Creative Mastering: A New Culture of Audio Post-Production

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ABSTRACT:

My thesis posits that a new culture of 'Creative Mastering' exists in the realm of audio post-production. This culture has evolved out of a more technical and procedural mode of engineering and music industry labour. My study takes seriously the mastering engineer, like the more conventional producer, as a creative participant in the contemporary recorded music production process. To better understand the modern-day mastering engineer, their culture and the creative aspects of their day-to-day work, I have conducted autoethnography and original interviews with 20 of the world's leading practitioners. These practitioners have operated out of major facilities such as *Abbey Road Studios* (UK) and *Sterling Sound* (USA). Through my thesis, I unpack some key aspects of mastering culture to demonstrate why this particular form of technical engineering work is now gaining acceptance as creative labour. My research demonstrates why better understandings of mastering and its culture will make for much richer appreciations of popular recorded music production. I examine issues of access, learning to master and operating as an expert in the space. I also theorise how mastering engineers identify with their role, engage their creativity and make use of their studio setups. These issues that surround mastering all bear the hallmarks of creative practice. Up until very recently, technical publications and trade literature made up the dominant stock of written information on mastering, or 'audio mastering'. I have surveyed ideas that emerge out of academic studies and discourse related to popular recorded music production, creative labour in the cultural industries, and social studies of sound. Having drawn from a large pool of scholarship, my research offers new and theoretical contributions to the field. It will help a growing collective of interdisciplinary academics who are now focusing on the creative aspects of audio post-production.

GRATITUDE...

…to the expert mastering engineers who were so generous with their time,
my supervisors for their guidance,
my parents and grandparents without whom this would never have been possible,
and Ashleigh for her love.

Anything is possible. Miracles may take longer.

- Mandy Parnell (Mastering Engineer)

You've got to finish it. Mastering is finishing it.

- Geoff Pesche (Mastering Engineer)

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Introduction

My thesis shows how a new culture of 'Creative Mastering' operates in the realm of audio post-production. This culture evolved out of a more technical and procedural mode of engineering and music industry labour. To better understand the modern-day mastering engineer, their culture and the creative aspects of their day-to-day work, I have conducted autoethnography and original interviews with 20 of the world's leading practitioners.[1] Autoethnography is a method of empirical data collection that, in this instance, has comprised of text-based explanation and illustration through critical reflection on my own mastering practice. Through conducting interview and autoethnography, I have been able to unpack some key aspects of mastering culture and demonstrate why this particular form of technical engineering work is now gaining acceptance as creative labour. My research demonstrates why better understandings of mastering culture will make for much richer appreciations of popular recorded music production and sound in society. Mastering is, just like recording or mixing, a creative form of work, and I show this through deep examination into issues of access, learning to master and operating as an expert in the space. I also theorise how mastering engineers identify with their role, engage their creativity and make use of their studio setups. These issues that surround mastering all bear the hallmarks of creative practice, and my key findings show how creativity is instilled in workers and realised in practice. My findings address the following research questions:

- How has professional audio mastering evolved as a creative practice?

- How does studying today's professional audio mastering culture aid a better understanding and theorising of creative labour in the cultural industries?

- In what ways is the culture of professional audio mastering significant to social understandings of popular recorded music production?

