayed within a painting, sounds can be positioned closer or further to the foreground or background within the mix, making those sounds appear more or less prominent because of their perceived depth. On another dimension, sounds can appear on a horizontal spectrum ranging from the left, center, or right sides of the soundbox, depending on the mixer's intentions regarding the final product. The soundbox also illustrates the verticality of the mix in terms of the varying frequency ranges and their musical interrelationships. It is also worth noting that a variety of frequency range templates are conventional due to styles consistent with musical genres (i.e., kick drum front and center in rock and electronic music genres; "transparency" of individual instruments in a live jazz recording with no extensive use of effects; etc.). Izhaki (2018) recognizes these genre conventions as the level of importance attached to various elements within a mix. Examples include hip-hop mixes with the vocals and the drum beat at the center of attention; the snare drum having more importance than the kick in jazz music (p. 11); or the spatial balancing of a four-piece rock band with their corresponding instrumentation of guitars, vocals, and drums and mixed to represent a live performance. These three-dimensional sonic categorizations are among the many ways in which sound engineers communicate ideas while working on mixes (Hodgson, 2010, p. 184). Figure 3.2 illustrates these soundbox dimensions.

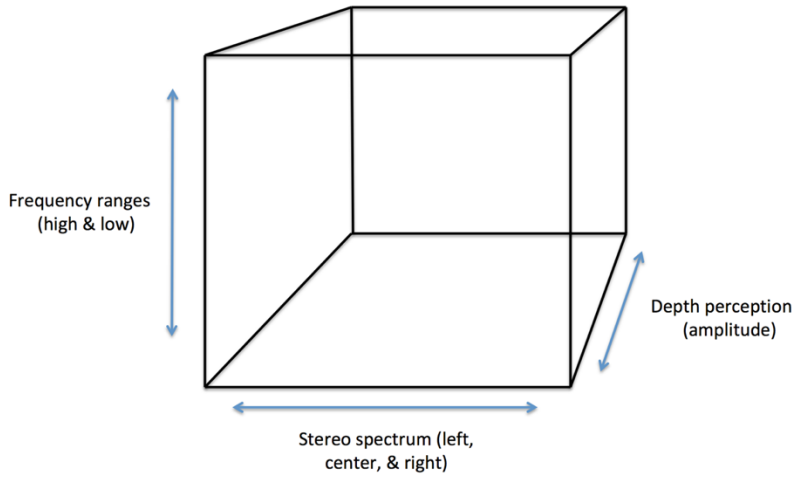

Figure 3.2: Soundbox dimensions

Zak (2001) characterizes mixing as a vertical and synchronic assemblage of sounds for them to be perceived differently according to their interrelationships, like a film scene where the camera angle and positioning of actors create a particular sense of depth for viewers. In audio production, signal processing tools are the means of providing sounds within the mix with a sense of depth or focus, or so they can work in complimentary or contrasting relationships. The vertical, horizontal, and length (depth) dimensions respectively represent the verticality of frequencies identified and differentiated by using Hertz (Hz) values, the positioning (panning) of these sounds towards the left, center or right dimensions by percentage or decibel-based allocation or panning, and volume/amplitude decibel levels (dB). Signal processing techniques such as compression, delay, and reverb also mediate depth perception and can promote an overall sense of width or space in a mix.

To illustrate with an example, the following bullet points describe a hypothetical mix's frequency template:

- Electric bass guitar and kick drum taking up lower frequencies

    - Bass Guitar: 30 Hz - 250 Hz; Kick drum: 60 - 80 Hz.
- Pianos, guitars, and some vocals sitting in the mid-range frequencies
    - Piano: 27.5 Hz - 3.5 kilohertz (kHz); Guitar: 90 Hz - 1500 Hz.
- Drum kit cymbals, hi-hats, and vocals, sitting in the higher level of frequencies
    - Sizzling of drum hi-hats and cymbals: 7.5 kHz - 10 kHz
    - Vocals
        - Full-bodied vocals: 120 Hz - 5 kHz
        - Sibilance:[6] 7.5 kHz - 10 kHz

Although frequency ranges characterize instruments, a piano might play lower notes in a recorded performance sharing frequencies occupied by a recorded bass guitar. The result could be a muddier mix because of these two instruments overlapping in frequencies. Mixers use equalization to mediate clashing frequencies in addition to affecting depth perception and the spatialization of audio cues (Reiss, 2017). Proper use of equalization can effectively "carve" out the frequencies either from the piano or bass guitar to negate any unnecessary doubling of amplitudes or muddying of frequencies (See p. 61 for equalization explained in greater detail).

In sum, mixers are working within three sonic dimensions: those of frequencies (vertical), stereo spectrum (horizontal), and levels or perceived loudness (depth in terms of foreground and background elements). Working along these guidelines requires a level of discernment while listening to a mix arrangement. Mixers are continuously judging their work for the aesthetic character and impact it will leave on listeners, hence the inclusion of connoisseurship in the

[6] Sibilance refers to the extreme hissing of high frequencies in sound sources and/or "plosive" sounds of consonants in vocal tracks. Too much sibilance might distract listeners.

present study. Connoisseurship is one of the components in the learning framework of the present study as it relates to judging and discerning aesthetic qualities.

Belland's (1991) notion of connoisseurship, which has already been mentioned, was influenced by Dewey's (1938/1997) and Eisner's (1975; 2002; 2017) work and philosophies on transactional and aesthetic experiences in education literature. Although connoisseurship might conjure notions of elitists taking pleasure in high-brow cultured activities, this mindset has its merits within certain musical styles and mixing practices. Connoisseurs are expert judges in matters of taste, which implies that they are knowledgeable of the musical genres and styles in question. The French word *conoistre*, meaning "to know," is part of a connoisseurship's etymology (Stevensen, 2010). Eisner (2017) defines connoisseurship as the "ability to make fine-grained discriminations among complex and subtle qualities" (p. 63) resulting in higher levels of appreciation. If mixers disassociate from the highbrow nature of connoisseurship while reserving some of its functions, such as making detailed and informed descriptions and discernment of sonic qualities while mixing music, they are more informed of what to listen for and judge within recording practice.

Connoisseurship

As mentioned earlier, connoisseurship is not a matter of judging things based on "good taste" (Belland, 1991). Rather, it requires the development of tools and skills that help individuals to appreciate aesthetic experiences organized to include, (a) fine perceptual discrimination, (b) concepts with indeterminate limits, and (c) hierarchies of concepts that describe an artifact's qualities at increasing levels of specificity (Parrish, 2012, p. 44). These three levels of organizing aesthetic experiences can help mixers describe and analyze the sounds in the following ways. In the first principle of fine perceptual discrimination, mixers are often

differentiating overlapping frequencies between two or more tracks in a mix before manipulating them, so their musical relationships are satisfactory. Mixers also must discern audible errors within musical arrangements and resolve these issues. Errors may include technical glitches, clipping, undesirable distortion, phasing, audio artifacts attributable to significant computer processor usage, and timbral artifacts within tracks, etc. Although some of these technical errors might overwhelm readers, a simpler identifier for this first level is hearing if there is something wrong within the mix. This is a healthy starting point for a mixer of any experience level and requires one to ask questions, including but not limited to,

- Why does the mix sound wrong?
- What sounds are occurring at that moment in time?
    - What sonic and musical relationships are involved?
- Is there anything I have neglected?
- What is occurring by visual means in the mix?
    - i.e., track amplitude/volume levels, muted or soloed tracks, odd waveforms, etc.

Belland's second principle, concepts with indeterminate limits, can refer to how mixers facilitate recorded musical communication while navigating open-ended concepts. Various effects parameters are indeterminate in value ranges such as decibels (dB) and time (milliseconds/seconds). For example, we might select a raw guitar signal to have a signal processing effect applied, such as reverb. The overall potency of a reverb effect (the dry/wet signals in the form of dB[7]) along with a decay time (0 seconds to infinity) are only two of the many parameters available within a signal processor. We also find the indeterminate nature of

[7] Refer to p. 32 for a definition and description of dry/wet parameters found within effect units.

mixing at the start of a new mix session, as the user is free to position or balance each sound source's amplitudes based on aesthetic judgment, there are no fixed rules.

Finally, hierarchies of concepts can help describe and explain a mix according to its various dimensions. Mixers must discern, navigate, refine, and highlight a track's musical structural elements (e.g., introductions, verses, bridges, choruses, build-ups, climaxes, endings) according to the genre conventions within which they are working. Besides these structural labels which help a mixer temporally navigate the mix, the sonic information within one or more tracks can span multiple bars, making up a phrase, or take up a fraction of a beat. The micro and meso elements of the mix, not limited to the musical information in seconds or beats and the musical form of a mix arrangement spanning multiple bars and phrases respectively, make up an intelligible track or song.

Belland's (1991) three levels of classifying and investigating aesthetic experiences are useful in aggregating and organizing artistic concepts that are complex because of their abstract and indeterminate nature. These interrelated principles function whenever individuals identify individual micro elements while transitioning into broader and flexible concepts, before leading them to a structured hierarchy of various units making up a competency. With film criticism, Parrish (2012, p. 44) applied these principles to show: perceptual discrimination such as lighting, editing, auditory cues; identifying indeterminate concepts such as archetypical ideas aligning or clashing with genre conventions such as the merging of science fiction and film noise in *Blade Runner* (Scott, 1982); and identifying hierarchical units of film images. This final principle of hierarchical units includes concepts such as sequence, scene, and shot, which are further subdivided into *mise-en-scène* which is translated as "placing on stage," and is a loose term used in film criticism to describe everything that appears before the camera or what audiences will see

before them such as the positioning of camera, props, stage, actors, and lighting (Martin, 2014). Other hierarchical units within film criticism could include composition, camera movement, transitions, and dramatic content. Belland's (1991) connoisseurship principles can guide users regardless of their experience levels as they analyze aesthetic and technical experiences throughout various dimensions of the mixing process.

The next component of the proposed learning framework for mixing practice requires an overview of Dewey's philosophical ideas such as transactional and consummatory experiences as the study incorporates them into useful guidelines. If beginner mixers have some guidelines for evaluating experiences and qualities, the varied and open-ended nature of mixing practice becomes less overwhelming because they are given a particular approach or direction to work within this craft. Using ideas from Dewey and Eisner that embody open-ended exploration in mixing practice contrasts orthodox pedagogies reinforcing step-by-step decisions, which are counter-intuitive to the craft from an artistic perspective. If beginner mixers are provided with pre-determined objectives and decisions to follow, they would lack control because of subscribing to a standardized style of sound and skill set within this craft. Guidelines offer students and teachers some choice to cultivate their own aesthetic agency when mixing while following soft boundaries. This is important when recalling the mixing idiolect or the sonic imprint an engineer leaves on a mix. As Dewey (1934) wrote, "[t]he enemies of the esthetic are neither the practical nor the intellectual. They are the humdrum; slackness of loose ends; submission to convention in practice and intellectual procedure" (p. 47). Dewey's works on transactional and consummatory experiences respectively address how one person's experience is shaped by other experiences in the world while shaping future and other people's experiences,

and how the situational framing of ordinary experiences can make them meaningful or memorable.

Navigating Consummatory and Transactional Learning Experiences

One issue with piecemeal standardized assessment within music education is that it ignores the situational contexts of learners' prior experiences (Väkeva, 2019, p. 109). Every experience is nuanced, which is apparent when people are engaging thoughtfully with others. This is pertinent to both students and teachers learning to mix. Some teachers and students might have had prior experience in this audio production domain, while others may have had less experience, leaving room for collaborative learning practices. As mentioned earlier, although there is no single way to mix, there are audio production guidelines and principles that increase the likelihood of creating a satisfactory mix. The present study is intended to contribute to that literature. Every mixer, including teachers and students coming from differing audio production expertise backgrounds and musical tastes, will approach mixing differently. With such a variance in experience levels, teachers and students may collaborate, teach, and suggest alternative approaches or techniques that might be novel to their pre-existing mixing practice repertoire.

Dewey (1925/2000) viewed most experiences as transactional, meaning that people co-create their present and future interactions with others and the world, thus influencing their varying forms of knowledge(s) which are then forwarded into ongoing and future practices (Parrish, Wilson, & Dunlap, 2011, pp. 16-17). Transactional experiences are inevitable in teaching mixing practices, as mixers differ in their genre preferences, levels of expertise in mixing and other audio production practices, availability in equipment, and their musical backgrounds. This is useful information for music educators sensing a gap between their own levels of experience with music technology or a mismatch between their preferred methods of

music making with those of their students in classroom settings. Finnish music education philosopher Väkeva (2012) writes from a Deweyan perspective that educators should:

> … participate in negotiations of the directions in which musical situations may proceed; it further suggests that we allow conflicts and disparities to emerge, and interpret them not as distractions but as signs of the need to learn more. Here, a teacher becomes as much a learner as his or her students. (pp. 104-105)

By embracing transactional experiences as a core component in mixing practice, educators can foster classroom settings in which musical experiences are celebrated as transactional and consummatory.

Evaluating consummatory experiences and qualities

Dewey identified two phases of value-judgements, those of valuing and evaluating qualities or experiences (1939, p. 13, 195; Väkeva, 2019, p. 107). Evaluations result from methodical and ethical inquiries requiring the critical questioning of ideas or products, whereas the act of valuing is more immediate, as objects or ideas are valued in relation to some standard or previous experience. Evaluation is thoughtful as it requires active questioning, and valuing is spontaneous in contrast. Questions might include whether something is good, and how good it is and/or how something might operate when being acted upon (Väkeva, 2019, p. 107). Evaluations also require the "ability to respond to novel circumstances by grasping their emergent qualities as values," and selecting the preferred outcome by assessing it against the rest of the decisions (p. 106). Rather than making impulsive judgements, one must continuously assess how qualities are stronger or weaker against others in their contexts.

Evaluating experiences is a contextual practice, because they can vary in terms of their scope, intensity, and materials. Subjectivity is also a factor when evaluating aesthetic

experiences, and Dewey's ideas regarding consummatory and transactional experiences clarify what are otherwise ambiguous ideas. Consummatory aesthetic experiences involve a relationship between an artistic product and the person appreciating the object. These experiences are more than the frillier notion of viewing or witnessing art forms for their own sake, because participants comprehend intrinsic meanings owing to their direct and unique involvement with works of art (Westbrook, 1991). The response generated by the person appreciating an art product is consummatory when it fulfills a unique and heightened experience (Regelski, 2017). Far from being trivial, these experiences contain additional qualities making them memorable or consummatory for individuals. Dewey explains:

> An experience has pattern and structure, because it is not just doing and undergoing in alternation, but consists of them in relationship… The action and its consequence must be joined in perception. This relationship is what gives meaning; to grasp it is the objective of all intelligence. The scope and content of the relations measure the significant content of an experience. (Dewey, 1934, p. 44)

Oral (2013) provides an example of consummatory aesthetic experience within a K-12 classroom assignment in which students read books and later write an essay reflecting their thoughts in relation to themes presented in the class. In one instance, a student disagreed with the values presented in B. F. Skinner's *Walden Two* (1948), a novel about a cooperative utopian society. The book challenged her values of what an ideal society should look like and caused her frustration. Within this heightened experience, she had to explain why this written account challenged her values and later explain why she agreed or disagreed with the ideas involved in the book, all of which was an unfolding of a consummatory experience (Oral, 2013).

How might consummatory experiences occur within mixing practice? Whenever mixers are working with musical arrangements that include vocal tracks, they must consider the meaning behind the lyrics and how the music might support or hinder their emotive impact. If mixers have musical theory expertise, they might ensure that the harmonic structure of the mix maintains the emotional character of the musical arrangement. Other mixers with sound engineering expertise might sense greater potential with the soundscape of a mix and push the boundaries of a musical arrangement in order to captivate listeners. To achieve a general intuition where mixers can experiment and push the boundaries of a mix, students should first establish a solid foundation by consistently practicing with sound engineering techniques and tools while improving their critical listening skills as they gradually work through mixes (Anthony, 2018). Gradually, students should critically listen to mixes and understand the mechanics that communicate creative and emotive ideas, which requires knowledge of advanced sound engineering techniques, thus granting these beginner mixers the experience they need to navigate mixing practice more intuitively (Anthony, 2018). Like the student in the previous example who unfavorably looked at the utopian ideas presented in *Walden Two* (1948) because they challenged her views of an ideal society, mixers will find themselves at odds with the presentation of certain aesthetic ideas in mixes, causing them to think about how to improve the mixes so they communicate musical and sonic ideas in the best possible fashion. This heightened experience may be one of the many catalysts sparking a consummatory experience within mixing practice. The significant factor within consummatory experience is considering how the emotive ideas involved within an aesthetic practice are shaped or negotiated by one's personal ideas and understanding.

Transactional experiences

Allowing transactional experiences to occur while learning to mix can both be memorable and beneficial for students as they collaborate alongside their peers and teachers. Every student and teacher will have subjective dispositions and approaches to the mixing process and the interactions between these two parties will inevitably be transactional because one group will always learn from the other party, or *vice versa* (Stark, 2020). There is vast potential for including transactional learning experiences in mixing practice, as teachers and students will come from varying musical cultures, experience levels, and audio production backgrounds. Regarding transactional experiences between individuals as they act upon their surrounding environments according to their prior involvements with the world, Dewey (1938) writes, "[t]he conceptions of *situation* and of *interaction* are inseparable from each other. An experience is always what it is because of a transaction taking place between an individual and what, at the time, constitutes his [*sic*] environment" (p. 43). Every mixer will approach the mix differently because of their prior experience levels and musical tastes, and in educational settings where classmates and teachers share their mixes, there will be various approaches to these musical arrangements. Digital mixing also requires users to regard the computer as an instrument that mediates recorded musical communication in creating or enhancing aesthetic listening experiences rather than using this everyday technology haphazardly. One must put in hard work and commitment when developing the skills necessary for recording practice techniques, especially when regarding and using the computer or mixing console as the instrument mediating the emotive and technical character of a recorded musical arrangement. Taking part in the aesthetic enhancement and shaping of a mix's emotive character further could foster memorable experiences as this requires responsibility, foresight, and thoughtful use of signal processing tools in an open-ended art form.

From a philosophy of music education standpoint, Väkeva (2012) suggests we use Dewey's ideas concerning aesthetics to "examine musical situations as open-ended frames for enjoying music both as a practice and as a consummatory experience" (p. 104). Väkeva's Deweyan suggestions compliment Bell's (2018) recommendation against prescribing a fixed pedagogy or mixing practice, as guided instructional designs typically include obligatory sequences of steps or problems that require solving before learners may move on to future tasks (Rudi & Pierroux, 2012; Pickering, 1995).

Music educators should accept creativity's messy and unpredictable nature rather than hinder it, as music and other aesthetic modes of communication enhance the vibrance of human experience. As Väkeva (2012) admonishes music educators, they "cannot know beforehand how or whether an experience will emerge: this is perfectly fine, since the idea of art education is not to control but to fertilize experience" (p. 104). How can aesthetic experiences fertilize if the conditions are closed, rather than open? Allsup's (2017) distinction of open and closed forms of literacies illustrates the nature of the situation here. Closed forms typically "represent culturally structured and norm-driven literacies, where valuations of excellence pre-exist an aesthetic encounter. Closed forms benefit from stability, with historically agreed-on modes of participation that are rigid and dualistic in nature" (p. 48). In contrast, open forms invite participation, include digital mediums and open-sourced ways of doing and learning about music that are not restricted to authoritative and rigid "valuations of excellence" (p. 48).

The "norm driven" and historically fixed literacies of closed forms are suboptimal for mixing practice and echo Allsup's (2016) admonitions against resorting to closed forms when studying or practicing musical cultures. Open forms are the better alternative as they allow for the conditions that maximize creative mixing practice. If educators taught every student to mix

according to a narrow vision of what was “excellent” in terms of valuation, there would be little variance among aesthetic visions within classroom settings. The contextually dependent nature of mixing makes teaching this craft in closed forms somewhat limited, because the practices in this craft often vary according to the genre and situational nature of every mix. Unfortunately, open-ended experiences are seldom the primary focus in educational practices, not because music educators wish to deny students’ creative experiences, but because of the latter’s oft times ambiguous and unpredictable nature, which is another reason educators might resort to strictly teaching linearly according to syllabus standards (Nelson, 2018, p. 3). Incorporating this craft into classroom settings that are typically affected by curriculum expectations requires mediating a balance between ensuring students achieve the learning goals of their classes while they develop approaches to mixing that are genuine and not prescribed in uniform fashion.

This is not to imply that mixing practice should be completely open-ended where students and teachers have free rein and no strategies for their mixes. There are basic principles within mixing practice that are conventional, such as ensuring early on that the mix is clean and free of audible technical or balance issues. Some of these principles that are conventional in practice will appear in chapter four. Mixing practice first requires an understanding of these basic competencies, specifically, how to listen, knowledge of psychoacoustics and signal processors and musical forms before crafting an aesthetic vision, a stage where consulting the connoisseurship principles would be helpful. To conclude this chapter and as is explained in the following, constructivist learning principles are used to explain how to navigate mixing practice’s open-ended experiences. Tinkering and reflective practice literature supplement the constructivist elements of the learning framework because they apply to real-world mixing scenarios.

Pairing Constructivism Theory with Mixing Practice

Given the above mentioned four knowledge domains necessary to understanding mixing practice and other audio production practices which are also indeterminate (listening, psychoacoustics, signal processing, and musical forms), newcomers must have points of reference which can be used for purposes of comparison while working in this craft. Otherwise, mixing practice would overwhelm novices owing to a lack of sufficient guidance. If mixing is intrinsically open-ended and often requires experimentation for an intelligible and structured song to emerge that can be memorably and meaningfully experienced, constructivism theory is a suitable approach owing to its flexible conditions and can facilitate practicing and learning audio production principles.

Constructivism as a topic of interest has been circulating within music education literature for the past few decades and used in varied approaches and strategies, including practical pedagogical guidelines for policy reform suggestions (Webster, 2011). Cognitive constructivists, which some argue as originating from Dewey, believe that "meaningful learning requires an active construction of meaning, in which [learners] make sense of new information by testing it against, and assimilating it into, what [learners] already know, often thereby achieving a higher level of thinking and understanding" (Wallace, 2015, para. 1). Constructivism does not reflect a single idea about learning and teaching in music education because of its conflicting definitions within the various sub-disciplines, such as policy, pedagogy, and curricular design (Shively, 2015). Constructivism should instead be considered as a "way of being" or vision, rather than a narrow approach or method (p. 129). Within constructivist paradigms, learners are encouraged to seek many solutions to a problem, experiment with the tools and resources available, take risks, and give themselves the permission to trust themselves

throughout this process (Martinez, 2013). Constructivism also requires teachers to work alongside students' ideas that are central to the learning and teaching process (Wiggins, 2009, p. 23). This is appropriate for mixing practice because a strict method limits the creative possibilities for mixers, while adopting an open approach or vision allows for varied learning opportunities and aesthetic potential. From a practical perspective, the following ideas highlight how constructivism as an approach can apply to music education practices:

- Learners engage in relevant, real-life, problem-solving experiences that enable them to construct and act on their own understanding
- Learners working with "big ideas or primary concepts" in ways that foster thinking
- Having opportunities to work with peers and teachers
- Learners are aware of their goals and progress towards their goals
- Assessment of learning is embedded in and appears from the learning experience (Wiggins, 2009; 2015, p. 26).

How would constructivism apply to learning audio production principles within music education? Approaching mixing with a mindset informed by connoisseurship principles and with a constructivist mindset would allow beginner mixers to better appreciate recorded music and appreciate recorded music. Although people might conflate appreciation with "a liking for," or misconstrue it as preferring one genre of music over another, Eisner (2017) argues that it is unnecessary for there to be a relationship between appreciating and liking something. Upon listening to a specific genre of music, individuals might make simple judgements, at other times they might make conclusions that are complex, subtle, and informed, even though they might not actually "like" the music (pp. 68-69).

To reiterate a previous point, mixing practice can also facilitate Dewey's transactional and consummatory experiences in educational settings in which students can bring to and/or present their ideas in class, while allowing teachers to co-learn. Considering that students will have ideas, dispositions, knowledge backgrounds, and music genres they typically listen to, mixing can be a platform where teachers can guide students to better understand the musical theory, form, and audio production practices, and skills that are requisites for making recordings sound how they do. Because most students associate their lived experiences with the internet and computer technologies, linking music technologies with constructivist frameworks is pertinent to upholding contemporary music education practices, given students' many experiences with concepts and tools native to them (Louth, 2015, pp. 475-476; Webster, 2011). Tinkering and reflective practice can guide beginner mixers while they experiment with the tools and techniques at hand alongside this constructivist approach.

Tinkering and Reflective Practice

Tinkerers are individuals who explore creativity as being open-ended and start by exploring and experimenting with various options at their disposal, revising, and then refining their goals, after which the cycle repeats itself (Resnick & Rosenbaum, 2013, p. 176). The earliest recording studio personnel of the World War II era were tinkerers as they learned the principles behind electronics through crafts like hobby radio sets which helped in navigating and maintaining analog mixing consoles (Horning, 2004). Tinkering can also work in a regulated manner if one adopts Schön's (1983) ideas on reflective-in-action processes, which originated from his studies with the complexities overlooked by professional education across disciplines. Specifically, professional education prepares individuals with the technical knowledge relevant to practicing disciplines but cannot capture the complexities that develop in real time, like in

human interactional relationships because this is knowledge not obtainable from technical learning resources like books or reference manuals (McIntosh, 2010). Based on Schön's (1983) seminal work, *The Reflective Practitioner*, individuals test problematic scenarios by thinking while doing (in-action), and thinking after these actions have been completed (on-action) according to the following criteria:

- Can I solve the problem I have set?
- Do I like what I get when I solve this problem?
- Have I made the situation coherent?
- Have I made it congruent with my fundamental values and theories?
- Have I kept inquiry moving? (p. 133).