[1] See *Appendix A: List of Practitioners Interviewed*

Though my research seeks to address and introduce mastering to a wide collective of scholarship, there are points at which where my discussion will assume that the reader has a rudimentary appreciation of music technology, audio engineering and the science of sound. At times, my discussions of existing literature and knowledge are supplemented with reflection and understandings gained through my longstanding experiences as an observer of mastering culture and participant within the wider audio engineering space. Back in 2013, I submitted an MA thesis that explored attitudes of music and radio industry aspirants towards issues of 'loudness' in mastering. The introductions, literature review and bibliography for my MA thesis offered a basis for more comprehensive literature review and introductory content when writing this PhD (see Hinksman 2013: 1-20). Brief elements of this earlier MA work have been incorporated, reexamined or reframed to offer much broader and up to date understandings of mastering culture. In 2017, I also contributed a short experimental piece for *Riffs* journal (see Hinksman 2017). Similarly, the contribution offered a basis for more comprehensive literature review and introductory content offered here in the PhD – specifically through *Chapter 3*. My final opportunity to publish before submission was for an edited collection by Braddock et al. (2020). I drew upon my research to form a short chapter, *The Creative Mastering Studio*, much of which is now incorporated into the *Studios* section of my sixth PhD chapter (see Hinksman 2020).

I have noticed that academics and documentary filmmakers have long celebrated the culture of spaces where the recording or mixing of 20th and 21st century popular music took place. Televisual serial documentaries such as 'Classic Albums' (1997-2020) and documentary films such as 'Sound City' (2013) have illustrated the culture of conventional recording studios and music producers in the process of creative music production. Rich scholarship has worked to bolster the cultural significances and creative practices that are associated with such places. It has also observed how conventional record producers evolved from technicians to creatives in demand for recording and mixing. Academics from various disciplines are beginning to recognise that analogous developments within the mastering industry

have been overlooked and have evaded critique.[1] Mastering engineers and academics Hepworth-Sawyer and Hodgson have stated, "very little at all has been written about audio mastering" (1); "we'd had the excellent *Behind the Glass* series from Howard Massey, but nothing really like it for mastering" (270; see Massey 2000; 2009). Up until very recently, technical publications and trade literature has made up the dominant stock of written information on mastering, or 'audio mastering'. Hepworth-Sawyer and Hodgson argued, "[textbooks] make excellent guides for beginners who are just starting the process of learning how to master musical material. But little has been written about audio mastering which considers the multitude of approaches to that craft which currently exist in the industry" (1-2). Shelvock (2017: 2) felt that "scholars rarely address [mastering] in any substantive way." To this, he added, "some commentators have even avoided addressing mastering by arguing that it is only used in particular genres, when it is practiced equally — though perhaps to different ends — to make records of every musical stripe, from so-called classical to trap music." In order to theorise and interpret my findings, I have surveyed ideas that emerge out of academic studies and discourse related to popular recorded music production, creative labour in the cultural industries, and social studies of sound. Having drawn from a large pool of scholarship, my research offers new contributions and will help a growing collective of interdisciplinary academics who are now focused on the creative aspects of audio post-production. It will help us to learn more about the mastering engineer, it will advance our understandings of this figure and it will help us recognise the understudied significance and creative development of mastering. I argue that if popular music scholars are to understand the entire creative recorded music production process, then developments in professional mastering culture should be studied in a detail commensurate to work addressing other production specialties.

Though mastering has been understudied, particularly throughout media and cultural research into popular music, the aesthetic of commercial and mainstream popular music has long been a subject of the mastering engineers' creative methods. (I use the term 'commercial and mainstream popular music' to denote

[1] See: Braddock et al. 2020; Birtchnell 2018; Birtchnell & Elliot 2018; Collins et al. 2019; Hepworth-Sawyer & Hodgson 2018; Nardi 2014; O'Grady 2019; Shelvock 2017; Sterne & Razlogova 2021