Reflective practice is a necessity for digital musicians, as it requires them to listen to sounds and add or refine them to address problems (Hugill, 2019). This type of reflective thinking is also Deweyan because the interactions made among differing cultural groups make the unfamiliar more familiar whenever musical perspectives are combined in the process of problem solving (Woodford, 1994). Belland's (1991) connoisseurship principles reference and integrate Schön's (1983) reflective-in-action method, as individuals must apply critical analysis, reflection, and attempt to better understand music with which they are unfamiliar. Four of Belland's (1991) connoisseurship strategies necessary for navigating mixing consoles to enhance the aesthetic character of mixes so they are better experienced by listeners include: (a) maintaining "extensive and intensive" involvement, (b) interrelating new experiences with previous experiences, (c) ensuring that critical dimensions have been observed and analyzed, and (d) reflecting on new experiences in relation to previous experiences (Dickey, 2012, p. 110). Although this connoisseurship framework does not explicitly detail what it is teachers and

students should do in mixing practice systematically, they act as a set of principles that students and teachers can use to guide their learning experiences.

Mixers often trust their intuition, a skill founded on personal experiences and experimentation when performing with audio technologies (Anthony, 2017, p. 49). Manipulating a variety of tactile interfaces while critically reflecting on a variety of sonic cues and relationships is only one of the many examples of experimenting or tinkering in mixing practice. Creative practice research methods involve a variety of practices such as experimentation, making, touching, editing, failing, and reflecting actions that were completed throughout this study via autoethnography (Kardos, 2017, p. 320). Similarly, creative practice research methods like autoethnography offer first-hand perspectives that capture the nuances and complexities of subjective, personal, and embodied phenomena that might not conform to the rigid conditions of objective methodologies (Piotrowska, 2020). With this study, the researcher actively practiced mixing and constructed meanings based on his previous notions and misconceptions of this audio production practice.

Summary

The fundamental idea behind mixing practice is for students and teachers of all levels to work within musical conventions appropriate for their chosen genres, but without becoming a slave to those stylistic or other conventions. The decisions made by mixers can impart a particular signature sound, or mixing idiolect within the mix, that shows personal authenticity (Marrington, 2017, p. 207). Although stylistic and musical genre conventions provide mixers with work guidelines, a personal sense of artistic agency gives mixers their distinctive sound and character. This point reaffirms the argument against prescribing a pedagogy for mixing practice which subtly or sometimes unsubtly implies rigidity and conformity. Learning to mix requires an

understanding of recognizable technical and aesthetic guidelines while allowing room for creative decisions that further shape how listeners will experience recorded music.

Mixing at first might seem esoteric or sterile in contrast to traditional music education practices, but there is a considerable amount of literature specific to this audio production stage. Because mixing enhances or shapes composed music to be enjoyable listening and aesthetic experiences while adhering to recording practice ideals, audio production requires users to adopt an open-minded attitude towards music making. The music education framework described in this chapter guides mixers to listen intently and mould the music further, so they not only learn to mix, but create recordings that possess a degree of aesthetic character. This is easier said than done, as music educators already have the challenging responsibility of navigating the musical traditions of the past, present, and future (Jorgensen, 1997, p. 77), especially when considering how digital instruments and other technologies mediate contemporary musical practices.

CHAPTER IV

MIXING AT THE COMPUTER: DATA COLLECTION

Introduction

The focus of this chapter is on themes and recording practice concepts which the researcher encountered during the early to middle stages of this study on mixing practice. These firsthand experiences and the insights and knowledge obtained from them can guide readers through thought processes and decision-making as they explore mixing tools employed in recording practice and its techniques. Although not intended to be a comprehensive overview, this chapter nevertheless provides many insights into some of the more nuanced elements required in mixing with the aid of audio-visual references. Readers will encounter general functionalities of signal processors such as compression and reverb and why a psychoacoustic phenomenon experienced by the researcher like ear fatigue occurred over longer periods of work. This chapter presents selected mixing vignettes intended to illustrate and help untangle broad and contextual themes that mixers or readers interested in recording practice techniques at all experience levels will encounter, some of which include:

- How does one listen with a mixing-oriented ear?
- What are the uses for certain signal processors, effects, and recording practice techniques?
- What skills, tools, or decisions are necessary to troubleshoot problematic mixing scenarios?

To explore these research questions, the researcher was provided with six instrumental mixes recorded in an alternative/experimental rock genre (*French Connection*, *Learned Astros*, *Denathio*, *Nightfall*, *Oregon*, and *Summer Solstice*) from Dr. Jay Hodgson, an experienced

mastering engineer and scholar in record production studies. The instrumentation of these mixes consisted of electric guitars and basses, acoustic and electronic drum kits, keyboards, sampled orchestral instruments such as cellos or wind instruments, and an assortment of percussion samples. The author and/or recordist of the mixes was made anonymous to the researcher.

Before examining how the researcher began mixing, the chapter begins with a brief overview of the data organization structure. The chapter then commences with themes covered in the early stages of mixing, beginning with an overview of how the researcher organized individual tracks and prepared them for mixing, before leading to the general "housecleaning" tasks in which the researcher isolated and resolved unwanted audio problems. Fundamental recording practice techniques not exclusive to mixing are also explained, namely headroom and splicing, as they were prevalent during these preliminary stages. Learning how to listen with a mixing-oriented mindset and following one's previous learning experiences and intuitions were later themes examined during the early stages of mixing.

The middle stages of the study entailed learning to refine and enhance the musical elements of each mix with the help of the soundstage or sonic compass. Audio-visual references supplement the text to better explain how the researcher navigated the soundstage, specifically the horizontal, proximal, and vertical dimensions of the mixes. These audio-visual references provide readers with before and after comparisons showing how the researcher attempted to broaden and work alongside these recording practice concepts. As readers might expect, signal processing tools, effects, and recording practice techniques were necessary to enhance these various soundstage dimensions. This was especially the case when experimenting and using compression, a signal processor known for its transparent character in finished recordings thereby rendering it difficult to identify. Looping musical materials, a process where a selected

portion of the mix replays without interruptions, was especially prevalent during these middle stages of the study, allowing the researcher to focus on specific sections within the mixes. However, ear fatigue developed because of looping or extensive mixing and will be explained in greater detail. This is a common phenomenon within recording practice, especially for unseasoned recordists and engineers.

This chapter would have proved over-long had the researcher included the later stages of the study in which he revised the mixes according to the feedback received from an experienced mixing and mastering engineer. For that reason, the following chapter summarizes the later stages of the mixing process. Examined themes include ways of captivating listeners' interests and maintaining their attention, implementing genre characteristics into the mixes, the notion of creativity in mixing work, and becoming a collaborative author alongside the original recordists/producers during this recording practice stage. The chapter then addresses the feedback from Dr. Hodgson and the creative/technical mixing decisions the researcher took when revising the mixes.

Data Organization and Analysis

The researcher generated and analyzed mixing practice subthemes from his fieldnote reflections as the primary means of autoethnographic data collection. Chang (2008) recommends distinguishing data organization into two phases that ensures reliable data recollection and is necessary for subsequent and reiterative analysis stages, those of data labelling and data classification (pp. 116-118). Below is a figure including factors relevant to mixing practice demonstrating how data labelling and classification occurred within the study. Table 4.1 specifies how the researcher indexed the broader theme of "low-end" mix elements into smaller sub-themes of kick drum frequencies and bass line frequencies according to field note label and

page number. Table 4.2 illustrates another example of how equalization subthemes appeared during data collection, such as how melodic or percussive elements received equalization treatments within specific mixes. There was no limit to the number of themes and subthemes generated in the study.

Subthemes relevant to mixing low-end elements		
Kick drum frequencies	Bass line frequencies	A/B mix comparisons and impressions over the course of mixing sessions
#15, pp. 5-6; (shorthand verbatim excerpt)		

Figure 4.1: Indexing and labelling low end elements sub-themes template.

Sub themes relevant to equalization		
Melodic EQ treatment	Percussion EQ treatment	A/B mix comparison and impression
#12, pp. 2-4; (shorthand verbatim excerpt)		

Figure 4.2: Indexing and labelling equalization sub-themes template.

Indexing data to subthemes assisted in the process of tracing any patterns during the study. The researcher worked with data sets which are collections of data obtained in single time frames while generating sub-themes (Chang, 2008, p. 116). These single time frames were the hour-long mixing sessions. Data sets ensured a consistent retracing of when and where themes originated and allowed the researcher to interpret any possible patterns which occurred throughout the study. With this structure in mind, labelling data sets with several kinds of identifiers ensured proper data organization, specifically with the use of primary and secondary

labels (Chang, 2008). Primary organization labels revealed the manner of data collection, including identifiers such as collection time/date; collection technique (e.g., mixing fieldnotes or literature analysis); and data source (e.g., transcribed textual data, video footage, image screenshots, DAW project files). Secondary labels provided information based on contextual data, such as the timeframe of data, the topic of the data, and geographical information on the data (p. 116).

The second step in autoethnography data organization was the classification and labelling of data so that it could be recalled later for data analysis. Labelling data was also a form of analysis since the researcher actively interpreted the data and classified the information accordingly (Chang, 2008). Interpreting data in this manner was not conclusive as subsequent stages within the cycle of a reiterative autoethnography included data collection, management, and analysis (p. 123). Working with the collected data in this manner is also philosophical, since the researcher was "asking questions, searching for meaning, clarifying analyzing, synthesizing, evaluating, judging, identifying underlying assumptions, relating to other ideas or systems, distinguishing, framing, formulating, exposing, and more" (Reichling, 1996, p. 123). Nonetheless, analyzing information through autoethnography generated tentative themes which required ongoing analyses. For example, the researcher had to question and formulate how his identity as a musician, student, educator, writer, and an apprentice-level sound engineer evolved through the course of the study. Other themes included how did the researcher's views of work/labour in mixing differ from those that "aligned" with his previous identity; uncovering and addressing personal assumptions/misconceptions; and the rationale for why particular themes reoccurred.

As mentioned earlier, data analysis plays a reiterative role in autoethnography because of

its constant revaluation of emerging topics and themes. When analyzing the data collected from the autoethnography, the researcher interpreted how his prior experiences as a musician and educator predominantly trained in the western art tradition affected mixing learning processes. More importantly, the researcher described how music educators might orient themselves to mixing practice according to how one listens and reacts to various sonic elements.

The following strategies may be applied in autoethnography data analysis while keeping memos in repeated topics, emerging categories, themes, and patterns:

- looking for cultural themes,
- identifying exceptional occurrences,
- analyzing patterns of inclusion and omission,
- connecting the present with the past,
- analyzing and comparing the relationship between the self and others,
- contextualizing,
- comparing with social science constructs and ideas,
- framing theories (Chang, 2008, p. 131).

When generating themes and subthemes in the process of organizing data, recognizing significant and insignificant events allowed the researcher to make the “invisible” obvious. Questioning the omission of themes not found within the course of the study revealed biases or lines of thinking not apparent at the time of data collection (pp. 133-134), which in turn affected how this study can be replicated in the future.

Early stages: Where to start?

Mixers of all genres will have personalized workflow approaches which they have learned and developed. There are also varying preferences in terms of which sonic elements are the

starting points within musical arrangements. No matter where one starts within the musical arrangement, however, beginner mixers should consider what the aesthetic vision of the mix will be. An aesthetic vision distinguishes skilled mixers attempting to affect and "move" their listeners from those that avoid making an emotional impact. Listening to feedback may present mixers with information that could reorient their mixing approaches and improve the musical and sonic character of their musical arrangements. For example, although the mixing in one track was clean and free of technical errors, the researcher struggled to maintain musical interest in one of the sections of the musical arrangement according to the feedback; reasons and solutions for this scenario are explained in greater detail within chapter 6. Mixing intended to captivate listeners' interests requires ingenuity and involves more than simply balancing levels between sounds (Owsinski, 2013). Nevertheless, beginner mixers must start somewhere.

Mixers could navigate the mix in conceptual terms and conceive of the mix in vertical layers according to the various sonic elements making up the musical arrangement. With a recording, producing, and mixing career of over 40 years, Harding (2017) describes his personalized mixing approach as either being "top down," or "bottom up." The former approach involves working from the vocals, being of chief melodic importance, down through the other supporting harmonic and rhythmic elements such as guitars and keyboards, before finishing with the drums. The "bottom up" approach follows the reverse direction, starting with drums and working up towards the vocals, and was the traditional approach for mixing within rock, pop, and dance music genres since the 1970s (p. 62).

Although the researcher in this study does not identify himself as an experienced mixer, he took an audio production course in the past which introduced some of the important concepts and tools necessary for mixing practice. One of the most important tools he recalled from the course

was the role of equalization (EQ) in mixing practice, a signal processor responsible for treating frequencies. Because of this previous educational experience which introduced the researcher to equalization, he started his work on mixes from the "bottom up," focusing on lower frequency sounds before working with the audio tracks composed of higher frequencies. This typically resulted in working with tracks in the following order: percussion, basses, guitars or keyboards, and other high-pitched tracks or frequencies. However, before doing any equalization work or mixing between tracks, the researcher first dealt with the foundations or "housecleaning" by organizing, labelling, and ensuring every track was free of auditory errors.

Organizing the tracks

When first starting up a DAW application for any music production purpose, users start with a blank work-session window. The first steps require importing the audio tracks into the DAW session window and labelling them before committing to any mixing decisions. The researcher first imported the audio tracks from a series of folders, each containing the files respective to their original musical arrangements. After importing and playing the audio tracks simultaneously within the DAW, users may then hear the musical arrangements in their original formats and may begin their mixing work. Figure 4.3 below presents readers with an Ableton arrangement view window with several imported audio tracks. When starting the first mixes, the researcher manually left-clicked and dragged each audio track from the document finder folder within Ableton into the mix arrangement window. In subsequent mixes, the researcher took advantage of a keyboard shortcut, a combination of keys allowing users to complete tasks automatically rather than pointing and clicking on various icons and tabs, which improves workflow. After left-clicking and selecting all the tracks making up a mix within Ableton's document browser, dragging one track over to the session window while holding the ctrl-key

allowed for all the tracks to be moved over simultaneously into the Ableton session, as depicted below in figure 4.3.

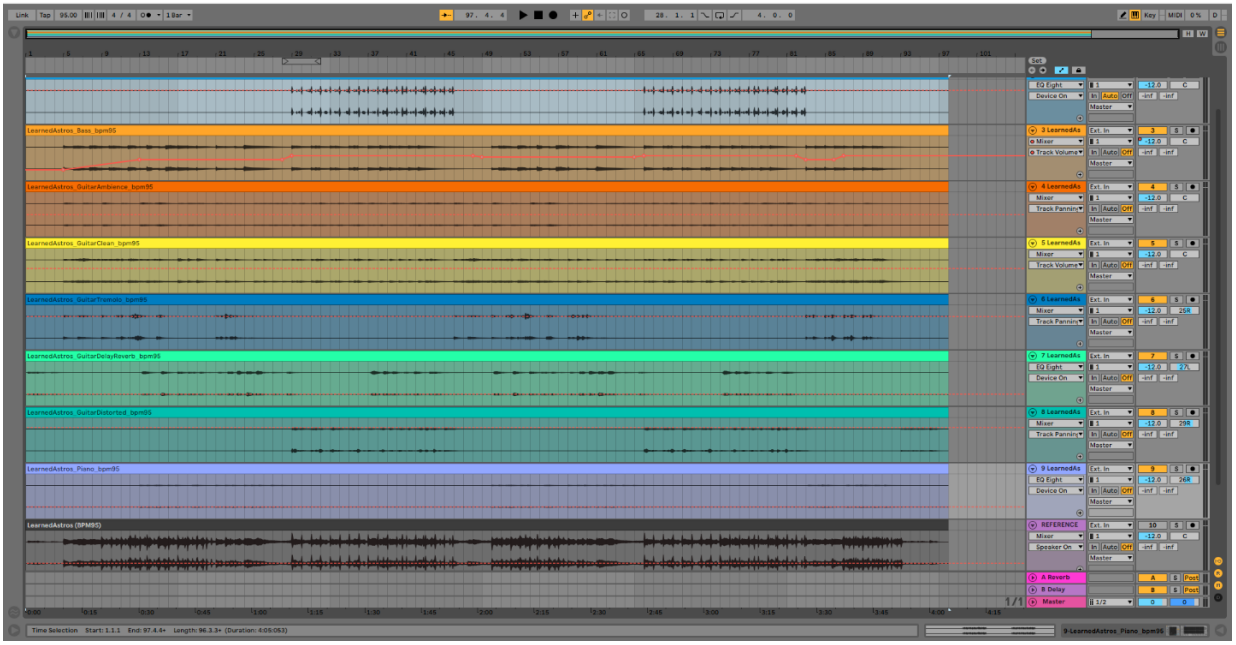

Figure 4.3: Ableton session with new tracks imported.

DAW users may then label the tracks with information helpful for the mixing process, such as instrument or recording name, and/or the tempo in beats per minute (BPM) of the recorded tracks, as illustrated below in figure 4.4.

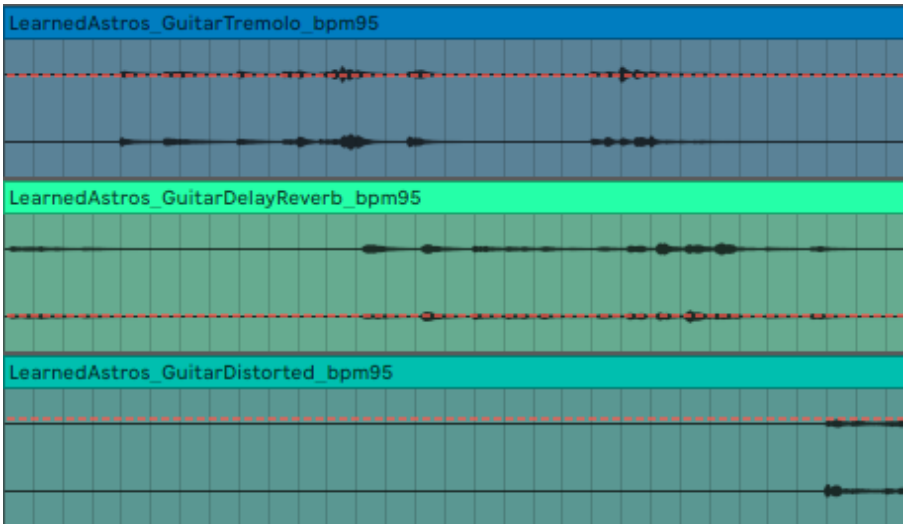

Figure 4.4: Magnified view of audio tracks with accompanying textual information.

The tempo of an Ableton project is 120 BPM by default and whenever users import audio tracks, the tempo structure changes to match the DAW arrangement's speed, a feature designed to improve the efficiency of individuals recording, producing, and sampling music. Unless the imported tracks were originally in 120 BPM, any changes in speed to match the DAW's tempo would have resulted in an effect sounding as if the tracks accelerated or decelerated from their originally recorded state, an audibly strange sound if left unattended. The researcher noticed this issue when first listening to the reference track[8] of the mix and comparing it to what was being played in the new Ableton session window. For mixing purposes, the researcher went into the Ableton preferences tab and deselected this default setting. The researcher could then change the tempo of the mix arrangement and align it with the previously recorded audio tracks' tempi. This also benefited the researcher in another way, as the mix arrangement's bar lines and grid aligned with the musical form of the tracks (i.e., 4-8 bar musical phrases, 2-bar transitions, 8-bar choruses, etc.).

[8] For more information regarding the rationale for using reference tracks in the mixing process, refer to p. 134.

After completing these preparatory importing, labelling, and setting adjustments, the researcher could listen to the mix arrangement and develop some preliminary objectives. Listening served an organizational role during this early mixing stage. While referring to the textual information of the audio tracks, the researcher organized the tracks from top to bottom within the DAW session window according to their musical purpose and frequency profiles. Because of the mixes' alternative/rock group format, the researcher arranged the tracks in the following order, starting with the percussive/drum elements, basses, rhythm and lead guitars, and keyboards. After quickly listening and organizing the tracks according to their frequency ranges, the mixer could navigate and find audio tracks with greater ease, which is important for equalization work because one follows the ear rather than reading track labels.

General "housekeeping" and cleaning the tracks

After organizing and relabelling the audio tracks, the researcher was ready for technical mixing work dealing with eliminating or reducing unwanted auditory elements that would interfere with the musicality of the mixes. This introductory preparation necessitated general equalization work, which included "rolling off" unnecessary frequencies in certain audio tracks. Equalization of this type effectively silences large portions of frequency ranges unnecessary for a track's audio profile according to its musical purpose. For example, a drum kit's high-hat cymbal is composed of mid to high frequencies, characterized by its splashing and clanging elements, whereas a bass drum emanates sub-resonating and punchier low frequencies. Because the hi-hat cymbal and bass drum recordings are distinctive in their pitch and frequency ranges, mixers typically negate the unused or unwanted portions of these audio recordings, besides ensuring there is no unwanted layering of frequencies between the two sound sources. Reducing and eliminating these unused frequency areas is beneficial for the mix as it increases overall clarity.

Failing to roll-off or cut unnecessary frequencies may cause them to overlap and clash, a sound quality which mixers often refer to as “muddiness” (Shelvock, 2017, p. 182; Constantinou, 2019). Figure 4.5 below illustrates a before and after comparison of this mixing decision, where the lower frequency range of an audio track is “rolled off” or cut to preserve the desired mid to high frequencies.

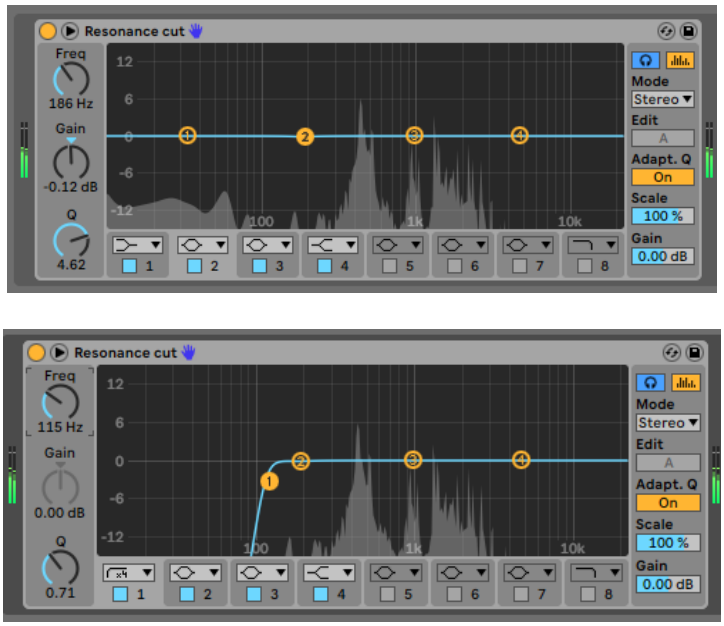

Figure 4.5: Before and after images when rolling off low frequencies with a hi-pass filter taken from the mix, “French Connection.”

Within the above figures, an equalizer is working with the same audio signal (depicted by the grey mountainous formations) but with two differing settings. The equalizer setting in the top example is inactive, represented by the horizontal blue line not affecting any frequencies, while the equalizer below shows a hi-pass filter steeply rolling off the lower frequencies, yet allowing the higher ones to pass through. Represented along the X-axis from left to right are the low to high frequencies, depicted by the 100, 1k, and 10k frequency labels. The reasoning behind using a hi-pass filter for the above example is that its frequency profile and role within the musical arrangement is that of a lead guitar melody with activity in the mid and upper frequency ranges,

as illustrated by the jagged spikes within the figure. In both images, frequencies are predominantly occurring in the 400-500 Hz range, while repeating themselves after the 1 kHz range within this snapshot of time. The roll-off occurs at just above 100 Hz within the bottom example of figure 4.5. The audio signal's frequencies below the first yellow-coloured numeral frequency notch in the above figure with a steep filter assigned to the 100 Hz range are inaudible.

What was the rationale behind this equalization decision? Frequencies within the 50-100 Hz range, before the first yellow notch in the above figure, characterize sub-bass qualities reminiscent of thunder rumbling in the distance. These extremely low frequencies contain minimal melodic information necessary for the musical arrangement and only muddy the mix further. In other instances, mixers might choose to keep or enhance these lower frequencies. Considering that the audio signal within figure 4.5 was that of a lead guitar track, the researcher judged the lower sound qualities as unnecessary because they would compound problems for other tracks and the mix itself. This equalization and mixing decision served the musical and sound design intention of achieving clarity.

Eliminating these unwanted frequencies also leads to a quieter mix which is beneficial to the arrangement, as rolling off frequencies allows more room for more decision making. Metaphorically, the mix can only handle a certain budget of decibels before the stereo bus effectively goes into debt, or clips by going over the 0 dB (fs) limit. Although clipping might achieve musical qualities such as distortion, engineers avoid maximizing the stereo bus levels from the outset, as it is good practice to leave space or, as it is more commonly known, "headroom," within the mix (Hodgson, 2019; Izhaki, 2018; Owsinski, 2013).[9] With this additional space as unused decibels, mixers and engineers can boost frequencies or employ other

[9] Readers may refer to p. 71 for more information relating to headroom.

signal processing/effects, especially if the mix is to be handed off to other mixers or to mastering engineers. The video below shows the researcher using equalization to minimize loud resonances within a guitar track which created greater headroom for the mix. The section following this video link explains how the researcher isolated frequencies associated with overbearing resonances and minimized their decibel output.

French Connection 3 - Looping before and after comparisons of an audio track which received EQ treatments with the goal of reducing unwanted resonances.

Eliminating clicks, glitches, and other audio errors with bandpass filtering.

In contrast to the earlier general equalization practice where the researcher rolled off substantial portions of frequencies from an audio recording, there were many instances when equalization achieved more specific editing requirements, such as eliminating audible clicks, resonances, or other unwanted sounds. This type of equalization is very surgical as one first identifies problematic frequencies before modifying them. In one of the researcher's mixes, the overtone resonances within an audio track were too loud and nearing the point of distortion while also interfering with the overall musical balance of the arrangement. The researcher sought to reduce the strength of these resonances by using an equalizer to identify four frequencies (196 Hz, 313 Hz, 392 Hz, and 468 Hz) creating the overtones. As illustrated in figure 4.6 below, the researcher used equalization to reduce the strength of these frequency ranges, effectively hollowing out four narrow grooves within the audio signal.

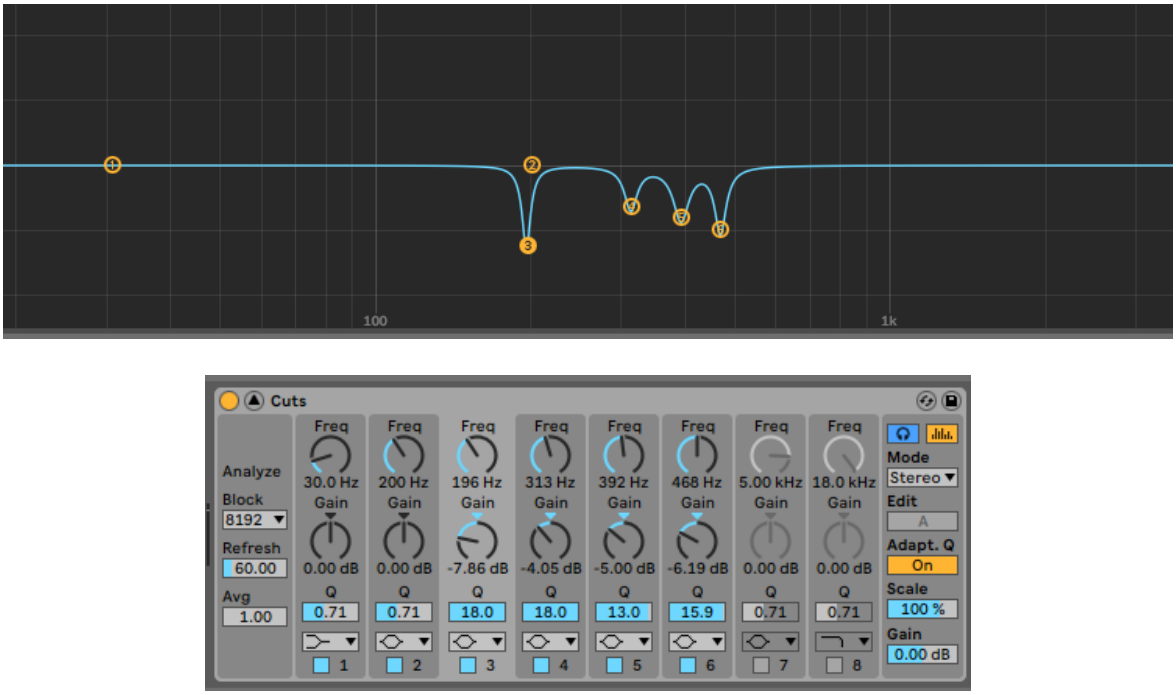

Figure 4.6: Graphical representation of equalization parameters.

How did the researcher find these numerical frequencies problematic in the first place? He used bandpass filtering, an equalization technique which allowed him to sweep through an audio track and identify the problematic frequencies. Bandpass filtering can be used to isolate audio issues such as audible clicks or glitches; unwanted resonances or overtones; or any undesired frequencies within the mix arrangement. The opposite applies as well since bandpass filtering can magnify and boost isolated audio elements in situations where mixers might want to enhance sonic characteristics. Figure 4.6 above depicts the equalization parameters used for this equalization practice. Bandpass filtering first requires users to select individual frequency notches (depicted by the yellow circles in figure 4.6) to "sweep" through an audio signal and either boost or cut selected frequencies. The researcher first did this by selecting a frequency parameter and changing its type to a bell curve. Readers will notice the difference in these bell curve equalization parameters, in contrast to the low-cut filter displayed earlier in figure 4.5,

resembling a gradually curving line. After selecting the bell curve frequency-type, the researcher then applied a maximum Q-value of (18.0), which narrowed the bell curve frequency. The higher the Q (quality factor) value, the bell curve adopts a narrower shape whereas a lower value such as 0.1, the bell curve assumes a wider and horizontal shape (Izhaki, 2018). This Q parameter is common across most digital and analog equalizers and is also known as a bandwidth or resonance parameter (DeSantis et al., 2018). After selecting a high Q-value, the researcher searched for frequencies by applying a large amount of gain[10] and "combed" for frequencies, a process in which mixers carefully listen to various frequencies within an audio track while attending to problematic issues. Within the video example below, the researcher is modifying this Q-value in real time while hearing its effect on the frequency. In the second video, he combed through frequencies listening for unwanted overtones before cutting one.

Learned Astros 2 - Modifying the Q-value of a frequency while holding the Alt-key and hearing its effect.

French Connection 2 - Bandpass filtering and cutting a resonance.

Once the researcher found the problematic frequencies using this technique, he cut the gain or applied negative decibel readings to the selected frequencies, intending to reduce the overtone resonances. As shown in the above video, the Q-value is boosted and shaped to match the resonance represented within the equalizer's graphical interface. Having done this, the researcher then cut this frequency to lower the resonance. Readers may again refer to the screenshot in figure 4.6 for the result of bandpass filtering and applying equalization settings to an audio track which previously included overpowering resonances interfering with the mix. Bandpass filtering

[10] Gain within this context refers to the amount of dB input (gain) applied to a particular frequency band, which emphasized the selected harmonics and overtones, making them more audible (Shelvock, 2012, p. 25; Hodgson, 2010).

is precise in its nature, as it can leave an audio track nearly identical while removing specific frequencies. The video example below shows a before and after comparison of a looped bass track with and without equalization cuts.

French Connection 2 - Before and after comparisons of bass guitar track with equalization cuts.

Compared to the example in figure 4.6, where the researcher treated many frequencies within an audio signal, he sometimes troubleshooted a single audible click or glitch that was interfering with the clarity of the mix. The following is an account in his fieldnotes of how the researcher identified problematic frequencies.

> While working with equalization around the mix, I notice a hiccup in the yellow guitar EQ… After a couple quick listens, I believe the sound is a recording click, which you can both hear and see on the .wav file when zoomed in. (Kapron, Day 4 Oregon)

While the researcher could hear the click, he also verified this issue by magnifying the audio track's visual representation to isolate it, as seen below in figure 4.7.

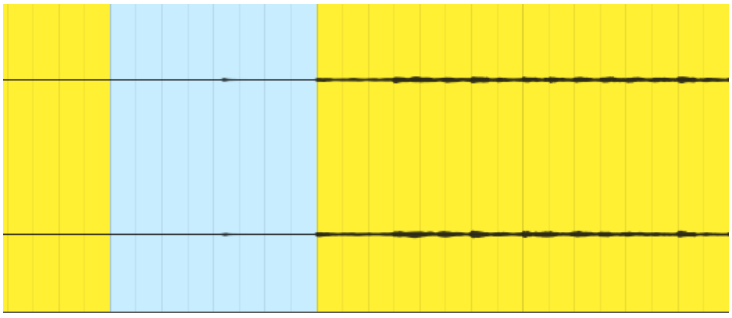

Figure 4.7: Audio track with highlighted portion showing the area of the audible click prior to the entrance of musical material.

Because this audible click occurred prior to any musical material within the audio track, the quickest solution was to splice and remove this area of the audio recording. If this click occurred while musical material was playing, bandpass filtering could first allow users to zoom-in on a problematic click and then cut the frequency value by a desired number of decibels.

Mixers working with recordists or covering both roles should avoid including recording glitches, clicks, or pops as these compound problems in the editing and mixing phases. These recording issues, however, are sometimes unavoidable. In the video example below, the researcher used an equalizer to broadly comb through the frequencies of a guitar track while it looped, helping him in the process of identifying an unwanted click/pop in the guitar strum of a chord. This audible characteristic is heard around 0:15 - 0:17 within the footage below.

Summer Solstice 1 - Seeking frequencies and isolating an unwanted click.

If the context of the mix is permitting, splicing is a quicker way of removing unwanted portions of audio tracks and may also ameliorate technical issues or achieve creative goals within the mixes.

Splicing.

Splicing is the separation of an audio file into one or more units. This task was unforgiving in the analog days of recording practice and assigned to the expertise of recording engineers, as they carefully cut taped recordings with scissors before rejoining them with adhesive tape or glue (Bell, 2013). With digital technologies, splicing is simpler, provided a few key bind commands replicate tasks that previously required the use of scissors and tape. If recordists or mixers make a mistake, they can undo a splicing decision while preserving the audio sample. The process of splicing is also found across all stages of audio production and is not exclusive to mixing. Nor is it necessarily limited to the earlier stages of mixing. As it will be made clearer in the following paragraph, splicing granted the researcher greater technical and aesthetic control over audio recordings within the earlier stages of mixing tracks.

Splicing audio samples was prevalent when working with percussion. In all the mixes made available to the researcher, the drum kit recordings, for example, were played back as a

single audio track, rather than as a collection of individual tracks (i.e., snare audio track, bass drum audio track, cymbal audio tracks, overhead microphone audio tracks, etc.). The researcher noticed this because of his prior experiences of performing and recording with rock/pop bands. Recalling where a bandmate recorded a drum track in his home recording studio, the researcher noticed an assortment of microphones tracking the drums and linked to several audio tracks in the DAW arrangement window. Although the researcher did not have separate drum audio tracks, he spliced what he could of the audio file into a series of individual sounds to enact greater technical and artistic control, as illustrated below in figure 4.8.

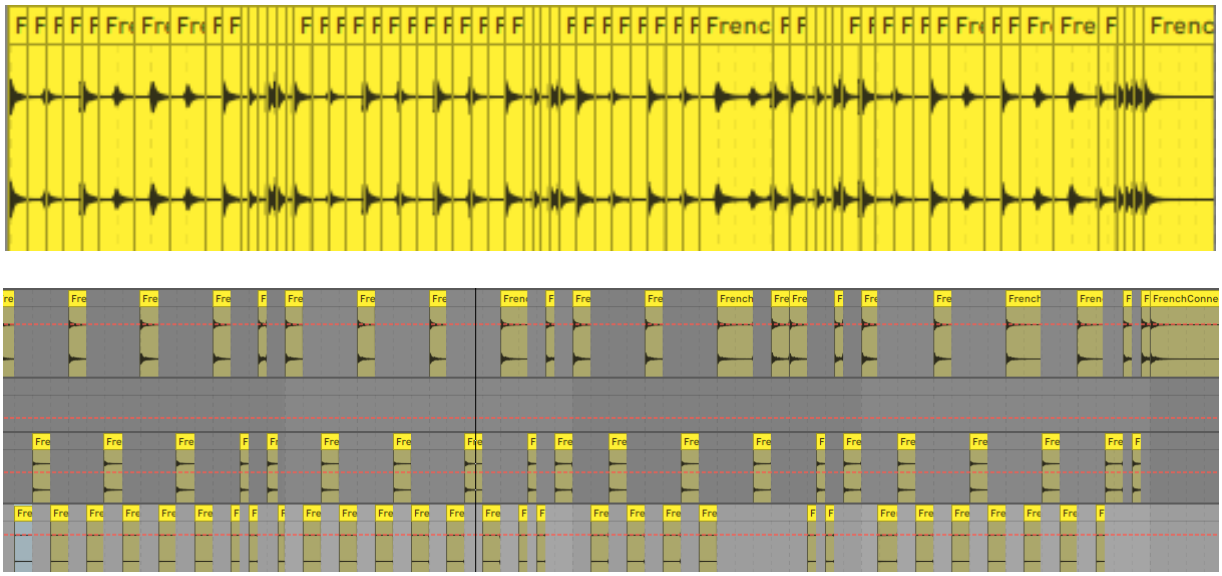

Figure 4.8: Original drum sample followed by the same drum sample duplicated and spliced into individual audio tracks. The researcher could then apply equalization, gain, and other signal processing effects to each drum hit individually.

This drum sample was easier to splice owing to its sparse rhythmic pattern. If the recording included many resonating or sustaining cymbal crashes or splashes, splicing would have been more difficult, if not impossible, for the researcher if attempting to make a transparent mix because of managing a series of audio tracks originally recorded into one file. For example,

when splicing an audio sample containing a prolonged resonance or sustained tone, the probability of hearing a technical clip or glitch when editing or changing the spliced region is increased and likely to interrupt the overall flow and quality of the audio recording.

The researcher spliced the sparse drum track for a few aesthetic reasons. For example, he could apply EQ to each drum hit individually, as opposed to imprinting this signal processing effect onto the entire drum track. Alternatively, if he had wanted a “punchier” snare drum sound, the researcher could have applied an EQ parameter to one element of the drum track, such as the spliced snare drum. Applying a “punchier” EQ parameter to the original drum audio sample would have affected all of the drum kit’s elements, which would have been problematic for the bass and snare drums, as those two elements overlapped at mid-level frequencies. The researcher could then add another signal processor or effect, which occurred in the study with the use of slight reverb or delay to a particular element without having those reverberant or echoed effects applied to the entire drum track. The researcher also wished to affect the emphasis on certain beats within a drum pattern, as depicted below in figure 4.9.

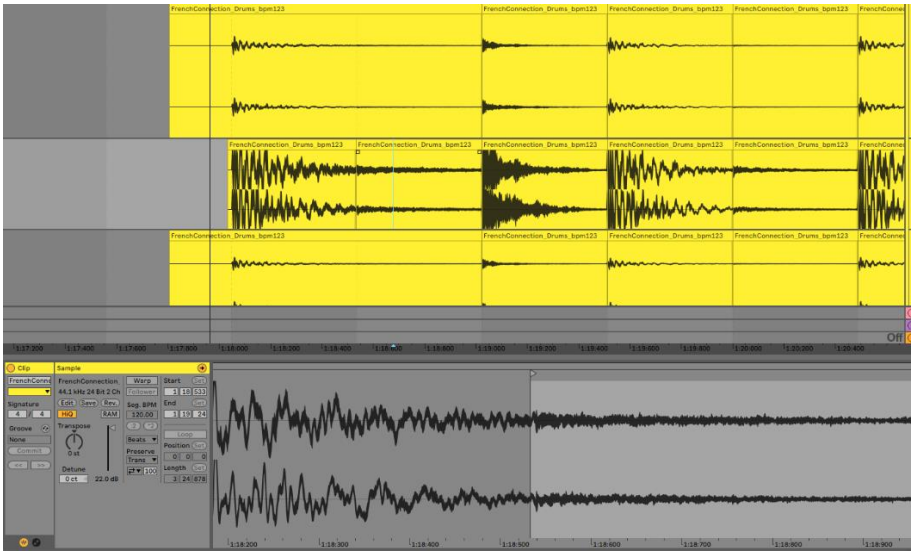

Figure 4.9: The spliced snare drum in the second row depicted by the bold waveforms after receiving an increase in dB gain and equalization.

The original drum track had a monotonous character because the “strong” and “weak” beats of the drum pattern lacked their distinctive emphases. It was likely that the drum pattern had been digitally sampled due to its uniform quality, and the researcher found this unappealing for a mix recorded in an alternative/rock genre, which is generally performed by musicians in live settings. By emphasizing the snare drum’s weak off-beats by increasing its gain levels, the researcher could provide a more organic sounding drum track as if it were recorded in a live setting.

Splicing is a function that serves many audio editing purposes within DAWs, similar to how mouse cursors within word processors allow users to navigate throughout a document to edit, copy, paste, or delete characters making up words and ideas in a document. With the drum tracks, splicing served organizational and technical roles, as the researcher could duplicate and splice one drum sample into a collection of individual drum tracks, along with an aesthetic role, wherein the researcher applied signal processing and effects such as reverb to these drum tracks, providing the mix with the sensation of greater depth.

Headroom

Although not exclusive to any stage of mixing, the recording practice concept known as headroom was important during the later mixing phases of the study. Metaphorically, headroom represents the average amount of unused decibels or space above the level of activity in the faders. Experienced recordists and mixers treat headroom as a commodity because it is a limited resource within audio production. Some mixers preemptively attenuate all the track levels by an equally fixed amount such as -7 or -12 decibels because they will not have to worry about clipping the stereo bus (the final audio channel which groups every signal of the mix in addition to their combined signal processing and effects), while they are recording new musical materials

or making mixing decisions (Krotz & Hodgson, 2017). Headroom is especially important when considering what the absolute decibel limits are in recording practice, and it differs whether someone is working with analog or digital systems. Experienced mixers and mastering engineers working on analog consoles could afford to record signals reading positive headroom levels of 3 dB, regardless of the audio signal surpassing the fader clip limit of 0 dB (Izhaki, 2018). Mixers on digital consoles consider 0 dB as the absolute limit and avoid exceeding it, which explains why track fader levels usually read negative decibel values when played back. Figure 4.10 below illustrates a mix close to peaking the fader with a reading of -0.88 dB.

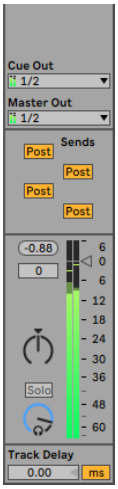

Figure 4.10: The stereo bus of a mix with the peak reading of -0.88 dB with 0.88 decibels of remaining headroom.

Headroom is important for many reasons, but primarily reserves space as unused decibels for transients (early and aggressive portions of sound that might clip the stereo bus), often characterized as large vertical spikes in audio waveforms (Owsinski, 2013). When mixes continue to the mastering stage, engineers will request or expect there to be a certain amount of headroom to provide further boosts, which requires that the stereo bus has unused decibels

(Izhaki, 2018; Krotz & Hodgson, 2017). The large spike at the start of the audio file in figure 4.11 below illustrates the dramatic impact of a drum hit transient, highlighting why headroom is an important idea within recording and mixing practice. Failure to reserve headroom would cause the transient to clip the meter and surpass 0 decibels full-scale[11] (dBFS) for a millisecond or two, resulting in a digitally distorted sound for that moment of time.

Transients are rapid changes in sound pressure where the immediate onset of a sound can fluctuate between 10 or 20 decibels, best characterized by percussion or drum hits (Zak, 2001; Owsinski, 2013). All audio waveforms are recognizable by their envelope profiles which include the initial transient or immediate onset of a sound, followed by a constant fluctuation of amplitude, and a period of free decay where the sound stops as depicted in the example below (Gough, 2014).

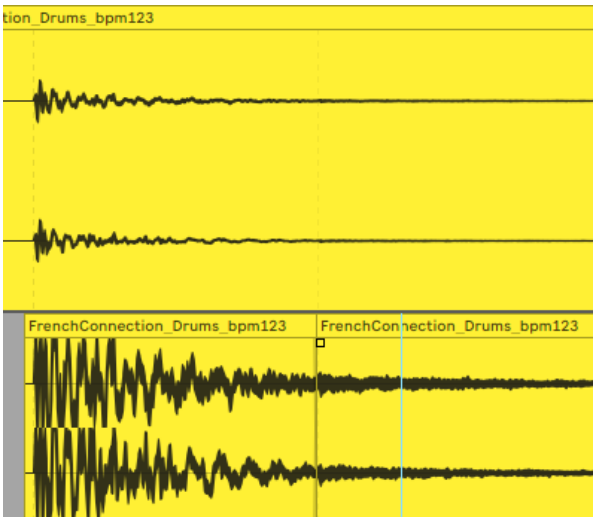

Figure 4.11: Two identical drum recordings, with the bottom version severely boosted to illustrate the starting transient, the fluctuating amplitudes, and decay.

Listening and developing a mixing vision

[11] Decibels full-scale (dBFS) is a term reserved for digital audio and 0 dBFS denotes the absolute limit which a device, such as a sound card or digital converter, can accept or output (Winer, 2018, p. 7).

After organizing, labelling, and ensuring the mixes' respective tracks were free of glaring blemishes, the researcher was ready to listen with a musical ear. This early stage of listening dovetailed into the middle stage of mixing practice since the researcher finished his tasks that revolved around technical issues and started planning on furthering creative goals. This type of listening required the researcher to play each mix more than once from start to finish, while considering how to improve the musical and sonic character. He would first listen to the tracks while making notes of any audio issues that interfered with the flow or clarity of the mix. Concerns included intonation problems, imbalances in overtones or resonances, frequency range overlapping between two or more audio tracks, rhythmic misalignments, imbalances in amplitude levels, artifacts, glitches, and clipping, etc. The researcher would then consider aesthetic ideas including but not limited to:

- How could the mix be more musical?
- What sonic and musical elements provided the tracks with three-dimensional qualities?
- Which signal processors, effects, and recording practice techniques might enhance the three-dimensional sonic relationships occurring within the mix and how?

These preliminary listening sessions also illustrated the technical/aesthetic dichotomy which the researcher experienced in mixing practice. Technical issues are first resolved, which required troubleshooting with signal-processing tools. Once the mix was clean of technical errors and glitches, the aesthetic nature of the mix was then the focus. Aesthetic solutions are more difficult and require creative thought and decision-making by the mixer, and are not readily available in manuals, message boards, or other reference sources because of their context-dependent nature.

Learning what to listen for in mixing practice and following intuition.

Because the researcher took an introductory course in recording practice, he was aware of a

few important principles that allowed him to manage these mixing practice stages with greater ease. Highlighting this previous experience is important because the more comfortable or intuitive users feel behind a DAW or mixing console, the more time and energy they will save from having to troubleshoot any audio issues. Mixers and recordists will have less difficulty while working with musical and sonic ideas because of this unhampered attention and focus. This immediate ability in decision-making, or intuition, is a by-product of many experiences behind the mixing console or DAW. It is for this reason seasoned mixers recommend novices mix without hesitation, as practicing this craft first-hand provides immediate learning experiences which books, forums, and manuals cannot fully replicate and generates a multitude of listening experiences providing them with the ideas necessary for navigating auditory phenomena (Owsinski, 2013; Moylan, 2017; Izhaki, 2018).

Aside from having an awareness of the technical and general mechanics behind DAWs, the sonic compass was one of the many concepts introduced in the aforementioned recording practice course which helped the researcher analyze recorded musical arrangements in ways not typically encountered in his traditional musical education background. Chapter 6 investigates the researcher's personal and music education background further, as this is another step of data analysis vital for autoethnography. While keeping the metaphorical sonic compass in mind, the researcher considered how listeners might perceive recorded musical arrangements in terms of how mixes mediate implicit sonic information along their horizontal, vertical, and proximal planes (Hodgson, 2006). In addition to his experience and knowledge acquired from his previous mixing course, the researcher also used DAWs to record and write music for himself. Because of this, he was comfortable in configuring musical instruments, speakers, and other computer hardware to the DAW while also having control over the general key bind and software

commands.

The researcher identified issues with the mixes in the early stages because of his prior musical experiences, which are explained further in the following autoethnographic excerpts. The first account resulted from intuition and related to prior experiences with playing guitar. In this specific instance, the researcher noticed something strange with the sound of the guitar picking; the action used by a guitarist with fingers or a pick (plectrum) to strum, pluck, or brush strings (Kapron, *French Connection* Day 3). The issue with this sonic attribute specifically dealt with what the researcher referred to as the "attack" of the picked strings, a term he adopted from his experiences experimenting and using software synthesizers. Attack is one of the four variables within the audio synthesis amplitude envelope. Attack, decay, sustain, and release (ADSR) are the four stages of the amplitude envelope collectively responsible for the overall loudness and onset of a note; its articulation, duration of sustain, and resonance played back via synthesis (Hosken, 2011). Although synthesis is beyond this study, attack was a term and idea used often by the researcher as it involved the quality of a sound's onset. For example, the immediate attack and timbre of a picked guitar string contrasts in character against the gradual crescendo of a single tone played back by a trumpet, owing to each instrument's sound reproduction design.

Returning to the picked guitar's notes, the researcher found the sound of the guitar picking to be intrusive and overly loud, which interfered with the balance of the mix. To mitigate this immediate onset of the guitar track, the researcher recalled his synthesizer experiences with DAWs, and modified the attack of these picked notes. By delaying the attack, the onset of a sound begins later. Sounds could start twenty milliseconds later than intended, as in the previous example of the guitar plucking. After changing the attack settings, the melodic idea of the guitar

track was more audible, rather than the harshness of the guitar pick contacting the strings. Changing the guitar track's attack was a subjective preference and identifying this guitar picking characteristic was only possible owing to the researcher's previous experiences, which included having played guitar in the past, and having an awareness of synthesizer ADSR envelopes within Ableton. In sum, mixers have significant control over the timbres of individual sound sources and may emphasize or de-emphasize their qualities by listening intently and discerning among sounds based on their previous experience.

Middle stages

Until this point in the research, resolving technical errors was a dominant stage of interest because the researcher believed these issues would interfere with the musical and sonic expression across the mixes. One cannot fully enjoy a written work if there are grammatical or spelling errors, and the same applies for musical and sonic ideas. After mixing and resolving obvious technical audio issues such as clicks, glitches, and/or unwanted frequency resonances, the researcher thought of and questioned each mix in more musical terms. Questioning ranged from the trivial to complex, and examples included:

- What's next?
- Where might listeners' interests decrease in the mix?
- To which sonic and musical elements does the ear gravitate throughout the mix?

This exploratory questioning was the catalyst driving the researcher to focus on less emphatic musical areas and events in the mix arrangements. Chapter 5 addresses some of the mixing blind spots identified by an experienced audio engineer who provided helpful suggestions for their aesthetic improvement with respect to musical and sonic interests. However, and as detailed previously in the section on intuition, mixers' prior experience levels will also determine

how effectively they can impart creative elements to a musical arrangement, and no matter how nuanced their work might be. Similarly, the more mixers practice this craft, the longer they can focus on the mix before ear fatigue sets in. This cognitive phenomenon is explained in greater detail shortly.

It is important to note here that the researcher was not aware of entering early, middle, or later stages of mixing during the study. It was only after analyzing the data collection notes from his personal mixing process that patterns, ideas, and themes were found that the researcher was able to categorize as belonging to the earlier, middle, and later stages. Two defining features identified as closing the earlier stages of mixing were the resolution of apparent technical issues requiring minor problem solving or experimentation, and the desire to achieve complex mixing vision tasks demanding greater attention to aesthetic ideas. Looping is a vital tool in mediating intricate mixing tasks, as it allows users to listen, analyze, and adjust musical materials within a selected area of the musical arrangement. After readers examine how looping was used to manipulate aesthetic ideas in the study, they will also encounter a few more dominant themes which the researcher encountered during his middle stages of mixing practice. Themes include ear fatigue; using signal processors while achieving artistic goals across mixes; considering and embellishing the soundstage, namely the foreground, vertical, and horizontal dimensions; and the need for troubleshooting and resolving problematic scenarios within mixing practice.