chart pop - content that might feature in UK Top 40 and *Billboard* 100 rankings.) Mastering engineers imbue the consistent timbres of mainstream and commercial popular music recordings through essential processes that happen after tracking and mixing. Over the latter half of the 20th century, timbral consistencies became increasingly relative to each engineer's creative agency when using select combinations of digital (software based) and analogue (hardware) signal processing tools. To whatever degree, each practitioner will adopt a unique creative approach and each piece of processing equipment is said to impart an audible 'colouration' across a recording (see Shelvock 2017: 14; Wyner 2013: 19). In the analogue domain, this is a function of electronic circuit scheme, component design and how electrical load is shared across devices. Like Shelvock (17), I consider 'timbre' an appropriate term to describe the coherent sonic architecture across a record (see also Cousins & Hepworth-Sawyer 2013: 91-131; Hodgson 2010: 206; Katz 2007: 103-4). Shelvock also explained how "phenomenological evaluation of a record's timbral and dynamic configuration informs every audio mastering session" (201). Zak (2001: 49) defined 'timbre', alongside 'musical performance', 'echo', 'ambience (reverberation)' and 'texture' as his "five broad categories that represent all of the sound phenomena found on records." He added, "It is the configuration of relationships among these elements that gives the Hendrix track, or any other track, its full meaning and its unique identity." Moylan (2007: 90) explained that "audio professionals" use 'analytical listening' and 'critical listening' to evaluate sound. Both listening modes "seek different information from the same sound." Moylan held that analytical listening "evaluates the artistic elements of sound", whereas critical listening "evaluates the perceived parameters". He said:

> The recordist must understand how the components of sound function in relation to the musical ideas of a piece of music and the message of the piece itself. These are analytical listening tasks. The audio professional must also understand how the components of sound function to create the impression of a single sound quality, and how they function in relation to the technical quality of the audio signal. These aspects are critical listening tasks.

And so, via Moylan, I have understood that analytical listening is concerned more with understanding sounds in their musical and communicative contexts. Moylan

further described analytical listening as “a detailed observation of the interrelationships of all musical materials, and of any text (lyrics).” He said, “It will enhance the recordist’s understanding of the music being recorded, and will allow the recordist to conceive of the artistic elements as musical materials that interact with traditional aspects of music.” I have also understood that critical listening is, for the audio professional, concerned more with how sounds and sonic timbres fare in terms of audio quality and integrity. Through critical listening, sounds themselves are evaluated with less attention paid to their context or meaning. Moylan said, “In critical listening, the states and values of the artistic elements function as subparts of the perceived parameters of sound.”

My research will show that both analytical and critical modes of listening are pertinent to audio mastering, like most other phases of music production. Moylan (157) stated, “The critical listening process and the technical areas of the audio industry are often juxtaposed with creative applications and analytical listening processes.” Engineers would “shift between analytical listening (for the qualities and relationships of musical material) and critical listening (for the characteristics of the sound itself) to allow the evaluation of sound” (94). In spite of this, I do suggest that critical listening is particularly applicable to mastering. Moylan (91, his emphasis) said, “Critical listening must take place at all levels of listening *perspective* […], from the overall program to the minutest aspects of sound.” Typically, a mastering engineer remains focused on the overall program when or if they perform signal processing adjustments.

Via critical listening, mastering engineers can evaluate how signal integrity and the perceived quality of an overall program is impacted by signal processing equipment and alterations performed in the realms of frequency, amplitude, phase et cetera (see 158; see also 318). Although mastering engineers will listen analytically, Moylan (162) conveyed that, typically, “sound quality and timbre evaluation will take place out of musical contexts. In these critical listening applications, clock time is used to evaluate the characteristic changes that occur over time.” Moylan’s (370, his emphasis) glossary states that critical listening “makes use of the concept of sound as an abstract idea, or a *sound object*.” His glossary states that ‘sound object’ “is the perception of the whole musical idea (or abstract sound) at an instant, out of

time; it is understood as the qualities of a sound itself in its many variables and as it exists as a global quality or 'object'; it is used for critical listening applications and is always considered without relationship to another sound" (377).