Looping sections and shaping aesthetic elements

As the word suggests, looping within DAWs allows users to select a time region, such as a musical phrase, a single bar, or even fractions of a second, and have the chosen area repeatedly played back until the user stops the sequenced selection. During the researcher's prior experiences with DAWs, looping was mostly used to experiment with new musical ideas,

allowing him to improvise or test a new sonic element while the supporting musical materials or accompaniment were played repeatedly. Looping helped the researcher to isolate areas requiring technical fixes or allow him to pay closer attention to aesthetic or musical details.

While mixing the track *Learned Astros*, looping was used to experiment with compression applied to individual drumbeats. With looping, the researcher often soloed and looped elements to hear how audio tracks would sound on their own, and to judge how they would compare against other tracks. To do this, DAWs have a "solo" function wherein the user may cue a track and hear it independently while muting others. Similarly, users can apply this solo function to multiple tracks, where one or more tracks are "soloed" and heard in pairs and groups rather than being forced to hear the entire arrangement while discerning among auditory details which may be overwhelming to the beginner mixer or recordist. Looping provided the researcher with time to reflect on a particular moment of the mix and manipulate a sound source's timbre and other characteristics. Although looping single beats or phrases of the mixes proved helpful in testing the utility of signal processors, effects, and troubleshooting technical areas within isolated areas, the onset of ear fatigue and loss of concentration transpired after long or repeated looping use. The following video link depicts the use of a soloed drum beat looped with applied compression and equalization parameters before hearing the relation of the drums as they relate to the rest of the mix.

Learned Astros 1 - Kick drum looping footage.

Ear fatigue.

Ear fatigue is a by-product of the ear and brain adapting to modifications made to sounds and may be noticeable when working with an individual signal processor or effects unit over a long period. As readers can imagine, listening to a particular element of interest becomes

monotonous, especially when a single phrase of music repeatedly plays back. An equalizer applied to a looped musical phrase can exemplify this scenario. Users will adapt to timbral modifications made by the equalizer until certain frequencies are perceivably duller because of over listening, which then requires further modifications through EQ boosts, before the cycle repeats itself to the point of causing psychoacoustic fatigue (Howard & Angus, 2013, p. 400). Ear fatigue is common in audio production and is unavoidable, even when monitoring mixes and musical arrangements at lower volume levels, as the brain simply gets tired after prolonged periods of attentive and focused listening (Howard & Angus, 2013; Hugill, 2019). With experience, however, mixers can maintain focus during longer mixing sessions (Izhaki, 2018).

In the present study, ear fatigue was apparent during the early to middle stages of mixing tracks and was particularly noticeable whenever the researcher was straining to hear details that were previously audible with less effort. Ear fatigue was also noticeable whenever the researcher struggled to maintain mental clarity and began losing the ability to focus on details within individual audio tracks. While the researcher was fixed on eliminating a resonance within a distorted guitar track, for example, he gradually lost focus and mental clarity, as described in the following excerpt,

> My attention in this mix goes in a pattern at this point as it widens and attempts to balance out or bring different instruments or sounds into prominence when needed musically. Occasionally, I will hear something “off” or obtrusive in musical material one bar or less in length. I spend roughly 10 minutes trying to get rid of a guitar pick resonance after minimizing too much distortion in one of the rhythm guitars. I take a break and sense mental/ear fatigue after 40 minutes. (Kapron, Day 4 *Oregon*)

This loss in mental clarity was also apparent after mixing for approximately 40 minutes. In

a similar instance, the onset of ear fatigue was noticeable after working through the mix for technical audio glitches while looping one bar of an acoustic guitar track for 30 minutes. Taking frequent breaks from the computer or mixing console whenever necessary can help mitigate ear fatigue (Hugill, 2019; Howard & Angus, 2013). Regular breaks became a natural occurrence for the researcher, especially when having to focus and listening to mixes while attending to subtle auditory details.

Signal processors

Use of signal processors required experimentation on the researcher's part to better understand how to manipulate these tools to achieve musical and aesthetic goals. As the researcher continuously diverted his attention between listening to, manipulating, and evaluating changes made to sounds, it seemed apparent that ideas from Schön's (1983) *reflective practice in action* theory were applicable to the decision-making within mixing practice, before repeating this cycle seamlessly with the goal of creating satisfactory sonic outcomes. The researcher often experimented with signal processors and effects while looping musical phrases and attending to subtle details within the mix arrangements, especially when tinkering with unfamiliar tools or concepts. It is one thing to understand the principles behind certain signal processors and effects, and another to manipulate them firsthand based on what a mixer hears when seeking to achieve musical and sonic goals. The paragraph below unravels how the researcher experimented with a signal processor's variables in relation to what he was hearing within the mix.

Compression is known for its inconspicuous nature, as most casual listeners would have trouble distinguishing this quality within a musical arrangement. One reason compression is difficult to identify is because of the lack of real-world stimuli references (Hodgson, 2019, p. 103; Case, 2007, pp. 161-162). Whereas sounds can naturally echo or possess ambient qualities

emulated by delay and reverb, there are no natural occurrences of sounds in compression. Delay units imitate the repeated echo of a shout in a valley and reverb units replicate the cavernous reverberations of a sound within an expansive space, comparable to the reflective surfaces in a cathedral. Although the researcher understood one of the basic functions behind compressors, that of manipulating the dynamic range of an audio track, the signal processor's utility was only noticeable after applying aggressive compression variables. To see whether the compressor worked in the aesthetic direction presumed by the researcher, he would apply a maximum value to the wet parameter of a signal processor and verify whether its utility or purpose steered the mix in the desired musical direction. The following is an explanation of how compression works when applied to audio tracks.

Compression.

As a signal-processing tool, compression can help mixers to achieve countless musical and sonic goals within recording practice. Compression acts as a magnifying glass within audio tracks by increasing the strength of quieter frequencies while minimizing louder frequencies. Audio engineers within rock genres treasure compression's potential for shaping the loudness contours of respective sounds while providing transparent resolutions and overall clarity to the mix (Zak, 2006, pp. 123-124). Although applying aggressive compression ratios to an individual audio track or bus (a track housing a group of sound sources) might provide listeners with a perceptively louder sound, this decision might come at the expense of causing an imbalance by downplaying other sounds or relationships in the mix or sounding harsh or overly "tinny."

Compression raises the average volume level of a sound signal or waveform by electronically compressing the distance between its peaks and valleys or compressing the dynamic range of an audio signal (Devine, 2013, p. 163; Hodgson, 2010, p. 289). These signal

processors commonly function through five variables: (i) threshold; (ii) ratio; (iii) attack; (iv) release; (v) and knee. Manipulation of these settings allows users precise control over a compressor when pursuing creative and technical objectives (Hodgson, 2019, p. 103). Presented below is a series of waveforms illustrating compression use. The first screenshot within figure 4.12 depicts an uncompressed .wav file, characterized by its varying valleys and peaks. The following image depicts stronger compression, as the gaps between the lowest points of the valleys and the peaks are "squeezed" together. With a decreased dynamic range in the heavily compressed example comes a perceivably louder sound source. These patterns are heavily exaggerated within the screenshots in figure 4.13.

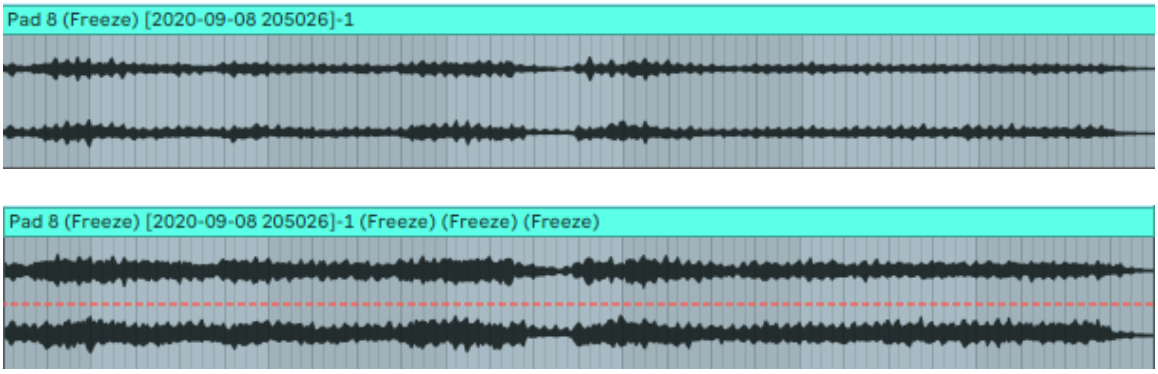

Figure 4.12: Uncompressed audio file followed by a copy with moderate compression.

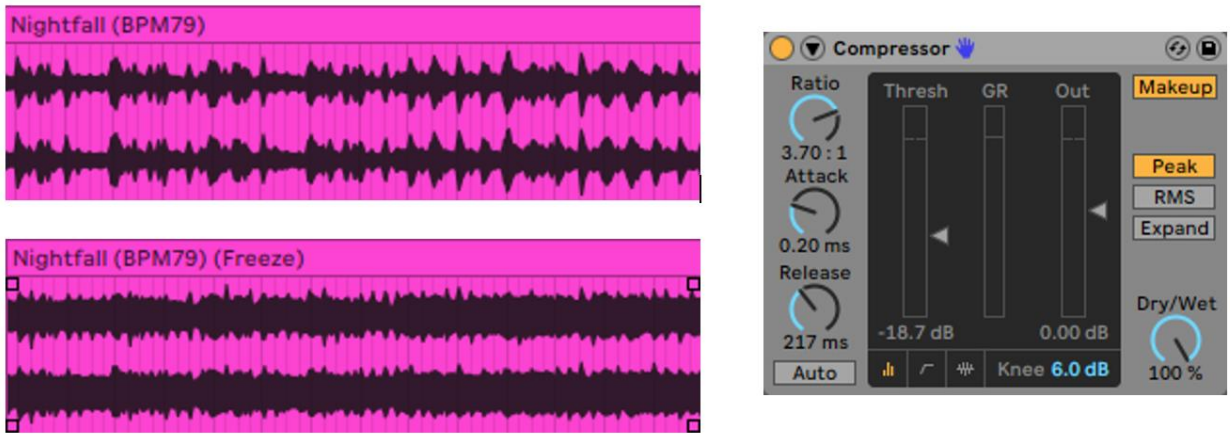

Figure 4.13: Uncompressed audio file followed by a copy with aggressive compression along

with the settings used.

Figure 4.11 No compression applied.[12]

Figure 4.11 Compression applied.

Readers might notice a similarity and difference in the above audio waveforms of figure 4.13. While the peaks in both waveforms are symmetrical, the valleys within the lower figure and audio example are compressed, expressing a closer dynamic range. All of the sounds within the compressed example are perceivably louder, which may or may not suit the character of the mix arrangement. If readers recall the budget metaphor for headroom used for equalization earlier, compression provides recordists and mixers with greater technical and creative mixing options while abiding to the decibel limits of the stereo bus (not surpassing the 0 dB limit). By squeezing an audio track through compression and having its lesser heard frequencies sound audibly louder while minimizing the levels of its louder frequencies, mixers can use compressors to allocate frequency decibel levels across audio tracks according to their best judgement.

The next account of how the researcher experimented with compression to achieve an intended sound is significant as it embodies ideas from Schön's (1983) model of *reflective practice in action*. First, compression was applied to increase the perceived loudness of individual elements within the mix. Next, the audio track was replayed with applied compression to verify whether his decision was correct. Although the mix grew louder, it was not as the researcher intended. The compressor was not creating the perceivably louder effect. This problem was attributed to the researcher's unawareness of how the send and return buses functioned within mixing consoles and DAWs. Below is a fieldnote excerpt of the researcher's thought processes while problem solving this issue.

[12] To simplify listening comparisons, readers are recommended to open both audio links on separate internet browser tabs while pausing and playing the above audio files

> I have everything set at 0 dB, except for a few tracks, but the reference track is still louder. This really makes me curious. I could bus some tracks to a compressor… After 'sending' 4 tracks to the compressor bus, I instantly notice an increase in volume. But this isn't the compressor working. I know this because I disable the compressor within the return bus. (Kapron, *Nightfall* Day 2)

This outcome puzzled the researcher, as the reference track was louder than the mix, and the goal was to achieve similar loudness levels between the two recordings. When comparing the mix with no compression against the reference track,[13] the researcher's mix was much quieter. This was an interesting puzzle for the ear in terms of problem solving. How could the mix be lower in volume compared to the reference track, even after maximizing the volume faders to the limits of the desired audio tracks? The following excerpt captured the researcher's thought processes in relation to his "eureka" moment, attributed to the soloing and muting functions within DAWS.

> I solo the return bus which contained the compression effect. It's not the blend of sounds I want, so I adjust the gain of the four sends to get a nicer balance. They're all at around 75-90 percent routed to the compression bus. I adjust the ratios and settings of the compressor further to get a nicer blend. To compare the effects of all this, I solo the return bus against the regular tracks without the use of the compressor bus. It's a good, bigger sound. However, I know the compressor squeezes the dynamic range of the four tracks. I'm much closer to the reference track's loudness. (*Nightfall* Day 2, Kapron)

The soloing function, in which users can individually play a track or bus and hear its audio independently from other tracks, allowed the researcher to discern and then resolve the problem.

[13] For more information regarding the use of reference tracks, refer to p. 134.

One consequence of this instance of problem-solving was that the researcher came closer to his aesthetic goal while simultaneously gaining an understanding of the use of sends and return buses, which is explained further in the next paragraph.

Until this point of using DAWs, the researcher neglected the use of sends and effects buses and avoided them owing to their unfamiliarity. Using these return buses allows DAW users to override computer processing limitations. Readers might be familiar with the sluggishness that occurs when many on-screen or off-screen applications are active on their computers. The same is true for DAW signal processors and effects. With lower processing power, the audio quality of the mix deteriorates significantly. Prior to the above compression experimentation example, the researcher only applied signal processors and effects individually to tracks, a process informally known as 'using inserts,' which changed signals' sonic signatures before continuing their signal paths to the stereo bus. The employment of independent inserts is commonplace in mixing practice, although DAW users can save computer processing power and achieve greater aesthetic control by using the return buses that store one or more effects units and create more elaborate combinations of sonic modifications. Rather than inserting the same signal processor or effect on a series of tracks, which robs the computer of its processing power, DAW users may send a copy of a track's signal to a return track, which imprints its stored signal processor or effect. By experimenting with the send and return functions within Ableton, the researcher found additional technical and aesthetic capabilities available to mixers as described in the above account (*Nightfall* Day 2, Kapron).

Considering the soundstage

As mentioned in earlier chapters, the three-dimensional soundstage is a significant theme within mixing practice. The thought processes and decision making relevant to the soundstage

were different depending on whether the researcher was in the early, middle, or later stages of mixing tracks. In earlier phases for example, the researcher identified generic aesthetic and technical problems while resolving obvious audio issues. The following quotation outlines first impressions and mixing goals after a preliminary listen-through of the mix.

> The first thing I notice already is the orange and blue tracks sharing similar EQ areas. So, I will either make cuts, or pan them to share different areas… Guitar heavy track, so there will be some layering of parts. I'm not sure if this is a good thing (because I might have to duck some elements underneath other tracks.) The goal is to make this lusher and/or spacious. (Kapron, *Oregon* Day 1)

These preliminary observations were broad, and the focus on details increased the longer the researcher worked on a mix. One listens, writes notes of general impressions, attempts to isolate, and resolves an issue before listening to the mix again as a whole. Having made observations across the various soundstage dimensions (horizontal, proximal, and vertical), the researcher decided on pursuing one of the ideas, such as the horizontal nature of the mix made in his notes, and attempted to improve an aesthetic or technical feature.

Horizontal dimension.

The researcher enhanced the horizontal dimension of a mix by manipulating the stereo spectrum and using the Haas effect, among other methods. Panning relates to how listeners perceive auditory stimuli in the left, center, and right areas of a mix's stereo spectrum. The Haas effect effectively "widened" sounds, causing them metaphorically to take up greater horizontal space within the mix's sonic compass with the added benefit of sounding more prominent. Before explaining the Haas effect in greater detail, the following sections illuminate how the researcher panned sounds across the mixes for greater aesthetic effect.

While mixing *Oregon*, the researcher panned the two guitar tracks to the left and right speakers and expanded the horizontal dimension. Two or more tracks sharing frequency areas may cause redundancies and/or unwanted layering, because these congruent sounds are "vertically" placed one on top of another within the metaphorical sonic compass, commonly known as "masking" in audio production. Although the guitar tracks shared the same frequencies, they were heard on the left and right sides of the stereo spectrum due to panning, which is explained further in the next paragraph. This decision imparted a greater sense of width for listeners and the researcher believed this goal would provide the mix with additional horizontal space. The following audio examples provide readers first with an idea of how the guitar tracks sounded without panning, before hearing the result of aggressive panning, where each guitar track is positioned on both ends of the stereo spectrum. Figure 4.14 depicts the final panning settings selected for the mix.

Unpanned guitars

Panned Guitars

Figure 4.14: The highlighted light blue areas within the clock-like symbols are the panning settings within Ableton's tracks. These variables allow users to pan audio tracks from left to right.

The mixing done on a separate track (*Nightfall*) provides another example of the horizontal dimension, where the researcher noticed individual percussion elements when listening through the arrangement early in its mixing stages. Most of the recorded sounds were not panned to the left or right channels. Sometimes mixes contain sounds recorded with previous panning decisions made in the arranging and recording process. With *Nightfall*, every sound was playing straight through the center. As the researcher continued listening, various percussive sounds were heard, including bongo and drum toms and the researcher panned these separate percussion sounds to the horizontal areas to enhance the mix's sound design slightly. In rock/pop genres, it is common for the various instruments and sounds to be panned according to ways perceived in a live setting, with the vocalist, kick, and snare drums taking the center, the high hats off to the right, and cymbals and toms positioned from left to right (Zak, 2001). Rather than having these individual percussive elements played simultaneously down the center stereo

channel in *Nightfall*, the researcher opted to position them slightly more to the right or left channels to provide the mix with greater horizontal variety. Figure 4.15 below illustrates how one might pan individual tracks within Ableton to the left, center, and right areas of the mix, as shown by the blue highlighted areas.

Figure 4.15: Three separate audio tracks with the differing stereo panning decisions represented by the light blue markings (read from left to right, approximately 60 percent to the left; 25 percent to the left; and 25 percent to the right).

The researcher also experimented with above aforementioned Haas effect, another technique that introduces an increased perception of width to sounds within the mix. Although the researcher never implemented the Haas effect prior to this study, he learned the concept in a previous recording production course and had frequently heard the term used in passing whenever discussing audio production with others or watching online videos on mixing topics. While mixing *Oregon*, the researcher applied the Haas effect as a goal for this mix, intending to make this arrangement sound "lusher." The chapter will later clarify how the researcher implemented the Haas effect (p. 97), a process requiring him to experiment, troubleshoot, and research how to achieve this recording practice technique.

Proximity dimension: Considering the foreground and background.

Mixing tracks while considering their foreground and background characteristics is similar to the implicit thought processes occurring while perceiving paintings or photographs, in which certain objects hold the viewer's interest owing to their proximity or juxtaposition with other elements. With a sound's proximity to the listener in mind, the researcher mixed the tracks in two directions. The first consisted of using equalization and gain staging to have the tracks sound closer to the listener's position, and the simplest route to this goal was by manipulating their perceived loudness in contrast to the accompanying audio tracks. Gain staging is the proper setting of a signal path so that an audio input does not overwhelm another section's input signal, before reaching the destination, the stereo bus (Owsinski, 2013). This can be exemplified by a guitar audio track with signal levels originating from a microphone capturing an amplifier's levels, including whatever effects were used by the guitarist, before encountering the preamp (a device that boosts the electrical voltage of a signal without increasing the noise floor, an undesirable static sound quality or electrical hum), and before reaching the USB interface, responsible for translating the guitar's audio signal into a digital audio waveform recognizable by the DAW. The signal path continues through various signal processors and effects within the DAW. Gain staging is of lesser importance within digital mixing consoles due to their software calculation models rather than having sounds processed via analog signals, although an awareness for these factors can help mixers identify where distortion or any other form of static or noise might occur in a signal path (Winer, 2018). Gain automation was the second method wherein the researcher altered sounds' gain levels over the course of a musical arrangement. Not to be confused with volume, gain levels are the decibels of an audio signal entering a device or system, while the decibel levels exiting a device are the volume levels.

Gain and volume levels are constantly in flux within DAWs and mixing consoles, especially whenever recordists and mixers are manipulating signal paths between an audio source and its destination, the stereo bus. As a practical example, gain automation applied to a bass line (*Learned Astros* 1) provided the sensation of a sound coming closer to the listener's position, characterized by the track growing louder in decibels as the track was played back. This gain automation decision contrasted with the original mix arrangement with no prior modifications, in which all sounds, including the bass track, were played back simultaneously at the same decibel levels as a block of sound. Gradually increasing the gain of a track entering the soundstage also created the impression of a sound entering the mix dynamically. The video example below includes the mix entrance with no gain automation, followed by the same introductory phase repeated with gain automation applied to the bass track. Readers can follow the automation parameter represented by a red line within the orange bass track and compare between the examples provided.

Learned Astros 1 - Bass track without and with automation.

Automation serves versatile functions and applies in the other dimensions of mixing a track. The vertical nature of the mix can modulate and develop as the mix plays back in real time with the use of automation and occurs whenever mixers might close or open EQ filters gradually to restrict or allow frequencies rendering them audible. When panning sounds horizontally, automation, a process in which the computer automatically manipulates a variable in real-time such as panning, can be used so that frequencies played from the left side are gradually heard to the right speakers or headphones. Automation has many versatile functions within DAWs and is not limited to manipulating a track's gain levels. It can apply to many signal processors, effects, and other DAW functions to achieve technical and creative goals. The following example

combines the elements of panning and automation, where one listens to a series of guitar chords played from left to right, as heard, and seen in the provided link.

French Connection - Guitar chords with automated panning, alternating from left to right.

The researcher also used equalization to manipulate the proximal dimension while mixing, as this affected the prominence of sounds by modifying their timbral and resonant qualities that are manifested via frequencies. One feedback suggestion from Dr. Hodgson required the researcher to re-conceptualize the snare drum and make it more impactful. Figure 4.16 below portrays the EQ parameters which the researcher believed would add a "punchier" character to the snare drum track while providing a subtly brighter quality to the lingering resonances of the snare drum hits. The important identifiers within the figure below are the yellow numbered notches. The third notch corresponded to the punchier quality just described, as that is where 1.5 dB of gain boosted the 200 Hz range with a narrow Q-value. Similarly, a 1.90 decibel boost to the sixth notch responsible for the elongated and low gradient curve covering a large frequency portion provided a slightly brighter resonance to the snare drum.

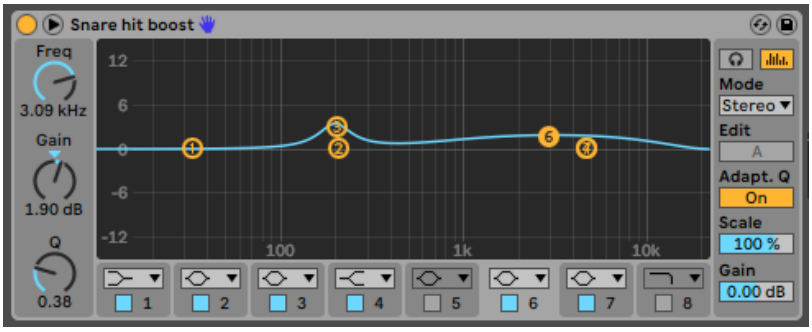

Figure 4.16: Equalizer applied to snare drum track in French Connection 1.

Vertical dimension.

The verticality of the soundbox relates directly to the frequency assortment and treatment across the mixes. Although equalization can shape a sound's prominence within the mix and proximity to the listener, equalization is also vital in facilitating the vertical dimension of the

soundbox. Mixers and recordists conceptualize this vertical plane as the height of a mix, a relational construct according to which frequencies occupy positions above, below, or along similar frequency levels (Hodgson, 2019). Equalization is therefore a vital signal processor within this dimension as this tool magnifies or negates broad or narrow frequency areas of an audio source, or in recording practice terminologies, boosts, or cuts frequencies.

Adjectives were utilized in this study to characterize sound qualities (i.e., dull, crisp, full-bodied, underpowered, etc.) and served as immediate and informative markers for the researcher within this and other dimensions. The following fieldnote excerpt from one mix illustrates how adjectives associated with higher and lower elevations related to a drum track's frequency ranges.

> I play with another band on the equalizer, between 1 kHz and 10 kHz frequencies, so I can get the higher, airy character of the snare drum to sound brighter in the mix. It seems to stick out more now… Something I've noticed is that this track could be more interesting if we fill up the space with more high-end elements, such as the rides/cymbals in bar 41. (Kapron, French Connection Days 1 & 2)

The idea behind "filling up space" related to the researcher's perception of unused frequencies within the confines of the mix's three-dimensional sonic compass. By using this "free space," one could potentially express creative ideas leading to greater sonic variety within the mix's vertical dimension. After boosting the equalization in the following frequency ranges, "between 1 kHz and 10 kHz," the drums sounded brighter compared to previously. The following link provides readers with drums receiving no equalization treatment, with a following example with substantial equalization boosts.

Looped snare drum pattern with and without equalization.

If mixers or recordists are conscientious of how frequencies are distributed within a mixing arrangement, they could either refine their relationships or enhance them to make use of any unused decibels while ensuring the stereo bus does not clip.

Understanding the general pitch ranges of each audio track is a good starting strategy that will immediately inform mixers of the musical arrangement's frequency template. It may in fact be easier for beginner mixers to identify the verticality of a mix by considering frequencies from low to high pitches or, as mentioned earlier adopt, a bottom to top approach (Moore, 2012). Advanced listeners will notice that questions of pitch are inextricably linked to timbre, as the instrument selection, energy of performances, and pitch ranges within the mix will paint a thorough picture of musical ideas (Moylan, 2017).