These ideas are evocative of work by French composer Pierre Schaeffer (see Schaeffer & Reibel 1966). Chion (2012: 50, my emphasis) explained that Schaeffer "gave the name *reduced listening* to the listening mode that focuses on the traits of the sound itself, independent of its cause and of its meaning". Chion (2012) himself outlined three 'listening modes' – 'casual', 'semantic' and 'reduced'. An example of casual listening could be playing a test tone to simply establish whether or to what degree a loudspeaker is working or not. Via casual listening, a person can establish whether a certain sound and its cause is human or animal. Via semantic listening, we can interpret emotions, meanings and human emphasis embedded within a sound source – this could be spoken word or music. I see this as somewhat akin to Moylan's outline of analytical listening. Reduced listening, as I conveyed already, involves hearing sounds more as objects, evaluating their quality and characteristics and not how they may act as vehicles for emotion et cetera. I see reduced listening as akin to Moylan's outline of critical listening. Chion (51) said, "When we identify the pitch of a tone or figure out an interval between two notes, we are doing reduced listening; for pitch is an inherent characteristic of sound, independent of the sound's cause or the comprehension of its meaning." Through Chion, I have understood that reduced listening can be learned, practised and refined. He said:

> [R]educed listening has the enormous advantage of opening up our ears and sharpening our power of listening. Film and video makers, scholars, and technicians can get to know their medium better as a result of this experience and gain mastery over it.

Chion has also described how modern "everyday language" and also "specialized musical terminology" remain "totally inadequate to describe the sonic traits that are revealed when we practice reduced listening on recorded sounds." This statement is made interesting if mastering engineers engage in critical and reduced listening. Hepworth-Sawyer and Golding (2011: 241) stated that mastering engineers "enjoy a 'dark art' status"; that "the guarded secret of mastering is kept behind closed doors in a cloak of mystery". These authors provide telling illustrations of how outsiders

and the industry media still make sense of a mastering engineer's day-to-day involvements with recorded music. In shedding light on the culture of professional mastering, my research will explode such ideas.

Through the two subsequent sections of this introduction, *Contextualising Mastering,* and then *Defining 'Creative Mastering'*, I explain mastering in greater detail and I consider the complex definitions of both 'post-production' and 'creative mastering'. I also theorise much of what has already been made known about the cultural and creative aspects of mastering. After my introduction, I offer further exploration of existing knowledge and scholarship through chapters one to three. These chapters examine ideas around popular recorded music production, creative labour in the cultural industries, and social studies of sound. These chapters highlight the importance of understanding mastering engineers and their culture. I explain my research methodology and finish situating my study in the scholarly field through *Chapter 4*. My primary research findings will then be set out through two expansive chapters that examine six core themes – access, education and expertise in *Chapter 5*; people, studios and equipment in *Chapter 6*. Through my conclusion I will revisit my three research questions, summate my findings and consider further prospects for scholarship. Issues related to the future of mastered audio in society were beyond the scope of my core research. Nonetheless I have also chosen to offer, through *Appendix B*, some considerations of how mastering and mastering engineers may retain significance going forward. In this appendix, I examine some current recorded music industry politics and further discussions that are happening around technological innovations, automation and mastering for emerging formats. Some of my final observations draw from autoethnographic reflection on having spoken and observed others speak in London at the 2018 inaugural mastering conference held by the *Audio Engineering Society* (*AES*).[1] Through *Appendix B: The Future of Mastered Audio in Society*, I explain how research and development teams who support the growth of modern formats and standards are appealing to the professional mastering community for feedback. In

[1] See *Appendix C* for a full conference schedule.

this way, we can understand mastering engineers as agents for technological change.[1] I suggest that this is read after my conclusion.

Contextualising Mastering

What is mastering? From a technical perspective, this question is addressed in print by a small handful of mastering engineers and audio professionals. They have offered published technical guides covering mastering specifically. These sketch out mastering as a modern day process through which sole practitioners use specialist signal processing equipment to sonically fine-tune, polish and fix digital stereo mixdowns of multitrack recorded music productions deemed 'ready' for release (see Hepworth-Sawyer & Golding 2011: 241-244; Katz 2002: 11-12; Owsinski 2008: 5-8; Waddell 2013: 1-5; Wyner 2013: 1-8). Through reading this technical literature I gleaned that, for the typical high-earning project, each phase of production (tracking through to mastering) is performed in separate locations and by separate engineers, who identify as specialists in a given field. I will address these 'phases' of production later in the introduction, as I now offer continued focus on the definition of mastering and current understandings of mastering specifically.