While these equalization tips and starting approaches might be informative for beginner mixers, some might ask, "so what?" Why is this vertical dimension of the soundbox critical in terms of how frequencies are distributed in the mix? The brain and ear process a limited amount musical information at one time, and issues such a lack of clarity or contrast in musical ideas are solvable problems if mixers are aware of this vertical dimension and ensure it is free of technical errors. The distribution of frequencies within a musical arrangement can be illustrated by using a budget metaphor. The mixer's currencies are sound frequencies as Hertz and decibel values, and one can allocate them with the caveat of working within the confines of one's budget, in this case, ensuring there is enough headroom within the mix (Anderton, 2018). Clipping the stereo bus or leaving no headroom are likely indicators that the recordist or mixer is spending more frequencies than the analog or digital mixing console can afford, although there are many instances where engineers pushed records to or surpassed decibel level limits intending to create recordings with an aggressive and digitally distorted character. The Red Hot Chili Peppers'

Californication (1999) is a notable example of a record crafted with excessive loudness exploitation practices, which prompted some audiences to petition for an unmastered release as digital clipping and aggressive compression severely reduced the dynamic ranges of the album's tracks (Hodgson, 2019; Shelvock, 2012).

Mixers and recordists aware of how frequencies are vertically situated and structured throughout their musical arrangements may then use their best judgement when improving sound design features, such as ensuring clarity, facilitating sonic variety among sound sources, and confirming melodic ideas are prominent. Technical concerns resolvable by equalization include mediating the clashing of frequencies between two or more tracks; and "carving out" resonances or rolling off low/high portions of recordings. Equalization could also be used to isolate and mitigate unnecessary rumbling, high frequency noise, or static found in previously recorded tracks or digital samples and eliminating clicks or glitches. The researcher considered the verticality of the mix from a musical perspective by examining the mix's musical elements while played back in real time. Explained further in the following chapter are questions related to facilitating musicality in the mixes, with ideas relating to what the researcher could have improved in a subsequent revision of the mixes according to his mixing feedback from Dr. Hodgson.

Researching and troubleshooting issues

Although at the outset of this study the researcher knew of certain recording practices and mixing techniques, he either had little experience or never worked with some of them. The mixing tools outside of the researcher's comfort zone included compression, gates, the use of send and return buses, and the Haas effect – as already explained to some extent above, a spatial localization technique that grants listeners the perception of hearing a wider stereo image. Prior

to this study, the researcher had worked very little with the first three signal processing tools and techniques mentioned but learned of the Haas effect in his recording practice course. The following excerpts are the descriptions and ways in which the researcher went about learning to apply these recording practice techniques to his mixing.

Experimenting and tinkering with the Haas effect.

The Haas effect works along the following principles. If two identical sounds played from two separate sound sources follow one another in close succession and between an interval of 1 to 30 milliseconds, there is little to no distinction between separate sounds. At 40 millisecond intervals between two sound sources, listeners perceive a marked separation, and increasingly so at 50 milliseconds (Gardner, 1968). When applied to mixing and recording practice, the Haas effect occurs whenever the gap between a sound and its duplicate is between 1-35 milliseconds; anything sufficiently longer is perceived as an audible delay or duplicated sound (Izhaki, 2018). Delays are a different signal processing effect used to create repeated echoes and are not conducive to the aesthetic goal within this context. Therefore, the Haas effect is used subtly to achieve increased width or panning to a sound.

Because one of this researcher's goals when mixing *Oregon* was for it to sound "lush" and "wider," he incorporated the Haas effect, as it seemed to be compatible with this aesthetic vision. The cellos within this mix played a strong supporting role during the verses, and the researcher wanted to enrich and make them sound fuller. Having known that the Haas effect is possible by having one sound follow an identical copy in close succession and played stereophonically (sounds originating from two audio playback sources, such as left and right speakers), the researcher made a copy of the cellos (done by duplicating or copying and pasting the audio track within the DAW) and applied delay to one track to achieve the Haas effect. By delaying the

duplicated cello track by 1-2 milliseconds, the researcher could hear phasing,[14] which was not the desired goal and attracted unwanted attention in the mix.

Having known 1-2 milliseconds of delay was not the desired result, the researcher tried to find the right sound by closing his eyes and adjusting this variable until the sound sounded "wider," which he achieved after a minute of tinkering. When working with DAWs, some recordists and engineers recommend looking away from the mixing arrangement shown on-screen while modifying signal processor variables and listening to their consequent relationships and positioning in the mix, as staring at the screen might distract users from what is more important, the sound of the musical arrangement (Owsinski, 2013; Anthony, 2018). After achieving the best possible sound quality, the researcher opened his eyes and identified the satisfactory result, 14 milliseconds of delay to the one track. After achieving this goal, work remained for the researcher, because there were consequences created by duplicating the cello tracks. Duplicating the cello track caused the mix to sound louder, an unintentional by-product of layering where identical or different audio tracks are stacked on top of one another and played simultaneously (Bell, 2018). Although duplicating the cello tracks and providing one of them with the Haas effect granted a greater sense of perceived width, the researcher did not intend for the cellos to sound louder as this positioned them closer to the listener's perspective. The last step of fulfilling the Haas effect within this context required the researcher to select these two cello tracks and soften them by -3 dB, a task achieved by selecting the two tracks on-screen and lowering the faders by desired decibel amount, which resolved the issue. Readers may listen to

[14] Phasing, a similar effect to chorus and flange although the most difficult to discern of the three, is a subtle bandpass effect with no harmonic variance in the audio signal, unlike that of flanging and chorus (Hodgson, 2019). In the researcher's experiences, phasing often resulted from alignment and timing issues whenever two identical samples were layered on top of one another, resulting in a subtle and slow "swoosh" effect, and occasionally left the two audio copies sounding underwhelming or compromised.

the following examples of the researcher working through the stages of achieving the Haas effect with cellos. The links below on the left contain the cellos played back independently from the mix, in their original state and with the Haas effect. The links on the right contain the cellos with the same modifications but heard in relation to the mix.

Cellos soloed with no Haas.

Cellos with no Haas and played back against mix.

Cellos soloed with Haas.

Cellos with Haas and played back with mix.

Summary

Across all the mixes, the researcher followed a common workflow pattern. He first organized the musical arrangements and ensured they were free of obvious auditory glitches and errors before focusing on creative or aesthetic details. Prioritizing these edits was necessary because the researcher believed that any audible errors, such as recording glitches, undesirable resonances, or intonation across the recorded tracks, would interfere with the overall clarity and aesthetic character of the mixes. These opening stages also involved the researcher setting up the DAW so that he would be more efficient when pursuing the creative and musical work. Key preparation tasks included importing the audio tracks making up the mixes; creating project files and backups; labelling and organizing tracks according to their musical function or purpose; significant EQ decisions such as rolling off high or low-end frequencies; and cleaning errors or unwanted auditory characteristics.

The preparatory work often coincided with resolving technical issues. Common scenarios included using equalization (EQ) to clean up overpowering or interfering frequencies within or among the tracks themselves; correcting intonation errors; splicing and moving audio samples for them to land on proper rhythms. Some tasks required balancing the technical and aesthetic responsibilities of mixing practice, such as using EQ to change proportions of audio tracks

working in relation to one another so there is little to no overlap, redundancies, or clashes between frequencies. After completing these preparatory tasks, the researcher mixed the tracks with an aesthetic vision in mind.

Continuously working with sounds as they temporally progress through a song from start to finish with their metaphorical three dimensions is one of the mixer's creative responsibilities. Reference tracks are a helpful tool to gauge the progress of a mix's character in terms of its three-dimensional qualities. As a reference track plays back against a mix, mixers will develop a general idea of what they need to improve or fix (Askerøi & Viervoll, 2017). Keeping a portfolio of reference tracks can be helpful for any mixer, and may act as a source of inspiration, calibrate their ears for the mixing session, or prevent mixers from remaining in a creative dead end, similar to writer's block (Izhaki, 2018). The researcher often compared the mixes with reference tracks that were provided to him from the beginning of the study, since they offered aesthetic character approximations, also acting as unspoken general guidelines.

Readers will have a sense of the introductory and central mixing processes that lay the foundations for a mix arrangement, along with synoptic explanations of signal processing tools and recording practice concepts by this point. Although this chapter provided specific mixing examples along with explanations supporting the researcher's rationalizations, readers will find these decisions rooted in subjective preferences shaped by stylistic genre characteristics or the feedback provided by a client or owner of a mix. The following chapter reviews the concluding stages of the mixes and addresses the feedback Dr. Hodgson provided to the mixer. This feedback was vital for the researcher's learning processes as it illuminated mix elements and aesthetic/creative goals, thereby assisting the researcher in his pursuit of greater refinement as a mixer.

CHAPTER V

DATA COLLECTION & ANALYSIS: LATE STAGES OF MIXING

Introduction

The final mixing stages of this autoethnographic study involved verifying if the researcher accomplished his aesthetic goals for each musical arrangement and whether the mixes sounded better than in their original states. How or why a mix might sound better than its prior version is context dependent and required analysis of the musical arrangement (Marrington, 2017). This involved, but was not limited to, variables such as understanding of stylistic conventions and knowledge and awareness of how the brain and ears respond to psychoacoustic techniques and musicians' decision making within recording and mixing practices.

This chapter fulfills a previously outlined goal of summarizing the researcher's decision-making during the late mixing process stages. In contrast to the previous chapter which explained signal processor and effect functions across specific mixing examples, the researcher used these devices sparingly in the final stages. The rationale for this mixing style was to maximize the amount of loudness without clipping the stereo bus. As readers might recall, mixers can either boost or cut decibels across signal processors, effects units, and other tools within DAWs. However, there is a finite limit of cumulative decibels allowed in any mix arrangement before the 0-decibel stereo bus limit is clipped.

The notion of "signing off" on mixes is also discussed in this chapter as it is an important final stage in professional mixing environments requiring finalizing of the artistic and technical contributions of members involved in a track or recording. Since the mixing was done in the context of an academic study, these work conditions were modified as the mixes' author(s) and recording artist(s) were made anonymous to the researcher. To imitate the working conditions of

a mix sign off, Dr. Hodgson listened to the mixes and provided feedback as to how the musical arrangements could be improved technically and aesthetically, which prompted the researcher to resolve issues and modify the mixes further. After revising the mixes, the researcher tested them on commercial listening devices to confirm whether his mixing decisions sounded satisfactory. Accounts of these listening experiences are documented later in the chapter.

The feedback process was important and exclusive to these late mixing stages, requiring the researcher to answer ambiguous research questions, such as whether the mixes sounded better than they did originally, and if so, why? Revising the mixes according to the feedback suggestions ranged in difficulty. Simple requests included changing the horizontal and proximal positioning of audio tracks within the mixes according to musical genre conventions. Complex mixing goals necessitated molding the musical or dramatic nature of the arrangements further, and it is in this section (pp. 116-124) where the researcher considered and experimented with creative solutions for maintaining listeners' interests.

Late stages of mixing process

Before continuing and describing the late stages of the mixing processes, it is necessary that the researcher remind readers how the middle mixing stages concluded. This involved experimenting and using signal processors, effects, and mixing techniques, such as with the Haas effect, to navigate the mixes' various sonic compass dimensions (proximal, horizontal, and vertical planes) with the goal of enhancing their musical characters and ensuring they were free of technical problems. After resolving these creative goals of the middle stages, the researcher mixed with the goal of maximizing loudness through minimal signal processor use.

Sparing use of certain signal processing tools and effects

During the late mixing stages, the researcher worked to make the mixes more aesthetically

pleasing to listeners, in contrast to earlier stages of the mixing process when the priority was reduction or elimination of technical errors and glitches. The following mixing examples depict the researcher using reverb and compression sparingly in the late stages to enhance his aesthetic visions for the mixes.

With *Learned Astros*, the researcher sought to fill its sparse musical character by sustaining and prolonging sonic elements with reverb, a common effect used in record production (Izhaki, 2018). To achieve this goal, the researcher manipulated the reverb tails of the snare drum hits. In other words, the reverb applied to the snare drum strikes created prolonged resonances that were sustained for longer durations, filling in the sparse nature of the mix. Mixers, however, must consider how reverb may affect their mixes, as reverb tails (the sustaining and softening decays, or reverberations which follow a sound source) might clutter a mix with too many sonic elements, rendering the sound muddy, or conversely fill in the empty spaces within a sparse arrangement (Izhaki, 2018).

Similar to the experimentation required for achieving the correct Haas values in the previous chapter, the researcher had to tinker with the decibel values of the reverb effect's embedded reflections parameter, which controls the tone and velocity of a sound source's earliest reverberations occurring before its resonating tail (DeSantis et al., 2018). The number of milliseconds or decay time for the reverb tail was another vital parameter conducive to achieving the aesthetic goal of filling in a sparse mix arrangement. While the reflections parameter affected the timbre or character of the reverberation, the decay time controlled the duration of the reverberation effect. In the audio links below, readers can hear the slight decay of the snare drum strikes while the effect is toggled on/off to hear before and after reverb comparisons.[15]

[15] To aid listening comparisons, it is recommended to open two links simultaneously while pausing audio playback. In this way, readers can play, pause, and compare audio files between their browser windows/tabs.

Isolated drums without reverb

Isolated drums with reverb

Mix including drums without reverb

Mix including drums with reverb

The idea of "less is more" was significant while mixing and apparent whenever the researcher was adding sonic elements or characteristics to the musical arrangements. Whereas sculptors chisel and *remove* pieces of marble and artists *apply* pigments, colors, and other mediums to create artwork, mixers balance the roles of adding and removing elements of originally recorded sounds to create a satisfactory mix. In these later stages of mixing, the researcher had the aesthetic responsibility of shaping already recorded musical arrangements to seem more pleasing to the ear. With compression, the researcher used this signal processing tool to subtly magnify elements of the mix, making them more apparent to listeners.

Before examining the mechanics and variables of compression, the researcher found himself faced with an initial aesthetic decision, that of selecting between two compressors, as these signal processors not only provide technical functions within DAWs but may also shape aesthetic qualities through timbral coloration (Shelvock, 2017; Bell, 2018). The two options available were Ableton's default compressor and a glue compressor, the latter based on a 1980s, built-in, analog mixing console bus model (DeSantis et al., 2018). Although the researcher never used the glue compressor, he tested the two with mild settings to see how they affected the timbre of the lead guitar melody. After looping a phrase of the mix arrangement a few times while listening to each compressor's effect, it was apparent that the glue compressor provided a warmer tone compared to the default Ableton compressor. The threshold and release variables were important in shaping the lead guitar audio signal. Threshold was determined by adjusting a decibel value within the compressor; whenever the lead guitar audio signal surpassed a fixed decibel value, the compressor would activate and modify the signal. The release variable

determined the duration of time in which the compressor worked with the audio signal before gradually tapering off before the next threshold activation. While a mix plays back in real time, these two compressor variables are continuously functioning. After some tinkering, the researcher found the threshold at which the compressor captured the signal of the lead guitar's sustained notes while adjustments made to the release variable caused the compressor to taper off after a particular time, in this case milliseconds. The end results were subtle in this mixing example and provided this audio track with slight warmth and definition. Readers can listen to before and after comparisons of this glue compressor within the following audio examples.

Isolated guitar solo without glue compressor

Isolated guitar solo with glue compressor

Mix including guitar solo without glue compressor

Mix including guitar solo with glue compressor

Going to the limits of the stereo bus

In contrast to the earlier mixes in which the researcher mixed the tracks while reserving 12 decibels (dB) of headroom, he wanted the later mixes of the study to be as loud as possible without the aid of signal processing tools. Although the researcher mixed with considerable headroom, his mixes were considerably quieter than the reference tracks. Whenever mixes are finished in professional recording practice settings, they are handed off to mastering engineers who often request there to be a certain amount of headroom, which was not the case within the study as Dr. Hodgson made no explicit suggestions to the researcher regarding headroom requirements. Given that the mixes would not be mastered, as this recording practice stage was beyond the study, the researcher decided to remove headroom in his later mixes and experiment with a different mixing approach which optimized loudness.

Prior to this switch in artistic direction, the researcher's mixing decisions reflected a modest approach, evident in reserving -12 dB of headroom and avoiding any drastic manipulations to the tracks while maintaining a transparent mixing style. However, the mixes with -12 decibels of headroom were much quieter than the reference tracks while the intended goal was to have the new mixes sound superior to them. This comparison concerned the researcher because the human ear is less forgiving and quick to recognize increases in volume (decibel boosts) than it is to decreases in volume (cuts) within quieter musical passages (Hodgson, 2019). Simply said, louder often sounds better within the field of psychoacoustics (Vickers, 2010; Ronan et. al., 2014; Izhaki, 2018). From a commercial perspective, record labels of the Motown era reified and exploited this phenomenon in part by utilizing fixed volume settings across jukeboxes in restaurants and public venues. If listeners are provided with two identical recordings of a song, they will likely prefer the louder version of the two. Many recordists and engineers of the Motown era were aware of this tendency and crafted records with loudness being an important factor for commercial successes, as the loudest songs within jukeboxes were played more than their quieter competitors (Katz, 2007; Hodgson, 2010). With music becoming highly compressed and perceivably louder over the last several decades, questions of musicality are in flux with recording practice techniques used with the intentions of optimizing loudness. As is explained next, within the confines of this study, navigating notions of headroom and loudness can be a mixed blessing for beginner mixers.

Readers might recall in earlier chapters that reserving an amount of headroom (i.e., -6 to -12 decibels) provides mixers or recordists with space which prevents them from clipping the stereo bus as they mix. Although providing the impression of having greater space to work with, mixers might be tempted to provide additions to the tracks. This might require decibel boosts to

certain signal processing or effects variables and, if left unchecked, these cumulative modifications will eventually clip the stereo bus. If beginner mixers recall that some mixing decisions, namely decibel boosts across track levels, signal processors, or effects unit parameters, come at the cost of subtracting decibels from the stereo bus, they are developing an awareness for the limited amount of decibels allowed in their given arrangements.

To maximize loudness, the researcher removed unused headroom by boosting the tracks within the mixes by the same number of decibels, and this number depended on the clipping point of the stereo bus. After clipping the stereo bus slightly, the researcher reached the headroom limits and accordingly stopped boosting the track. He then applied automated gain adjustments to prevent clipping the stereo bus during that one moment of time in the musical arrangement, as illustrated in Figure 5.1 below.

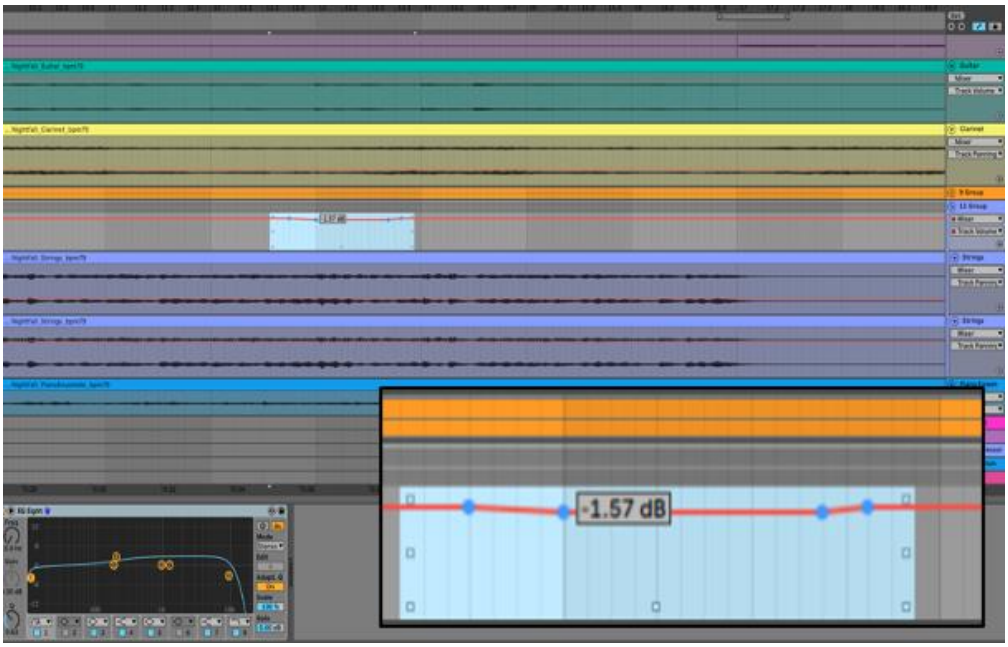

Figure 5.1: Screenshot of the mix arrangement window with a magnified portion indicating automated gain staging via the red line. If the levels were not automated to -1.57 dB during these highlighted bars, the stereo bus would have clipped.

The red line shown in the above figure depicts the automated gain parameter in the mix arrangement and slightly descends to maintain a value of -1.57 dB, before returning to its previous value of 0 dB. The researcher identified -1.57 dB through a process of trial and error while looping the track. Automating this track's gain levels down to a level of -1.57 dB during that moment in the musical arrangement prevented the mix from clipping. The researcher achieved a maximum loudness of -0.01 dB within the stereo bus because of this automation decision, as seen in figure 5.2 below.

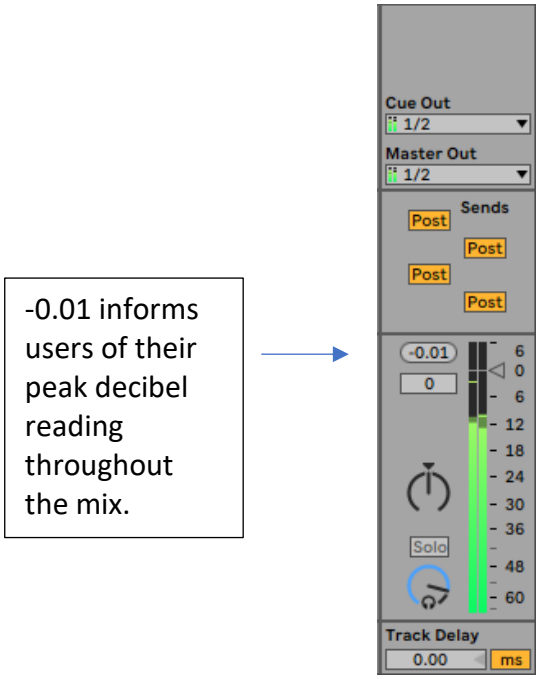

Figure 5.2: Stereo bus with a value of -0.01 dB, a significant increase from the previous reading of -0.88 dB.

These processes were not musical. Rather, they were highly technical, requiring the researcher to continuously manipulate values and adjust automation parameters for the purpose of achieving the greatest amount of volume within a mix. Although not aware of the term and process while initially mixing and collecting data, the researcher was involved in 'gain staging via automation.' Recalling from the previous chapter, gain staging is the adjustment of signal paths across various stages with the goal of not overloading any unit, especially the stereo bus (Owsinski, 2013). However, this task aligned with the goal of creating a mix louder than the provided reference track.

Although not used in the study, there are many digital tools available to mixers and engineers that provide loudness benchmarks allowing them to compare tracks against commercially acceptable standards. Comparing reference tracks against the mix and using one's

ears is the quickest way to realize whether the arrangement is on track to sounding commercially acceptable or whether further work is necessary. Consulting a reference track or two, and possibly using digital metering tools might prompt mixers to question, “how or what can I do to improve the mix?”

“Signing off” on the mixes: Confirming that the work is finished

Because the researcher mixed according to predetermined weekly timeframes, it was important that he worked on the mixes efficiently while ensuring they sounded better than in their previous states. This required the researcher to prioritize specific mixing objectives within the weekly mixing practice timeframes while adopting strategies typically used by mixing engineers to gauge mix quality during the late workflow stages. Replaying mixes on different listening devices and comparing them to reference tracks ensured that they sounded better than they did in their earlier stages and made it possible for the researcher to verify whether the aesthetic goals envisioned from the onset of the mixing process were achieved.

Despite having strategies and techniques to verify that mixes are technically and aesthetically satisfactory in their later stages, sound engineers and/or artists mixing for themselves might experience apprehension before concluding their mixing work, whether that be for mastering or sending the mix back to a client. This apprehension is associated with the mix “sign off,” and is worth explaining because it involves clients’ and mastering engineers’ expectations of the mix. Signing off on mixes requires online or in-person communication and agreement among everyone involved in the musical arrangement that their artistic and technical contributions are fulfilled, as the work done in the mixing stages serves as foundations to create musically satisfying master recordings suitable for commercial distribution. Once mixes have been ‘signed off’ on, and sent to the mastering engineer, this signifies that they can no longer be

changed and are ‘set in stone,’ which may cause apprehension for recordists and mixers with perfectionist mindsets. Signing off establishes that the mix is fully complete, as mastering engineers require a mix that is fixed in nature; providing engineers with a different version of a mix while they are mastering a previous version negates their work and time invested in the mastering process.

Technological advances in digital communication (i.e., internet file-sharing, e-mail correspondence) and recording practice have also affected the signing off process, making it more tedious. For example, after finishing mixing work in the analog era of record production, the finished product resulted in a two-track tape which could no longer be modified and was then shipped off to the mastering engineer. With today’s digital technologies, mixes and masters can be seamlessly transferred between parties using the internet (Toulson, 2017). Instantly accessing musical arrangements via internet and computer hard drive technologies while continuously editing or modifying them according to client demands or their own ‘perfectionist’ mindsets is a detriment as these factors prolong the time required to finish projects.

Signing off proves to be a difficult task for everyone involved within the mixing process, whether it be the mixers themselves, the recording artists, and even producers, as this stage reveals any uncertainties or insecurities these parties might still have regarding the recording or track (Toulsen, 2017). Record production scholar Mike Senior (2015) provides a pragmatic example establishing a collective agreement when signing off which requires diplomacy, especially if mixers are involved within a project’s earlier recording stages, as one of their responsibilities includes ensuring that the entire arrangement sounds excellent, which is not necessarily the same as having the tracks recorded in isolation to sound excellent (p. 63). Failing to consider and differentiate between these two ideas can be detrimental to a mix. Although the

tracks heard independently from one another might sound good, combining them together and hearing the musical roles they play against and along one another within the mix is entirely different. It is for this reason mixers should avoid signing off the mix until everyone involved has recorded and heard their parts against the backing tracks, or mix, and is satisfied with their work in its overall context (2015, p. 63; Toulsen, 2017). Considerations of this sort require tact or social intelligence, as concise and clear communication facilitates quicker progress towards the completion of a track or record. The following mix sign off scenarios experienced by the researcher below both explains this phenomenon further and conclude his preliminary run-through of the mixes before receiving his mixing feedback from Dr. Hodgson.

Testing the mix and simulating a "sign off."

To see if the researcher had overlooked any important details within *Oregon,* the mix was rendered into an audio file (.wav format) to be played through headphones on a separate listening device, such as a phone or personal computer. This allowed the researcher to look away from the DAW while strictly listening to the mix. After listening to *Oregon,* the researcher was pleased with his work and noticed a contrast between listening to the mix as a single audio file on headphones, as opposed to listening to the mix as a series of audio tracks within a DAW and played back on monitors. Although listening to mixes on reference monitors provided the researcher with a highly accurate auditory picture of the mix, listening on commercial audio playback devices provided the researcher with a neutral verdict on the quality of the mix. Many mixers often use and trust the "car test" by having their mixes played back through a car stereo system to test the viability of their mixes from an additional firsthand feedback perspective (Owsinski, 2013; Devine & Hodgson, 2017).

Having multiple vetting options is important to the mix "sign off" process within audio

production. Making the final call and announcing a mix is finished prevents it from receiving any more tinkering or edits before sending it back to clients and onward to the mastering stage. Mastering engineers often receive edit suggestions from clients after having listened to their final mixes on professional loudspeakers and address issues that should have been resolved in the mixing stage (Toulsen, 2017). Although this might seem obvious in saving mastering engineers from potentially unnecessary back-and-forth correspondence with a mixing engineer, it is recommended that when working with a client or group of recording artists, to provide them with a final listen of the mix before signing off to verify it is satisfactory to everyone's standards, as described earlier (Senior, 2015). Beginner mixers that are collaborating with recordists may benefit from some of the above sign off ideas, as these strategies help to ensure everyone involved with the creation and curation of a musical arrangement is satisfied and confident that their work is completed with the highest quality possible.

Comparing the mix to reference tracks.

While mixing *Denathio*, the researcher noticed that his mix was significantly quieter than the provided reference track and was not as energetic. These thoughts were expressed in the following fieldnote entry:

> I feel silly noticing this now, but just after listening to the first eight bars, and comparing the tracks to the reference track, I can immediately hear a difference. The reference is *thicker*, and *whole*, whereas the tracks in my mix sound *tinnier* and *lacking presence*. (Kapron, *Oregon* Day 1)

After listening to the mix arrangement play through from start to finish, the researcher was not interested in or captivated by any musical, creative, or other aesthetic elements. One good outcome, however, was the technical side of the mix, as it sounded cleaner and less muddy than

the reference track. The researcher quickly learned a lesson from this reference track comparison, concluding that he might have spent too much time on technical aspects, such as drum splicing and intonation. For example, three of the five days reserved for mixing *Denathio* involved ensuring the Hertz values across the tuner plug-in within the mix arrangement were consistent among all the tracks; this preoccupation with intonation resulted in tunnel vision and wasted time. More importantly, listeners will be unaware if numeral variables (i.e., Hertz/decibels) are accurate or consistent with others, nor does it matter. For the sake of efficiency, mixers should continuously assess how the arrangement sounds and refocus their attention to other musical ideas that might have been neglected. While concluding these late mixing stages, the researcher expressed this important musicality theme within the following fieldnote entry, "… it is the evocative and moving parts within the music that matters, not the technical workings. No one will know what is going on behind the box (the DAW or mixing console). Listening between the reference and first mixdown was revelatory" (Kapron, *Oregon* Day 1).

Receiving feedback for the mixing work

While meeting with Dr. Hodgson in person, he listened to the mixes from start to finish and provided the researcher with the following feedback. *French Connection* and *Denathio* received similar suggestions and required rearranging the horizontal and proximal spatial positioning of sound sources according to their levels of musical importance. The snare drum within *French Connection* was too underwhelming and quiet, especially near the beginning of the arrangement. *Denathio* required similar attention to the drums, especially since the guitars were too loud for its genre conventions. For this mix, the drums needed greater prominence

while the guitars should have played a supportive and accompanying role within the background of the mix.

Nightfall and *Learned Astros* were mixing examples that required greater attention to musicality. Although they were tidy in terms of technical details, with no audible glitches or apparent audio quality discrepancies in the musical arrangements, Dr. Hodgson expressed that there were occasions of "losing the mix." This is not to be confused with the term "lost in the mix," whereby listeners have trouble distinguishing sound sources clearly. Rather, losing the mix involves maintaining listeners' interests, which requires creative solutions. Within *Nightfall,* 'losing the mix' was especially apparent in the latter half of the arrangement when the drums were accompanied by minimal bass and chord patterns before the main theme or verse structure of the musical arrangement returned; it was unclear what this section's musical function served. After having been led to this low-energy fragment of the musical arrangement, it seemed boring to the researcher. On the notion of boredom, recording practice scholar Roey Izhaki (2018) outlines interest as one of the four mixing objectives mixers should manage while practicing their craft. Mixers can add or create interest in otherwise boring songs, while not all musics or genres are meant to be attention grabbing but require subtle variety in musical elements (pp. 68-69). Mixing with an aesthetic mindset requires inventiveness, as navigating musicality within recording practice is ambiguous given the vast selection of recording practice tools available.

Returning to an idea from the previous chapter, almost anyone can learn to balance sound sources and tracks (Owsinski, 2013). While this is an important skill, to consider the dramatic character of a mix and how it might further captivate listeners' attentions requires creative problem solving and ingenuity on behalf of the mixer. Record production scholar Brendan Anthony (2017) playfully references to a *Star Wars* theme of Jedi mastery, as learning to mix

"musically" is truly mysterious and transcends skills that might be learned from a book or internet forum. These inconspicuous abilities cannot be demonstrated or explicitly taught and depend on how one navigates the musical context of a mix, especially through their intuition as a mixer. Anthony (2017) argues that expert mixers either have a developed or natural creativity. Rather than attributing their successes to technical knowledge or owning the best recording and mixing technologies available to them, Anthony contends that "[i]t is for their sheer creativity---not for their technical brilliance---that some mixes are highly acclaimed and their creators deemed sonic visionaries" (Izhaki, 2008, p. xiv). Although the researcher's mixes were free of technical problems and were 'tidy,' they lacked musicality or features which captivated listeners' attentions. After receiving Dr. Hodgson's abovementioned feedback and advice, the researcher returned to the mixes and attempted to improve them with creative mixing objectives in mind (i.e., prevention of 'losing the mix,' flow, energy, etc.).

Revising the mixes

Before revisiting the mixes, the researcher made backups of the mixes as a precautionary measure. Afterwards, the researcher began mixing *French Connection* and *Denathio* with the goals of improving the horizontal and proximal balances. As mentioned earlier, the problem with *French Connection* specifically dealt with the guitars, including the bass, as they overpowered the snare drum. After resolving these simpler technical and aesthetic points of interests, the researcher improved the dramatic and musical characters of *Denathio, Nightfall,* and *Learned Astros* as described in the final excerpts below.

French Connection: Improving the snare drum

Since all the tracks within *French Connection* were lowered by -12 dB, there was plenty of headroom which prompted the researcher to make three significant mixing decisions with the

snare drum. First, he increased the snare drum track levels from -12 dB to -10.5 dB. The difference was audible, but not too loud. Next, he applied equalization and selected an EQ band between 1 and 10k frequencies to bring out the airier and brighter end of the snare drum. The final touch was subtle with the addition of reverb and 1 dB boost within the plug-in's EQ parameter (shaping the timbre of the reverberation). This decibel boost amplified the reverb tail, causing the snare drum to have a reverberant, cavernous quality. The reverb's pre-delay settings were also of importance as these parameters caused the reverb to activate 1. 72 milliseconds after the drum hits occurred, only capturing the resonances and not the entire strikes. Figure 5.3 below illustrates the final equalization and reverb settings used.

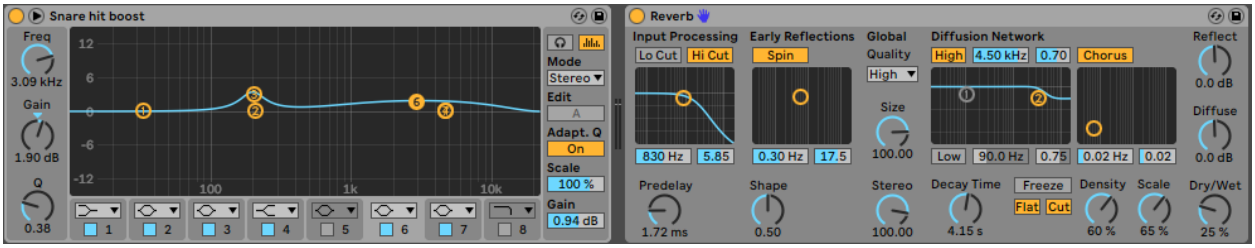

Figure 5.3: EQ boosts and reverb settings for the snare drum track in French Connection.

Revisiting Denathio

The main revision task with *Denathio* involved improving the drum sample's positioning and relationship to the mix, as it was previously underpowered. This was also an opportunity to experiment with the musicality of the mix and was done by affecting the drum sample by automating its gain levels at precise moments during the cymbal hits. The effect of this gain automation was reminiscent of coordinating the musicality of individual members within an ensemble, which the researcher recalled from his experiences playing in chamber music groups, choirs, and rock bands. How the researcher achieved these mixing goals is explained below.

Improving the drum track balance.

For the drums to be positioned at the center of the stereo spectrum and allowing greater prominence necessitated level boosts. It was also apparent to the researcher that in the preliminary run-through of the mixes, the drums were neglected compared to other sonic elements. Because every track's fader levels were approximately at -12 dB, the researcher had plenty of headroom or space for drum track boosts, which resolved the balance issue. Boosting the drums, however, unfortunately left the bass guitars sounding flat within the mix.

To compensate for this new imbalance, the researcher opted to shape the bass guitar's timbre with equalization, rather than boosting its decibel levels. Mixers can use equalization to pronounce, clarify, and sculpt features of an audio track with precision and accuracy. Raising the overall decibel levels of an audio track might not achieve the same objective. This mixing decision would be the metaphorical equivalent of asking someone to repeat a sentence with clearer diction, rather than repeating the sentence louder with poor articulation. Opting to increase audio track levels rather than employing equalization in this mixing scenario would require a Sisyphean effort. One boosts a sonic element with the intent of achieving clarity, while leaving the other sounds unusually quieter in comparison. Boosting the duller accompanying sounds as a reaction leads the mixer back to the original problem, an unclear sound source within a louder mix. Increasing decibel levels would have left no marked aesthetic differences between the tracks while potentially clipping the stereo bus because of cumulative boosts.

Shaping the bass guitar.

The researcher also wanted to mix the bass guitar, making it sound fuller and clearer using equalization or other effects. Unlike the previous snare drum example, this could not have been done by boosting the bass guitar's decibel levels. From a soundbox perspective, although boosting levels might bring a sonic element into greater focus and proximity, the sound could

still be flat in tone or timbre. An audio track could be mixed to take up greater space and listener attention while not achieving much clarity and definition. Metaphorically, this would be akin to a highly magnified photograph of an object, and although distinguishable, slightly blurry. How might a mixer modify a sonic element for it to be clearer, while not disturbing its proportions and interactions with other sounds in the mix?

The saturator, an Ableton plug-in and signal processor, seemed like a suitable solution to the current bass guitar problem. This built-in plugin allowed the researcher to color the bass guitar audio file and transform its waveform into an aggressive, hard-curved analog signal with an assortment of parameters to further shape its timbre. This plug-in contained a drive parameter which users control by boosting or cutting decibels, which in this context must be used sparingly, as the mixing goal within this context was to provide color while minimizing level variation. To use another photography metaphor, one could differentiate between two identical photographs by their color tone and saturation. The fieldnote quote below includes the researcher's thought-processes and decision-making regarding timbre in relation to mixing practice:

> It's all according to musicality. I wanted to bring out the bass in bars 41-45 and contrast it with the rest of the piece because of its neutrality. In other words, I'm trying to move elements around the sound box. After applying the saturator, it sounded like someone slapped a distortion guitar pedal to the signal. I change the dry/wet signal to 8.17 % and it's a significant change without it becoming glaring. This is a good additive change to the mix. (Kapron, Revising *Denathio* Days 1-2,)

Readers should note the small percentage of this signal processor's strength on the original signal (8.17%). The saturator's effect was very mild, and although slightly noticeable, the dry/wet variable automated from 0 to 8.17% whenever the bass had to play a supportive role in the mix

when transitioning in and out between the verse-chorus-verse sections. This was all done according to taste and whether the researcher liked the sound of the modifications. Figure 5.4 below shows the final saturator plug-in parameters.

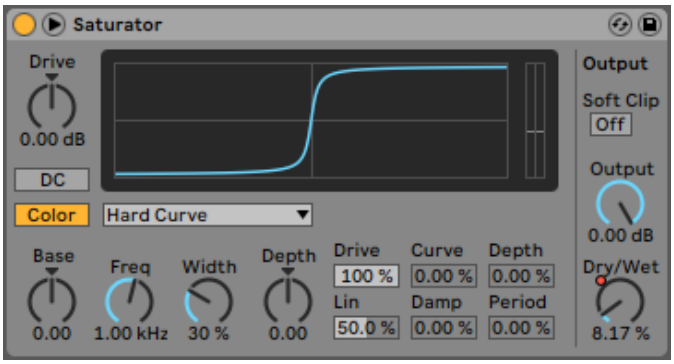

Figure 5.4: Ableton's saturator plug-in with a hard curve analog signal setting.

Denathio: Experimenting with musicality

Although the main feedback suggestion within *Denathio* involved resolving drum balance issues, revisiting this mix also proved to be a significant musical experience for the researcher. This experience resulted from following the ear after rebalancing the drums. Thought processes such as "what is my ear gravitating towards at certain points in the musical arrangement?" or "what is missing in the mix?" prompted him to pursue this creative side of mixing practice.

After rebalancing the drum track to make it sound stronger, the researcher increased its musicality by using automation processes. To remind readers, this is where a single or series of parameters within or across tracks are manipulated in real-time. Perhaps the simplest example of automation readers might recognize might be the gradual increasing or decreasing of volume as a song begins or ends, which results from the stereo bus being automated to increase or decrease decibel levels over a short period. With *Denathio*, the researcher automated the drum track levels between the verse/chorus sections without having the drums sound out of place.

Automation also improved the musicality of the mix by shaping the digitally sampled drums to sound as if a live musician were playing them. This was possible by automating the gain levels and emphasizing specific drum cymbal rhythms to be stronger than the other drum kit elements. Shaping the rhythmic and melodic emphases of sounds across the mix reminded the researcher of his past experiences of playing in bands and chamber music ensembles allowing the musicians to showcase their musical entries or motifs during performances. The musicians coordinated their music making whenever other members played softer or louder and rehearsed these modifications to ensure consistency. In contrast, when mixing for musicality or any other goal, mix engineers may control any variable at any moment in time. For example, an individual element like a cymbal crash during the moment of 2 minutes, 5 seconds, and 322 milliseconds in the musical arrangement can be increased in volume or provided with any form of signal processing, effect, or other mixing technique when intending to shape its musical role or timbre within the mix. This fine level of control might be one of the many reasons novice mixers might have the tendency to focus most of their attention on the information displayed on-screen while listening for sonic elements, which might serve as a detriment to their attention and prioritization of mixing goals (Reiss, 2017; Anthony, 2018).

Learned Astros: Increasing drama and potential listener interest

After listening to the mix and considering Dr. Hodgson's feedback, *Learned Astros* seemed static as the sound sources/tracks were fixed in place and thus motionless. The researcher considered bringing the sonic image closer in proximity to listeners for dramatic effect within areas of the mix. This mixing goal was analogous to the cinematography technique where cameras might focus on the face of a character delivering an important line of dialogue and/or positioned in a way to attribute a level of significance or drama to a scene.

Since one of the mixing objectives was to instil motion, the researcher selected parts of the mix arrangement that were most important or ear catching such as volume and proximity and automated these respective sonic variables. The researcher selected the ambient guitars and provided them with a significant 9.75 decibel boost, as they were underpowered, before automating them to a lower decibel level when their verse structure returned in the musical arrangement. The following fieldnote quote captured the researcher's thought processes when working within DAWs during this late stage of revising mixes, "… it is about using the tools at hand and having the tracks come to life while making them interesting. Prior to this, I was mainly thinking and approaching the mixes with a cleanup mode mindset" (Kapron, Revisiting *Learned Astros* Day 1).

To make *Learned Astros* more dynamic, the researcher diverted his attention towards the MPC audio track, an electronic drum pattern occurring within the middle of the musical arrangement. Although this sonic element was provided with EQ roll-offs and broad minor decibel boosts within certain areas so as to be more perceivable, it achieved no dramatic function or purpose. The problem here was failing to consider the musicality and overall energy and flow of the mix. As an attempt to make the MPC drum track interesting and novel to listeners, the researcher applied a slapback delay to contrast with the sparse character of the mix. Listeners can hear differences between the drum track with and without this delay effect in the links below.

Isolated electronic drum pattern without slapback delay

Isolated electronic drum pattern with slapback delay

Mix including electronic drums without slapback delay

Mix including electronic drums with slapback delay

Nightfall: Creating interest

When revisiting *Nightfall*, the researcher fixated on increasing its musicality. This included fine-tuning the sonic elements out of balance within the arrangement's mixing compass (the proximal, vertical, horizontal positioning of sounds), or were unusually quiet considering their melodic or harmonic importance. An example of this occurred with the cellos/string section audio sample. The researcher duplicated the cello audio file so he could pan[16] the original track and its copy to both sides of the mix, causing the cellos to sound greater in volume and width. However, this created a problem, as they sounded out of place in the musical arrangement when the chorus returned to the verse section. The reasoning for this was a gap in silence prior to their re-entry. To remedy this contrast, the researcher developed the percussion during this quieter section by having it increase in velocity and delay effects as to fill up space and tension before the verse returned. Besides reducing the glaring contrast from before, this mixing decision also could have achieved the goal of stirring listener interest. During these later mixing stages, comparing the revised version of the mix against the previous state served as a useful gauge of identifying whether the arrangement was heading in a positive creative direction.

Summary

One of the most important goals within mixing practice is considering how musicality is achieved in the mix, especially in how it maintains or increases listeners' interests. Although musicality within mixing cannot be fully explained, this topic can be a focus for future studies within recording practice and music education literature. If, for example, and as witnessed by this researcher in reviewing the mixes, there is any level of boredom or lack of interest from the listener's perspective during any point of the musical arrangement, this could be an indicator of

[16] Readers are reminded that panning is the action of spatially positioning tracks towards the left, center, and right 'areas' of a stereophonic recording. Readers may refer to chapter IV (pp. 88-90) for audio examples and more information related to this recording and mixing practice function.

the mix requiring further revisions. Finding creative solutions is ambiguous and mixers will pursue this goal differently according to their skill sets, musical tastes, and the digital/analog recording practice tools available to them.

The mixes in this study were instrumental. Vocal elements would have presented the researcher with additional challenges which might include mediating the emotional character of the lyrics through signal processors and effects to enhance or mold the consonants, vowels, and sibilance of words while considering the musical character of the mix, and whether these mixing decisions aesthetically support or distort its message. Learning to mix while navigating the lyrical component of an arrangement is an added layer of complexity within mixing practice and can also be investigated in future studies. Having examined the data collected across the mixes, the following and final chapter analyzes and summarizes insights for students and teachers from the study considering music education literature.

CHAPTER VI

Revisiting the Conceptual Learning Framework within the Context of Music Education Literature

Before proceeding with this final chapter, which summarizes and explains the implications of the collected data, readers are reminded of the study's primary purpose, that of engaging in mixing practice to explore the aesthetic and technical sonic elements mixers manipulate when seeking to improve the quality of musical arrangements, with the goal of providing pedagogical guidelines and recommendations. Instead of prescribing a strict mixing pedagogy, the study drew on autoethnographic[17] data which helped to identify applicable principles and guidelines that music teachers and novice mixers may refer to when navigating the craft's musical challenges. Thus far in this dissertation, readers were introduced to various mixing processes and tools and common pitfalls in the craft, and they will soon revisit its necessary competencies. The conceptual learning framework included within this chapter outlines learning goals which emphasize creative mixing habits without stifling individuals' potentialities for generating authentic sounding mixes.

It is important here to remind readers that the above four competencies (listening, signal processing, psychoacoustics, and musical forms) listed by Rudi & Pierroux (2012) and introduced earlier in this study (pp. 29-34) served as recommendations for students working with computer music in secondary and upper-secondary education levels and is not exclusive to mixing practice. These competencies alone are interdependent and cover broad fields of knowledge. For example, listening intently to the mix requires some perception and knowledge

[17] During data collection, autoethnography requires researchers to recall prior experiences which support their in-field findings with retroactive factors (i.e., previous life/experience factors that might impact data collection or studying phenomena).

in signal processing and psychoacoustics. To listen critically with a ‘mixer’s ear,’ one should know general psychoacoustic principles demonstrated through actions such as identifying frequencies below 50 Hertz (Hz) by recognizing their ‘sub-bass’ sonic qualities. Knowledge of musical forms alone, one of the other above competencies, is also of little benefit to mixing practice although it can be helpful in guiding mix decisions (i.e., building to a chorus requires knowledge of a verse-chorus basic song structure). Accompanying this knowledge should be the expertise or awareness of signal processors, effects, and mixing techniques that facilitate psychoacoustic ‘sleights of hand’ within the mix arrangements. Certain musical genres sound the way they do because of how these technological devices and software are used by mixers to achieve creative sonic visions. Missing from these competencies, and that are proposed below, are pragmatic recommendations for approaching a highly technical craft such as mixing.

The above competencies work interrelatedly, but they overlook many elements that mixers bring into the craft. Their prior experiences, cultures, and knowledges are unique, subjective, and vital to mixing practice as these variables affect musical arrangements according to what individuals already know, are experiencing in the world, and hope to achieve musically within recording practice. The above four competencies also overlook the ‘on-the-ground’ knowledge obtained through mixing and collaborative experiences which musicians, recordists, and engineers bring into this craft. Through the experiences gained via autoethnography, audio production, and music education literature reviewed, the researcher developed below five principles outlining general pedagogical guidelines for beginner mixers navigating this art form.

Principles

As just mentioned above, instead of recommending a pedagogy enforcing formulaic procedures, the following principles serve as guidelines which beginners may loosely follow.

Rigid pedagogies not only reinforce step-by-step guidelines but are also impractical as there are too many technological factors to control. Many variances exist across DAWs, digital and analog mixing tools, and the musical/sonic ideas within mix arrangements. Recommending guidelines exclusive to one DAW might overlook general mixing problems other DAW users might encounter within their contexts.

Precautionary measures to prevent hearing damage

Before listing the principles, it is vital to remind beginner recordists and mixers to work responsibly with sound amplification tools and DAWs owing to the ears' vulnerability to irreversible hearing damage. Izhaki (2018) includes an important warning within the introductory pages of his mixing handbook, that hearing damage is often not immediately noticeable, especially when exposing oneself gradually or immediately to high decibel levels over prolonged periods of time. Mixers should remember that sounds which are too quiet at first can always be increased in volume, and it might be too late for mixers and their auditors to manage sounds that are too loud at first (2018, p. 3). Listening in these mixing contexts should also be done in moderation. Indeed, professionals recommend that inexperienced mixers develop a habit of protecting the ears from hearing damage by turning down all the volume levels at the beginnings and endings of their mixing and recording practice sessions. Having drawn attention to this important safety measure which allows mixers to practice this craft for as long as possible, the five principles are introduced. They are 1) developing a familiarity with the DAW or mixing console, 2) prior recording stage experiences serve as pre-requisite mixing knowledge, 3) create a list of objectives after listening to the mix, 4) develop an ear for mixing/and or recording practice, and 5) experiment with the known and tinker with the unknown.

1. Become acquainted with the DAW or mixing console.

Countless mixing handbooks and seasoned mixers recommend beginners to dive in and mix, as practicing the craft grants mixers learning opportunities for listening and knowledge pertaining to computer technologies, DAWs, and recording practice (Owsinski, 2013; Moylan, 2017, Izhaki, 2018). This can intimidate novice mixers, as they might encounter technological pitfalls, nuances, and idiosyncrasies with DAWs. The very idea of learning and understanding the psychoacoustic principles and fundamental workings behind the mixing tools used within DAWs can also be overwhelming. Beginner mixers should identify and isolate specific skills related to DAW workings and remind themselves to repeat them. For example, after learning a series of splicing functions involving combinations of keyboard and mouse-click commands,[18] the researcher could identify and edit specific portions of audio files which required technical and aesthetic attention. Although seeming unintuitive at the start, a written reminder posted nearby with a list of shorthand computer commands saves novice mixers time and will remind them how to navigate and control the DAW as they access audio files with greater speed and precision. Regardless of what DAW a mixer works with, these shorthand commands are typically labelled within the drop-down menus beside the editing/function commands. Readers with word processor experience might recognize this by clicking the 'file,' or 'edit' drop-down menus within their software and notice the commands followed by their computer keyboard shortcuts, which improves workflow.

With technological efficiency and workflow improvements aside, one of the ultimate goals in recording practice is achieving and maintaining musicality in an arrangement, a task made more accessible with knowledge of general DAW workings. In line with this goal, music

[18] Splicing commands served similar functions to those of copy, cutting, and pasting commands in word processors (ctrl + c, ctrl + x, ctrl + v) when manipulating highlighted/selected portions of audio tracks.

teachers and beginner mixers can attempt basic mixing projects while acquainting themselves with the tools provided and tinkering with various DAW functions. The more one mixes, the more recording practice techniques, computer commands, and signal processor functions they discover. Over time, mixers build up a repertoire of mixing decisions that are intuitively recalled when creating a musically satisfying mix. In sum of this first principle, novice mixers should jump in and start using these tools and DAW computer commands to get a 'feel' of how to navigate musical arrangements while having preliminary objectives in mind, such as increasing clarity and balance among sounds, highlighting and emphasizing sounds' musical functions, or promoting musical interest or flow in the arrangement.

2. Experiences in the recording stages serve as pre-requisite knowledge

Becoming familiar with the earliest recording practice stages such as importing and recording audio tracks into DAWs is fundamental to the acquisition of transferable and other skills in mixing. Many tasks in the mixing process involve decision-making and can have an extreme influence on what the mixer can do later within the arrangement (Hodgson, 2019). For example, microphone selection and spatial positioning around the room or around specific areas of amplifiers are both recording and mixing decisions that affect their timbre, presence and/or spatial positioning in the mix. Deciding where to position a microphone can do more to help than any amount of post-production trickery and requires knowledge of a microphone's EQ-curve signature and how it will respond to the mix and other sound sources overall (Bromham, 2017, p. 248).

Knowledge of and with sampling also saves mixers time and effort. The sound quality of samples, and how they compare against other samples or recordings in the mix will either be satisfactory or compound problems for the mixer. Using built-in digital musical instruments

within DAWs also requires foresight and evaluations against other audio tracks in the mix. When using digital instruments, recordists and mixers should manipulate the built-in software instrument variables affecting timbre, velocity, and other sonic variables to ensure their musical objectives are compatible with their mixing visions. Mixers paying attention to these variables are rewarded with saved time, greater knowledge/less ambiguity of the musical arrangement, and finer control over possible aesthetic and technical outcomes in the mix.

3. Listen and create a shortlist of objectives.

One common theme that occurred for the researcher across all the mixes was the creation of objectives within the earliest moments of mixing every track. The very first thing mixers will do after importing audio tracks into their arrangements will be to listen as the mix plays through from start to finish. This step also reveals why prescribing a step-by-step pedagogy for mixing practice is impossible. Although there might be occasional similarities, all mixers create their own objectives and priorities in terms of where they will start working in the mix, the objectives they set out to accomplish, and the aesthetic visions they create.

Readers might recall ideas from chapter IV (p. 93) pertaining to vertical directions and how a mixer works through a mix (i.e., top-down, bottom-up approaches, musical function, etc.). Having few mixing experiences to recall, the researcher mixed with a bottom-up approach combined with the musical function or purpose of each audio track in the mix, as this seemed like an organized and logical method of approaching the musical arrangement. This required working with the tracks, starting with the lowest frequency content before moving on to other audio tracks containing mid to high frequency ranges, with the exception of the drums/percussion. The researcher always treated the percussion as its own sub-group and mixed it against all the other tracks possessing melodic/harmonic frequency content. These starting

methods are ideas teachers and students could adopt when mixing. Possession of a personalized list of mixing objectives, though, will help to prevent one from becoming overwhelmed or distracted by separate ideas of interest that might interrupt workflow.

4. Develop an ear for mixing (and/or recording practice).

Once beginner mixers are comfortable navigating the DAW and are not doubting themselves over what the keyboard, mouse click commands, and other virtual mixing parameters control, their attention is free for critical listening. It is for this reason the above first principle requires mixers to jump in and practice using DAWs for the sake of developing technical comfort and intuition, so they can later navigate mix arrangements with fewer disruptions to the musical elements encountered. This fourth principle contains sub-groups with further recommendations or strategies beginner mixers may use to develop an ear for mixing, and it revisits notions of headroom, suggestions for when mixers doubt what they should be listening for, and maintaining awareness of possible ear fatigue.

No matter the genre, mixes are composed by their audio tracks, which are manipulated through two variables discussed multiple times throughout the study, that of frequencies (Hz) and decibels (dB). As mentioned previously, these variables metaphorically represent currencies, as there is a limited amount of auditory information the ears and brain can process, and the maximum number of decibels allowed before the stereo bus clips. Frequencies and decibels respectively involve musical information related to pitch and loudness. By employing the soundbox, mixers can visually identify these variables by illustrating pitch, timbre, spatial positioning dimensions (left, center, ride, back, foreground, etc.), velocity, timbre, and other sonic ideas as novices navigate their musical arrangements.

When considering the notion of ocularcentrism – the dominance of information and ideas

through visual/ocular modes of communication, it might be helpful for beginner mixers to visualize frequencies in a tiered manner, such as layers of atmosphere or ascending through a series of levels (Abramo, 2014). Below is a list of frequency layers attached with descriptors that recordists and mixers sometimes use to describe sound qualities:

200 Hz and under: bass

200 to 500 Hz: warmth

500 Hz to 1500 Hz: definition

1500 Hz to 4000 Hz: articulation, presence

4000 Hz to 10,000 Hz: brightness, treble

10,000 to 20,000 Hz: sheen, air (pp. 42 - 43 Anderton, 2018, pp. 42 - 43).

Teachers, students, and novice mixers unsure of which frequencies they are hearing in the mix and curious how to verify which Hertz values they are hearing, may load a graphic equalizer to see the frequencies resonating in real-time. With some equalizers and DAWs, there are options to click and isolate a particular frequency and hear it resonate separately from other frequencies and audio tracks in the mix.

Headroom: Treat decibels and frequencies as finite resources

The field of psychoacoustics as it relates to mixing within DAWs covers a vast number of ideas, topics, and phenomena and can be overwhelming for beginner mixers, educators, and students venturing into recording and mixing practice. Rather than presenting psychoacoustics as a field of knowledge which novice mixers should be wary of, beginners should consider sounds for what they are within recording practice contexts, as existing in the forms of decibels and frequencies. By acknowledging or treating these values as finite, since only so many of them can be present within the mix arrangement before the stereo bus clips, mixers can then work with

these values with definitive boundaries. This is where the concept of headroom is useful for beginner mixers.

Music teachers, students, and beginner mixers can allow themselves -6, or -12dB of headroom from the very beginning of working within the mix arrangement space provided. These unused decibels, or 'available space,' are referred to as headroom. When getting accustomed to providing headroom, recordists and mixers will presumably notice that when comparing their mixes that averages at around -12dB for example, result in much quieter musical arrangements than is the case with commercial music. Anyone can boost or increase a track's fader levels to make an individual source louder, but this will not mean the mix will sound better. It takes skill and creative thought to make use of this space, as mixers should capitalize on the pre-existing frequencies and decibels and manipulate them further with the goals of clarifying the mix, improving its flow, and rendering the sound more pleasing to the ear.

What to do when in doubt?

Common to writing and other crafts requiring creative ingenuity, mixers might run into writer's block where they cannot conceptualize ways of proceeding to mix the track. This might be prevalent for beginner mixers familiar with a limited range of recording practice techniques. These problems stem from a lack of critical listening or mixing without a musical purpose, which is explained in greater detail below. Provided are four recommendations to overcome situations where beginner mixers might doubt their workflow approaches: 1) listening with closed eyes, 2) listening to the mix on other devices away from the DAW/mixing console, 3) using reference tracks, and 4) maintaining awareness of ear fatigue. These recommendations were generated as a result of collecting mixing experience data and consulting recording practice literature.

Listening with eyes closed.

An over reliance on visual information might be a hindrance to mixers, as the craft depends on how sounds are curated. Although mixers working via DAW processes navigate through information displayed on-screen, they must always listen for the qualities of the sounds themselves rather than rely on visually identifying musical elements. This idea is a reiteration of Anthony's (2015, p.115) study with tertiary-level students complaining about not hearing what they are seeing on-screen, when the real solution in mixing is to listen for, feel, and affect the variables they are seeking with their ears rather than their eyes. This problem replicated itself while the researcher collected data. When reviewing the earlier videos of the researcher mixing at his desk, there were a few instances when the researcher would bring his head closer to the computer screen, hoping to find problems in the mix. These behaviors could become bad habits that are not conducive to successful mixing practices, yielding few benefits.

When doubting which direction to take the mix, turning off the computer screen proved helpful when overly fixating on elements appearing on screen. Returning to the mix arrangement after small breaks in the study (i.e., weekends, holidays, prolonged absences, etc.) often caused apprehension with workflow decisions, which were resolved by turning off the screen and listening for what might be problematic or require enhancing. Listening, rather than looking for sounds, can save mixers invaluable time as this re-shifts their decision-making priorities. In his earlier mixes, the researcher found himself spending too much time isolating and resolving visual problems. This time was spent visually identifying detuned tracks according to the tuning gauge values. Consequently, the mixer fixated his visual attention on the tuning gauge while tuning the audio tracks to have congruent tonal values which aligned with the melodies in the musical arrangement. While he ensured every track was perfectly tuned, as indicated by green tuner prompts rather than the orange/yellow prompts, the results were negligible. He should have also

considered whether the previously ‘de-tuned’ tracks might have been an intentional aesthetic feature of the mix.

Listening on other devices.

Allowing the mix to play back on other devices forces mixers away from the DAW to listen to the musical arrangement in a different context and way. Listening to the mix in the car, using stereo speakers in a different room, or on a mobile phone compares unfavourably with listening to the mix in front of the computer and reference monitors. These listening scenarios involve differing frequency responses across the audio playback devices which further shape the mix. The surrounding acoustic environment in which the mix is replayed also affects listening conditions, as might distracting visual stimuli that should be minimized in the listening experience. Listening within these instances may lead recordists or mixers to further analyze their tracks by questioning where the mix falters and why, by testing its clarity, by considering how boring sections of the musical arrangement spring to life, etc. Mixers may also refer to the soundbox as a visual aid if they are apprehensive when determining what sounds or musical elements they should refine further.

Reference tracks.

Although the researcher did not have a personal collection of reference tracks to which he could refer, he was provided with sample reference tracks which accompanied every mix. Reference tracks can serve as points of imitation, solutions to creative dead ends, references against finished mix arrangements, ways of calibrating the ears to varying listening environments, and many other functions (Izhaki, 2018, pp. 27-28).

Reference tracks proved to be an early feedback/evaluation and learning source for the researcher, especially when listening to the mixes with the computer screen turned off. During

the mixes in which the researcher spent longer periods dedicated for tuning, it became apparent to him that the visual component of tuning and ensuring Hertz values were 'in-tune' was not as important to a mixing objective as he originally thought. This learning moment is explained below within the fieldnote entry:

> No one cares what the tuner says, it's about how [the mix] sounds. I got way too caught up in terms of time and workload with the tuner... It's the evocative and moving [musical] parts in the mix that matter, not the technical workings. No one will care what's going on in the DAW. (Kapron, Mixing *Denathio* Day 5)

If the researcher had not used reference tracks to gauge the results of his workflow, there would have been few to no self-reflection moments as to whether he was effectively using his time towards making the mixes musical. Prior to the evaluation made when comparing the reference track to the mix, the researcher worked to ensure that all the numerical values present in the signal processors, effects, and tools in the mixes were congruent and symmetrical, a goal that yielded little of musical importance.

Ear fatigue.

Beginner mixers should make a note of ear fatigue whenever they are failing or struggling to discern what to listen for. This often occurred for the researcher when fixating and listening for musical or technical elements for twenty or thirty minutes at a time. As mentioned before in chapter IV, mixers can mitigate ear fatigue by taking frequent breaks away from the computer and this will depend on the necessity and mental endurance levels of each mixer (Owsinski, 2013).

5. Experiment: Build on what is already known and tinker with the unknown.

This final principle requires mixers to make continuous evaluations while experimenting. For the researcher, trial and error processes occurred many times in quick sequences throughout mixing, as he listened, adjusted variables, and evaluated his mixing decisions. As one mixes over time, a sense of intuition is developed and might guide the mixer's attention throughout the mix. Prior to having many mixing experiences, and aside from trial and error, mixers might learn about DAW functions, signal processors/effects and recording practice techniques through videos of their usage in various contexts, reading manuals if completely uncertain, and experimenting with them while hearing their effects on the musical arrangement. The learning process and approach to mixing is unique and highly personalized. According to seasoned mixer Bob Bullock, "[w]hat I learned is that it's okay if your method is different from someone else's because it doesn't matter how you got there. Take all this information in, but in the end, use your ears" (Owsinski, 2014, p. 595).

What about beginner mixers with little to no prior experience or conception of mixing practice but eager to start? Fortunately, students and teachers with access to the Internet can watch mixing walkthroughs and tutorials on websites like YouTube or message boards explaining how to navigate specific mixing scenarios or the capabilities and functions of certain signal processors. Although resources of this type may be helpful, one should use them mindfully. Watching and copying other mixers will yield little knowledge if given no explanations as to why they are using certain signal processors, effects, or DAW functions with careful attention to details. Rather than copying DAW and signal processor parameters verbatim, novice mixers should also use their ears and experiment with the parameters to hear the musical and technical impacts of their mixing decisions on the musical product. This is not to discredit

the act of copying, as many artists, bands, and writers throughout history learned the rudimentary components of their crafts by copying successful ideas or templates (Reynolds, 2011).

Evaluations and feedback

The five previous principles contain a lot of useful information for beginner mixers, but without evaluation and feedback, mixers can overlook valuable learning opportunities. Evaluations are not included in the five above principles, but are nevertheless integral to mixing practice, as they are completed multiple times throughout mixing processes. One enacts a decision, judges it, either revises or repeals the action, or continues with their workflow. These thought processes are seamlessly made along a continuum of questions, such as how did this mixing decision affect the track? What is the track's musical relationship to the other musical sonic elements in the arrangement because of this action? Should I mix the other tracks because of this decision? How does the mix flow into and out of this moment of time in the musical arrangement? Mixing musical and sonic materials often involves an ebb and flow when managing the soundbox proportions of an arrangement. Broadly speaking, the mind can only process so much information, and it is the mixer's job to affect the sonic materials so listeners may comprehend the mix clearly and musically. With digital technologies, mixers can undo decisions or, in worst-case scenarios, revert projects to their original states. This, of course, assumes that they have reserved back-up copies of the arrangements, which is highly recommended.

Whereas mixers continuously make evaluations, feedback might require completing the mix and sending the project back to clients for their opinions or having a second set of ears to listen in on the mix. For beginner mixers with access to experienced mixers, this might require leaving their 'egos at the door' before approaching mentors for constructive feedback. In this

present study, the researcher was fortunate in having his second reader, who has considerable professional sound engineering experience, review his mixes, and provide technical and aesthetic feedback that would improve the mixes' sonic and musical qualities. Lack of access to qualified/seasoned mixers willing to review mixing decisions might present limitations or intimidation to beginner mixers entering the craft, but feedback is important to judging the merit and quality of overall mixing decisions.

Mixing principles within the context of music education literature

The remainder of this chapter recapitulates the music education literature introduced in chapter III to position it within the context of the mixing principles articulated in this study. After data analysis, it became apparent to the researcher that the learning framework introduced in chapter III (Fig. 6.1 below) required additions because of the new principles. Having encountered the personalized dimension involved within mixing practice, wherein individuals bring their own experiences and knowledge into the craft, student agency and habitus are included and explained in greater detail shortly.

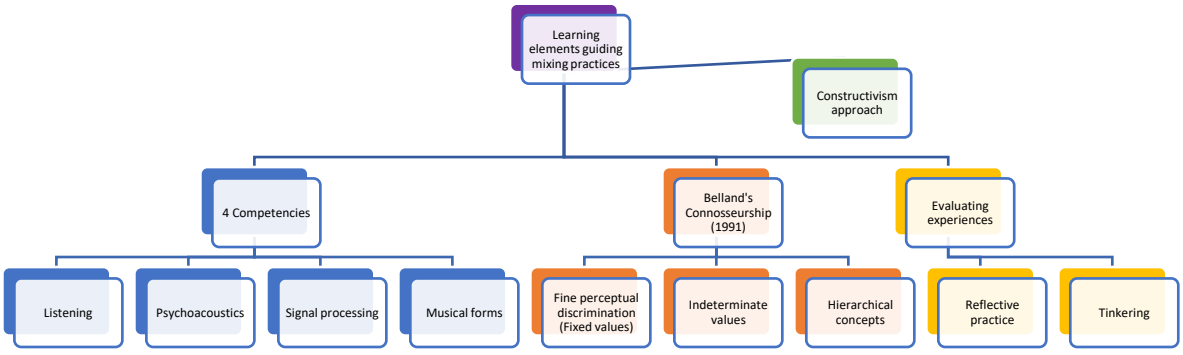

Figure 6.1: Original competencies and conceptual learning framework guiding mixing practice introduced in chapter III.

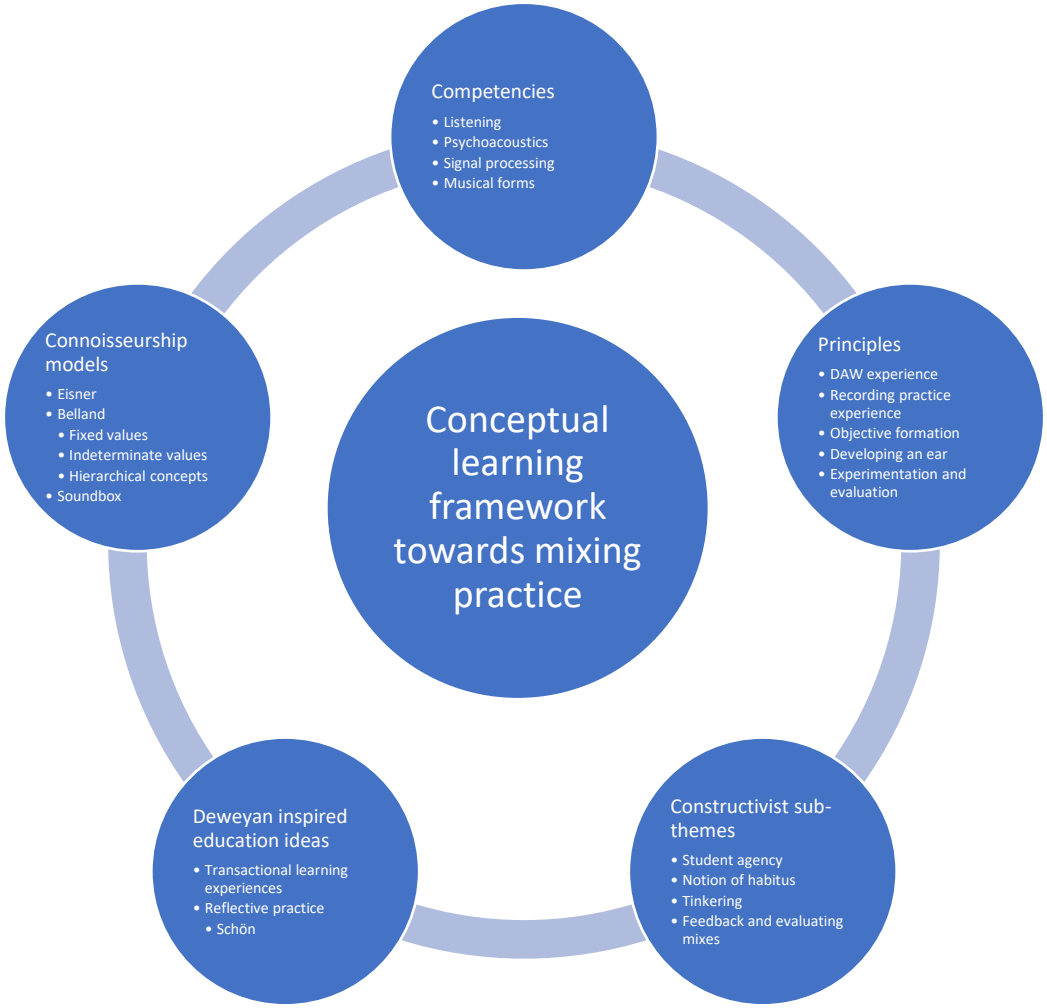

Figure 6.2: Revised conceptual learning framework with new additions of principles and modifications to constructive approaches and connoisseurship models.

Figure 6.2 presents a revised illustration of the conceptual learning framework and repackages the ideas introduced in chapter III while condensing them into a series of relevant themes when practicing or learning to mix from a music education perspective. Having addressed competencies and principles earlier, the chapter proceeds onto constructivist approaches, revisiting Deweyan ideas relating to music education, before concluding with the

connoisseurship models relating to mixing practice. After having mixed and collected data, the researcher noticed that most of what mixers learn in the craft is affected by other personal factors, such as musical experiences and preferences, skill-levels, and technological expertise. These subjective qualities were overlooked in the original conceptual learning framework (Figure 6.1). The revised conceptual learning framework as depicted in Figure 6.2. incorporates themes which address these subjective qualities through constructivist perspectives and is explained below.

Constructivist sub-themes in collaborative mixing contexts

Regardless of student age-groups and when factoring for recording practice, teachers should consider the musical and cultural backgrounds of their students, as they will have differing educational and cultural backgrounds and levels. Mixing can be rewarding because individuals will come to mix and listen according to their own experiences, as "[w]e each have prior listening experiences that uniquely shape our ability to engage sound and musical materials" (Moylan, 2017, p. 27). Some students might lack formal training in musical instruments common to the western art tradition, while proficient in practices not typically found in educational settings. Other students might be proficient in terms of formal music education performance requirements, but uncomfortable with the cultural practices surrounding them or prevalent in their immediate cultural zones (i.e., student demographic, city, region, etc.). Some students are likely to be already comfortable with computer-mediated musical practices, such as mixing or live musical performances through DAWs, for example, and will stand out in contrast to other students (or even teachers) with little experience with technologically mediated musical practices.

Then, too, and despite the researcher having provided a list of principles that can help

guide mixing practice, there are outside factors that will further affect how one approaches the craft. From educators' perspectives, they might have limited budgets in terms of what is technologically workable when designing and implementing an environment conducive to recording practice and their own musical practices. Others might be rooted in their pedagogical and curricular routines and might find the introduction of DAWs and recording practice into their music classrooms an obstruction and/or unnecessary. Although recording practice technologies are becoming increasingly accessible, crafting a musically satisfactory mix is not necessarily easier. Prior listening, learning experiences, and technological 'know how' will shape how people mix or approach the craft; there is no 'one-size-fits-all' approach to mixing. Additional factors such as a mixer's eagerness, attitude, and knowledge relevant to mixing practice may aid or hinder their learning experiences. To better explain how these broad variables affect mixing practice, Bourdieu's concept of habitus is explained next.

Habitus

Acting as a "multi-scalar construct," habitus operates beneath the level of consciousness and involves many factors which elucidate the rationale behind nuanced interactions among people and their cultural or lifestyle practices (Wacquant, 2018, p. 531). An individual's habitus is not static and may evolve. One's dispositions may be affected or dismantled by external forces such as receiving specialized training or being introduced into novel environments where one must learn the social norms and conventions (Wacquant, 2018). Habitus ironically operates as an "unchosen principle of all choices"; it is both shaped by the conventions of surrounding environments ('arbitrary' and agreed-upon rules upheld by cultures or societies), and an individual's present perceptions, emotions, and actions (Bourdieu, 1990, p. 56; Wacquant, 2018, p. 531). Although individuals might believe their interactions in the world are done without

constraints and complete free will, implicit cultural and social factors could affect their behaviours and thoughts.

Coined by French sociologist Pierre Bourdieu, habitus is a key feature within his theory of the relationship between culture and society (1984) and involves the established patterns of human preferences and behaviors used to maintain or further interests and cultural preferences (Wright & Finney, 2010, p. 225). These cultural preferences form,

> collective patterns of cultural values, as ideas and resources are mobilized by social groups to exercise dominance over others. A process of reproduction occurs therefore whereby culture is extended or expanded as material and ideological battles are fought and won. (Wright & Finney, 2010, p. 225)

These human preferences and behaviours function automatically within a collective group and are taken for granted during everyday experiences because of a habitus' homogeneity in a social/cultural context (Bourdieu, 1977). The actions within a group of agents, such as sound engineers or mixers, practice and work with activities and tasks through a collective set of predispositions, beliefs, and patterns which are attributable to their habitus.' Most mixing practice decisions and communication will be immediately intelligible to practitioners of the craft. What might be commonplace to mixers or people familiar with recording practice might be perceived as jargon to those not immersed in the cultures and practices of mixing and require further explanation, with commands like "increasing fader levels on track 12 or panning the same track to the right."

Wacquant (2014) further unpacks habitus into primary and secondary forms. Primary forms of habitus are those gained in early childhood experiences and include the social habits, customs, and knowledges acquired with no deliberate or explicit attempts at learning and might

have been obtained through immersion in familial environments. Secondary types of habitus are forms of organized, pedagogical labour that transposes information or knowledge typically through accelerated and organized periods of learning, such as studying and practicing music technologies in a music education course (Wacquant, 2014; Johnson, 2022).

A person's habitus will inform their learning process while shaping their style and approach in recording practice. For mixers already comfortable with digital technologies in everyday life, they might have a general intuition when using functions found across DAWs. This might be exemplified by using computer hotkeys, as these keyboard commands minimize the number of mouse-clicks needed to achieve one action. The cherished 'ctrl-s' save file function is an example of what might be a hotkey command automatically executed every few minutes to ensure DAW projects are stored onto the hard drive. It was for this reason in chapter IV the researcher isolated splicing from his data collection notes, a task involving the use of hotkeys to trim one drum track into hundreds of audio files for them to be manipulated. Although copying, pasting, and trimming using hotkeys might seem trivial to some readers, these commands became automatic and done without forethought, whereas the same process done solely with a mouse would have taken significantly longer.

Student agency.

Mixers are required to impart their own sound through mixing decisions into the musical arrangement and may present learning opportunities within music education settings. Students should be encouraged to take aesthetic ownership over their own or peers' recorded performances, while also presenting collaborative learning opportunities. This is explained in greater detail below within the transactional learning experiences section. The decisions of every

mixer will impart a sound, or 'character,' in the mix. Aesthetic ownership over a mix can pursue two directions on a continuum, as depicted below in figure 6.3.

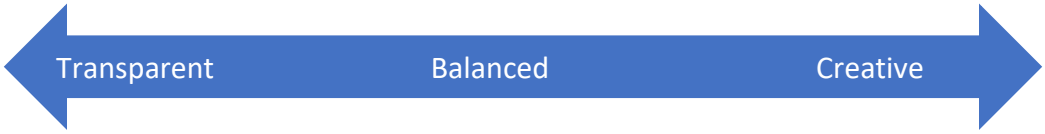

Figure 6.3: Mixing idiolect continuum.

Mixers opting for a transparent style in their mixes strive for little to no recognizable differences in their final products. Students mixing within this side of the continuum might work towards goals such as optimizing clarity between sounds and optimizing musical relationships within the soundbox dimensions of their mixes. The researcher mixed predominantly with a transparent style throughout the study. Mixers opting for creative approaches might incorporate novel sounds or attempt to take the musical direction of the mix to sound better using the devices available or known to them. Although using samples to replace or augment tracks is commonplace in mixing, this does not mean a mix will be inherently creative. Mixers with a transparent mixing approach will combine the original mix samples or audio files with new sounds (known as augmentation) to have the mix sound better in certain areas (Owsinski, 2013). Augmentation does not replace or modify previous elements in the mix. Mixers using this technique are layering additional recorded sounds or samples on top of the original sounds in the mix. This technique can provide sound sources with greater emphasis, depth, presence, or other aesthetic qualities.

Cultural factors might inform how students approach mixing practice from stylistic and creativity perspectives, as the musical genres they listen to and/or practice might serve as templates or references which they can refer to. Unless students have prior DAW or mixing experience, possibilities of mixing with musical objectives might be minimal. Beginner mixers

should have learned the necessary and rudimentary competencies (DAW navigation, saving and naming files, importing, and creating tracks, etc.), before forming their own unique recording practice signatures, or 'mixing idiolects,' where they develop and gain personalized and recognizable sonic or mixing styles (Marrington, 2017). Although mixers will develop their own workflow approach and personalized mixing style, receiving feedback and/or working alongside peers in collaborative projects may serve as transactional learning experiences in music education settings.

Deweyan ideas in relation to mixing practice

The evaluations needed to judge musical or sonic ideas within mixing practice share similarities with Dewey's concept of evaluating ideas or processes, as one questions whether something is good, and how good it is and/or how something might operate when being acted upon (Väkeva, 2019, p. 107). If educators can guide their students to evaluate their arrangements, mixing may present the opportunities where students develop their social skills, as they collaborate, provide feedback, and navigate their musical arrangements with goals of achieving musicality. Revisited below are Dewey's transactional and consummatory experiences within the context of mixing practice.

Transactional learning experiences.

Repeating an idea mentioned shortly before, it is unlikely that we can expect novice mixers, especially those with little to no DAW experiences, to achieve musicality in their first musical arrangements, especially if they are first learning to record/track, arrange, and edit their own projects. Transactional learning experiences might appear as students work through their projects and receive feedback from their peers and teachers while also learning about new mixing possibilities.

When receiving feedback, students might be required to explain how or why they mixed in a way to pursue their outlined mixing objectives. This is transactional, as their peers and teachers will have to listen and potentially learn new techniques or methods they can apply in their own projects. Peers and teachers might show mixing alternatives that might be more appropriate in achieving a better mix overall. Learning exchanges of these types are commonplace in professional recording practice settings. Recording studio apprenticeships often involved doing mundane jobs around the workplace, such as making tea or coffee-runs and cleaning, while informally learning about the practice through the work of careful observation and possibly working through the studio responsibilities and/or engineering roles (Bell, 2013; Senior 2015).

To reinforce transactional learning experiences surrounding recording practices, there must be some previously recorded music or arrangements that the students have created or have access to. Teachers might assign projects which reinforce pre-requisite mixing knowledge, such as gaining comfort with DAW functions as students create arrangements while adhering to project specifications (e.g., approximately 1 minute in length; 2-3 instruments; use of percussion; no lyrics, etc.). After becoming proficient with creating a series of smaller musical projects, classes could then mix the same musical arrangements while pursuing mixing objectives (i.e., evidence of equalization or another signal processor/effect among sound sources; illustrating the musical arrangements' dimensions by using a soundbox/sonic compass; critically listening to peers' mixes and committing to one or two mixing decisions that might improve the quality of the mix, etc.). Possibilities for introducing mixing into music education settings are numerous but depend upon educators' expertise levels with DAWs.

It is also within these transactional learning experiences where the researcher believes students and teachers may encounter Dewey's ideas regarding consummatory experiences.

Consummatory experiences are those which fulfill unique and heightened experiences (Regelski, 2017). For the researcher in the study, this was during his meeting with his second reader and where the mixes were first reviewed. This heightened experience involved learning about mixing phenomena and scenarios such as ‘losing the mix’ or maintaining the arrangement’s flow/energy. These feedback experiences served as ‘eureka’ moments, as the researcher sensed he was approaching concepts which were inherently musical. The number and quality of consummatory experiences students will encounter may be unpredictable due to several factors, such as the amount of previous musical experiences they bring into the craft, their enthusiasm for learning recording practice concepts and principles, and educators’ skill-levels while leading classes. Some students might have consummatory experiences when learning simple concepts that would improve their mixing repertoire, while others might have heightened experiences when having their mixes played within public settings.

Reflective practice and tinkering

Reflective practice and tinkering are essential to mixing, as one makes hundreds of evaluations when continuously altering the sounds involved within musical arrangements. Today’s beginner mixers are fortunate to have access to digital technologies with which to experiment and tinker with sounds, as hard drive technologies mediate ‘in-the-box’ DAW mixing instead of working with the limitations and fixed nature of analog tape. Digital hard drive technologies present an easier entrance into the craft, as mixers load audio files into their arrangements instead of importing tracks via tape and labelling them correctly. Mixers can revert their decisions with ‘undo’ commands, like those in word processor software. Hard drive storage technologies provide mixers with the flexibility to tinker with effects or signal processors and listen to whether the desired effects are in line with their mixing goals, and learn about their

technical functions, while having the option of reverting the track to a previous state. When mixing with analog recording practice tools decades ago, opportunities for tinkering were not as widespread or accessible, especially if the tracks were mixed down or a final copy was rendered onto tape. Therefore, strategy and planning were involved if one wished to tinker in the studio. Even if the technology itself did not present an obstacle, the amount of role specialization involved in commercial recording practices presented a hindrance to tinkering, evident by sound engineers holding exclusive control behind the mixing console and bound by contracts or record label conditions while artists were restricted to working in the recording booths (Bell, 2018; Kealy, 1979).

Although DAWs have become more accessible over recent decades, recordists and mixers should be vigilant and prioritize the sound quality and/or musicality of their arrangements instead of becoming distracted by what is presented to them on-screen. Whereas experienced mixers reflect on their mixes and know what audible qualities and elements to listen for, beginner mixers should attempt to apply reflective practice moments in their mixing as this cycle of questions prepares them to evaluate mixes for their technical, aesthetic, and musical potential. Reiterating Schön's guidelines (see below) that were introduced from chapter III may serve as a reminder for mixers, guiding them as they work through their musical arrangements and questioning:

- Can I solve the problem I have set?
- Do I like what I get when I solve this problem?
- Have I made the situation coherent?
- Have I made it congruent with my fundamental values and theories?
- Have I kept inquiry moving? (1983, p. 133).

Readers might recall the phenomenon presented near the beginning of the chapter relating to the notion of ocularcentrism – the dominance of sight over sound within recording and education practices (Abramo, 2014; Anthony, 2018; Hodgson, 2019). The researcher posited that if beginner mixers are aware of ocularcentrism and how it might be problematic for recording practice, mixers might instead take greater ownership and agency over their mixing experiences because of having to listen to their arrangements for their musical qualities and features rather than visually identifying problems across DAWs. Future research may investigate this postulation in greater detail, as this study was limited in scope by studying mixing practice via autoethnography rather than observing the craft practiced by a group of people. The moment students and teachers take ownership of the mix, they potentially engage in transactional learning experiences. Mixing also requires educators and beginner mixers to adopt neutral perspectives when reviewing and listening to musical arrangements for their sonic qualities, a theme which is addressed through connoisseurship in the section below.

Connoisseurship models

Eisner's and Belland's connoisseurship models are the final conceptual learning framework elements of this study, but summarize what are otherwise highly subjective ideas into organized and approachable concepts. To mix or take part in recording practice requires an element of connoisseurship, which Eisner defines as the "ability to make fine-grained discriminations among complex and subtle qualities" (2017, p. 63). Beginner mixers should not simply judge music according to their preferences, but for their qualities while learning about them. But how might one navigate aesthetic qualities in mixing practice? It is for this reason connoisseurship is listed near the end of the conceptual learning framework because it requires firsthand listening and mixing experiences. How else might one describe or affect ideas within a mix if the sounds

in question are not audibly present to readers or peers reviewing each other's arrangements away from the computer?[19] Written statements such as "equalizers can sharpen dull sounds" or "heavy compression might cause an overly 'tinny or tight sound,'" convey partial ideas, which audible examples and firsthand mixing experiences may assist in clarifying.

As in many other specialized crafts and disciplines, mixers often use language with nuance to describe the qualities and features which they are navigating. Moylan (2017) explains the difficulty mixers face when using language to describe how to listen,

> We do not have a vocabulary for describing sound and its specific dimensions. It is simply not part of our language. Instead, our custom is to describe sound by using analogy and by using the terminology of the other senses. We resort to words such as 'warm,' 'dark,' 'smooth,' 'mellow,' 'edgy,' 'bright,' 'crisp,' and a great many others—imprecise at best, and typically grossly inadequate and ineffective; often misleading, and commonly merely meaningless jargon. (p. 28)

As mentioned, using language alone to study mixing practice is too imprecise, while an autoethnography allows one to experience sounds firsthand. Mixing requires one to listen with a critical ear to sounds before transforming them and using the quantitative values that represent them (Hertz and frequency values). Although one-dimensional at first, the longer beginners mix and navigate sounds by using these quantitative values, the more they might develop their own lexicon of mixing adjectives and verbs to help them describe and communicate ideas within their own and their peers' mixing arrangements (Moylan, 2017). For example, mixers might identify

[19] Similar to printing and reading documents away from the computer, recordists may render mix arrangements into audio files which they can listen to on a variety of listening devices. Although mixing decisions must be made at a DAW or mixing console, mixers can make editorial notes or suggestions away from the computer. Listening and evaluating mixes away from the regular mixing environment might even promote novel ideas or highlight problematic areas in the arrangements.

or audibly conceive of sounds in the low 50-200 Hz ranges as having ‘bass or ‘punchy’ characteristics, while sounds in the upper 9000 to 16,000 Hz, or 9 to 16 kilohertz (kHz) ranges may be described as having ‘airy’ or ‘wispy’ qualities. These subjective descriptions alone do little to inform others of quantitative properties but are important when communicating ideas relating to timbre within mix arrangements.

Eisner’s notion of connoisseurship.

Connoisseurship and mixing share similarities in terms of how individuals appreciate art forms, crafts, and other disciplines. Carefully listening and considering how to enhance sounds so they complement one another within mix arrangements is integral to mixing practice. Eisner’s notion of connoisseurship across educational practices also describes the attention to qualities and characteristics necessary for mixing.

> Connoisseurship in education, as in other areas, is that art of perception that makes the appreciation of such complexity possible. Connoisseurship is an appreciative art. Appreciation in this context means not necessarily a liking or preference for what one has encountered, but rather an awareness of its characteristics and qualities.
>
> (Eisner, 2005, pp. 48-49)

Mixing practice requires one to listen, appreciate, and discern what is present in the musical arrangement. These functions are involved within Eisner’s definition of connoisseurship among educational contexts. Mixing also requires impartiality, as individuals should set their musical preferences and biases aside while attempting to improve the arrangement. Developing a level of connoisseurship means having the ability to view and appreciate art from various perspectives.

Far from strictly being a term reserved for the high arts or elitist activities, Eisner’s notion

of connoisseurship can apply to many disciplines and crafts. Eisner (2005) uses connoisseurship to analyze cabinet making for example, as one asks many questions or isolates factors such as the qualities of varnish used, the number of coats applied, what construction and joint methods were used, such as dovetailing, mitering, or doweling (p. 49). This type of analysis leads one to observe products through various perspectives or adopt conventional templates commonplace to the craft, while also investigating aspects about which one might have had little knowledge. With works of art and history, connoisseurship can lead people to further investigate the social contexts surrounding aesthetic products and how these factors might have been catalysts behind their creation in the world (Eisner, 2005). This type of connoisseurship and analysis when listening or working through musical arrangements is transferrable to mixing practice.

Applying connoisseurship through Belland's model

Belland's connoisseurship model may also serve as a useful reference to beginner mixers as they navigate the various concepts, ideas, and techniques necessary for mixing practice. This model also helps to organize concepts and ideas as to not overwhelm mixers. To reiterate from chapter III, Belland's connoisseurship model (1991) organizes epistemology respective to a craft into three categories: fine perceptual discrimination, indeterminate values, and hierarchical concepts.

1. Fine perceptual discrimination.

As implied within the subtitle, this category may include mixing phenomena that can be easily perceived and identified during mixing practice. When learning how to identify frequencies for example, most humans perceive sounds from 50 to 9000 Hz and above with ease. Conversely, there are limits or frequency ranges where sounds are not clearly heard but are felt or sensed because of residing at the extreme ends of the frequency spectrum. Common examples

might include the pulsating sub-bass rhythms of music played from passing by vehicles or the rumbling of thunder representative of frequencies below 50 Hertz, while dog whistles or the whining of cathode ray tube (CRT) TVs emit high pitches around and beyond 20 kHz (Lee et al., 2020). During adolescence, the hearing range peaks at around 20 Hz to 20,000 Hz, but as people age, the ability to hear higher range frequencies decreases markedly, a condition known as presbycusis (Firment, 2007). Understanding these extreme frequency ranges provides beginner mixers with the outer ranges which they can use to outline and identify frequencies.

By using the soundbox, educators and students can explore and/or contrast commercial recordings with the mixes created in class to observe how sounds are spatially positioned. To begin, fine perceptual discrimination guides mixers along the three dimensions of the soundbox, starting with the vertical (frequency), horizontal (stereo spectrum), and length (foreground/background) perspectives. Like the frequency ranges described in the previous paragraph, beginner mixers may categorize sounds from lowest to highest pitch ranges, whether they are isolated from or stacked one on top another or sharing portions of frequency ranges. Mixers may also differentiate the same sounds identified from the vertical perspective in terms of their horizontal positionings. Although two sounds might share high frequency ranges, one might spatially occupy the left side of the mix, while the other is on the right side. Readers may then assume the foreground perspective and consider how the same sounds are positioned in terms of their proximity.

2. Indeterminate values.

The unpredictable nature of mixing practice can be indebted to the number of indeterminate values present in musical arrangements and the many options available to affect musical and sonic ideas. Mixers are presented with a musical arrangement, and what at face

value might appear to be a determined and finished aesthetic product. However, it is up to mixers to go beyond what is presented to them and make the mix musically or sonically better than it was. Educators and students will encounter mixing scenarios much like the researcher did, as he encountered concepts or ideas that had no single answer or solution (i.e., achieving musical 'flow,' minimizing boring moments, maintaining energy, 'losing' the mix, etc.).

The fine perceptual discrimination element is also involved when working with indeterminate values. There are no ideal frequency ranges or decibels for a mix and are very much infinite in terms of how they may be allocated apart from clipping the stereo bus by surpassing 0.00 dB. Every musical arrangement is context dependent, as mixing requires educators and students to embrace unpredictable scenarios and indeterminate values while encouraging them to tinker and experiment with the available tools and techniques.

3. Hierarchical concepts.

Fine perceptual discrimination and indeterminate values on their own may be daunting principles when implementing Belland's connoisseurship model. Using hierarchical concepts may reinforce boundaries when navigating mixing concepts and ideas within musical arrangements.

As mentioned with indeterminate values, mixers can use the stereo bus as a primary boundary which they should avoid clipping. Once the mix clips at any point, this is an obvious indicator that too many decibels are present and are overwhelming the digital stereo bus. At face value, this is a simplistic hierarchical concept; one works with all the tracks present in the mix, with the goal of not clipping the stereo bus with too many cumulative decibels. Following this rule should also reinforce an awareness of headroom within beginner mixes. One may lower all the track levels by -12, -6, -3 dB, etc., to provide a certain amount of space with which to work.

Mixers may also use or work with concepts or guidelines in a hierarchical manner when resolving mixing scenarios. When working with equalization for example, mixers and recordists should consider sounds as belonging to pitch ranges categorized in Hertz values, which might have levels of musical significance according to the audio track's purpose. If there are extremely high 20 kHz frequencies present within a bass drum track, these frequencies might take the lowest priority when considering the musical function of a pulsating kick drum; therefore, they are negated or 'rolled off.' The same idea applies to audio tracks serving melodic or harmonic ideas in the mix arrangement; if there are too many interfering high or low frequencies, they are negated to preserve the timbre and melody. Every frequency present within the mix should be considered in terms of its hierarchical role and function.

Hierarchical patterns are also applicable to song structures or musical forms. One arrangement might contain the following hierarchical pattern (e.g., intro, verse, bridge, chorus, verse, chorus, etc.), with the chorus sections taking utmost importance in mixing attention. Sound sources within the metaphorical soundbox also might then be prioritized from greatest to lowest importance when considering their roles according to the song's musical form. For example, rhythm guitars panned on the right and left sides of the mix might require less attention or dominance compared to the drums, or the main hook or riff played by another instrument during the choruses.

Final Comments on Limitations in Music Mixing in Educational Contexts

Although recording practice technologies became accessible to the public over the last few decades, there could be limitations when implementing mixing into music education classrooms. The cost of integrating recording and mixing activities into classrooms will be a factor, especially when considering the minimum entry costs of providing students with basic

recording/mixing equipment: computers/laptops, DAW licenses, audio interface devices, and MIDI keyboards which they can use to navigate their arrangements. The economical alternative to the previous suggestion might be a single recording station, with all the equipment needed to practice mixing and other recording practice functions.

Acoustic factors affect listening bias

Beginner recordists and mixers will at one point or another encounter how the surrounding environment affects the listening conditions involved with recording and mixing. What separates amateur 'bedroom' producers from professional sound engineers might be the level of attention, effort, and investment placed into sound treating rooms. To engineer and mix at a consistently high level, one must create an acoustic environment ideally suited for recording practice or introduce environmental factors that are conducive to creating 'neutral' or unbiased listening experiences. This requires some knowledge for acoustics in relation to mixing. How mixers set up appropriate listening conditions for their recording practice spaces will shape how their mixes will sound because of several factors, not limited to the reflective surfaces present in a room (e.g., mixes played in densely cluttered and carpeted rooms will contrast in sound to those played in spacious rooms with hardwood floors); the type of reference monitors and their spatial positioning to the listener(s); room size dimensions, etc. (Winer, 2018). No amount of expensive recording tools will improve a mix when the listening conditions are poor or pose a negative influence. It is also for these reasons mixers replay their mixes on various playback devices and in various acoustic environments as to not have unbiased listening experiences.

Conclusion

This study has attempted to collect and bring attention to factors that are vital to learning the craft or lead music education researchers to further investigate this culturally ubiquitous

practice. As in many other disciplines and pursuits, one learns by doing when mixing (Owsinski, 2013; Izhaki, 2018), which recalls the fifth principle introduced in this chapter, that of experimentation—building on what one already knows while tinkering with the unknown.

The catalyst for designing and pursuing this study in mixing practice was spurred by the researcher's curiosity about how the recording practices of the twentieth and twenty-first centuries mediate various degrees of sound fidelity. This required investigating techniques, namely those involved in the recording and mixing stages, which shape sounds to be technically or aesthetically pleasing to the ear. Critically listening to mixes for their varying levels of sonic fidelity, such as transparent 'original' or 'authentic' recorded performances, or those with creative sonic visions can only be done if one is informed by recording and mixing practice techniques. Critically analyzing mixes might require one to consider what microphones might have been used to record a performance, the signal chain between the microphone and the mixing console, outboard/in-the box processors or plug-ins used along with their built-in parameters, quality and choice of samples if used, and a wide range of other factors.

Music education literature aided the generation of these principles, as ideas related to agency and habitus were informed by the researcher's prior experiences. As discussed earlier, Deweyan notions of transactional learning experiences are likely to emerge when incorporating the craft in music education settings, provided educators are skilled and comfortable when navigating the craft. This study may be replicated in future studies to observe recording and mixing practices in educational settings, as this study was limited by collecting and analyzing data by one person.

Implications for future research

Although the autoethnography occurred within a private setting, that of the researcher's residence, future autoethnographies could examine mixing practice within educational settings while involving additional research participants. Autoethnographies incorporating recording and mixing practices in classroom settings might investigate ideas and themes addressed or expand on phenomena not mentioned in this study. Educators might differentiate mixing ideas in classroom settings by using Belland's connoisseurship model. To reiterate, educators using Belland's connoisseurship model while learning alongside or teaching their students to mix could distinguish knowledge and concepts into the three epistemological categories of fixed values, indeterminate values, and hierarchical concepts. Autoethnographic accounts might describe how Belland's model encouraged flexible mixing guidelines for students practicing the craft. Educational research of this type might also help detect and elucidate musical nuances when incorporating recording and mixing within classroom settings. Mixing this aspect of musical practice may be affected by a variety of factors, such as the audio production equipment available for students and teachers, how educators might include mixing in a predetermined music curriculum, and the skill/comfort levels educators have when facilitating recording practice technologies in class.

Autoethnographies focused on mixing practice may also occur in non-educational settings similar to the structure of this study. Rarely will people share identical musical experiences and skill levels in mixing practice while using the technological devices required for its facilitation (i.e., computers, MIDI keyboards, musical theory, optional audio production gear, etc.). Future autoethnographic approaches to mixing will also differ because the musical arrangements and their genres will differ from the ones examined in this study. Autoethnographers will refer to

their own sets of personal musical experiences and expertise levels that affect their decision-making when working through the musical arrangements.

Finally, academic research may further elaborate on the technical and aesthetic components necessary for mixing practice. Distinguishing research interests between these two categories is recommended; while mixers must consider the technical and aesthetic responsibilities involved with mixing practice, they cannot handle both simultaneously (Bromham, 2017). Artist Peter Gabriel, for example, produced music with an 'Alpha and Zen' approach; he did not pursue creative objectives when performing the technical and mundane tasks such as editing and organizing tracks (p. 246). To reiterate, there is no one singular approach to mixing, as mixers often follow their intuitions and do what 'feels right,' which may be an ambiguous idea for music researchers (Owsinski, 2014; Bromham, 2017; Izhaki, 2018). Individuals should experience the mixes for themselves by listening and thinking, before experimenting with the tools provided while considering how they could further improve the musical character of a given mix. Sound and mixing engineers of the past and present continue to have the responsibility of considering how a piece of music in their care evolves at every second, before refining the mix further into aesthetic products which they are curating. By this point hopefully, readers might listen to records with an added appreciation for how records are mixed while considering ideas and concepts introduced throughout this study.

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CURRICULUM VITAE

EDUCATION

Doctor of Philosophy in Music Education In Progress
Western University, London, Ontario Canada
Dissertation: Sound Judgements: Music Education Framework for Guiding Digital Mixing Practice
Supervisor: Dr. Paul Woodford; Second Reader: Dr. Jay Hodgson
- Ontario Graduate Scholarship, 2016

Master of Music in Music Education 2014
Western University, London, Ontario Canada
Course-Based program; Viva Voce Examination
- Joseph Armand Bombardier Canada Graduate Scholarship – Masters, 2015
- Received Kodály Level 1 Certification

Bachelor's Degree, Honours Music 2010
McMaster University, Hamilton, Ontario Canada
- Dean's Honours List
- Golden Key Member
- The Reginald Bedford Award for Excellence in Piano Playing

TEACHING RELATED EXPERIENCE – HIGHER EDUCATION

Western University, London, Ontario Canada.

Graduate Teaching Assistant (2020-2021)
2831a: Choral Conducting Foundations

Methods course for choral educators and conductors that explores singing and the voice, their direct application to gesture, and effective, efficient leadership on the podium.

- Assisted in facilitating, teaching and setting up classes
- Recording and submitting piano accompaniment to students based on their requested scores and musical arrangements
- Responding to student e-mails/misc. questions along with other general GTA tasks/responsibilities

Graduate Teaching Assistant (2020-2021)
MUSIC 2911: Les Choristes (Women's Choir)
MUSIC 2913: Chorale (Choir)

The rehearsal and performance of repertoire for women's and mixed choirs.

- Assisting in facilitating rehearsals and teaching repertoire
- Accompanying choral rehearsals
- Score preparation & study
- Responding to e-mails & misc. GTA responsibilities and tasks

Graduate Teaching Assistant (2014-2020)
Practicum in Choral Techniques 2831
Methods course for choral educators and conductors that explores singing and the voice, their direct application to gesture, and effective, efficient leadership on the podium.

- Assisting in facilitating rehearsals and teaching repertoire
- Accompanying choral rehearsals
- Score study and effective rehearsal preparation.
- Responding to e-mails & miscellaneous GTA responsibilities and tasks

McMaster University, Hamilton, Ontario Canada.
Teaching Assistant – Accompanist (2012-2014)
Accompanist to the McMaster University Women's Choir

- Piano accompaniment during rehearsals
- Piano accompaniment during recitals/public performances

TEACHING RELATED EXPERIENCE – MUSIC STUDIOS

Private Piano and Guitar Instructor (Stoney Creek, Ontario Canada) 2008 - present
Strive Studios – Professional Music Studio - Music Lessons & Performance Coaching in the Niagara Region (Grimsby, Ontario Canada) Spring & Summer 2016

- Taught guitar, piano, and coached popular music ensembles.
- Prepared and facilitated annual concert for students.
- Prepared students for RCM examinations, and public performances.

Studio E – Music Teacher (Stoney Creek, Ontario Canada) 2010 – 2013

- Piano, guitar, and music theory instructor

Conservatory for Musical Studies (Stoney Creek, Ontario Canada) 2008 – 2010

- Guitar and piano instructor