Hodgson (2010: 190) defined mastering engineers as "gatekeepers between the recording studio and the record store". I suggest that if engineers make refined adjustments to ensure productions are fit for release, sonically speaking, then it is fitting to understand mastering as a process of post-production. Respected mastering practitioner Bob Katz (2002: 191) distinguished pre-production as "recording and mixing"; post-production as mastering. In a comprehensive technical guide to digital audio production, Truesdell (2007: 310-311) covered the mastering process first as part of his chapter titled 'Post Production'. Burgess (2014: 48) attributed the mid-twentieth century inception of magnetic tape recording as the catalyst for increased segregation in music production. Burgess said that this

[1] The concept of users as agents for technological change surfaces via: Akrich 1992; Barber 2012; Jones 1992: 75; Kline & Pinch 1996; Oudshoorn & Pinch 2003; Pinch & Bijsterveld 2004: 639; Thèberge 1997

gave rise to “post-production phases of editing and mastering” (see also Birtchnell & Elliott 2018: 80; Sterne & Razlogova 2021: 7). Others are less prone to establish mastering as something of a metonym for post-production. Instead, they position mastering as one of a few processes that form post-production. Gander (2011) briefly explored mastering as part of his PhD thesis investigating the complete production process of a popular song. In a similar way to Gander, McIntyre (2012: 157) defined post-production as the point at which “the project comes together as a complete piece”. McIntyre said that this encompasses “mixing, editing and mastering”. Despite the nuance, mastering has clearly been understood as post-production, or to quote reputable New York mastering facility *Masterdisk* (2021, online), “the final stage of post-production”. Though Burgess (2014: 112) also reasoned that the work of a ‘mixing’ specialist involves post-production processes, he clarified that mixing became attributed to “the producer and/or recording engineer’s job description.” It is at this point where questions as to which production specialties are most associated with creative methods of working come into question.

Setting them aside, mastering engineers are also defined by some of the aforementioned literature as professionals valued for having a degree of emotional distance from the projects they work with; their unhabituated ears are deemed better disposed for corrective work. Of course, the prospect of emotional detachment with ones work clashes with traditional notions of artistry, and such definitions may complicate efforts to understand mastering as a creative process. Technical literature also renders the mastering engineer as one who made it their discipline *only* to master rather than mix recordings and, as mastering engineer Gebre Waddell (2013: 3) attests, “the world’s greatest mixing engineers, almost without exception, do not perform mastering on their own mixes.” Despite these significances, the emergence and development of mastering culture had, when I started researching, been understudied and poorly theorised. I had observed some practitioners within the industry itself present inconsistent narratives to describe when or in what way a specialism, catchall term and demand for mastering first surfaced. Burgess (2014: 48) expressed that the specialism’s emergence coincided with the inception of magnetic tape, implying that technical knowledge was needed to integrate the format in processes of post-production. Shelvock (2017: 30)

affirmed that the term ‘mastering engineer’ crept into parlance over the course of the 1980s, with the advent and industrial adoption of digital.

Hepworth-Sawyer and Hodgson (2018: 1) observed that contemporary mastering “looks—and, more importantly, […] feels—very different”. They aimed “to document how the industry’s most successful mastering engineers have greeted and navigated this tumult and transformation.” The authors published *Audio Mastering: The Artists* just after the completion of all my interviews in June of the same year. They declared their book as the first to offer, with my emphasis, “a comprehensive overview of the audio mastering process told from the point of view of the *artists* who engage in it” (i). They added, “in so doing, [the book] pulls the curtain back on a crucial, but seldom heard from, agency in record production at large.” The book presented a collection of interviews that draw from over 60 hours of discussion with some of the biggest engineers in the mastering industry. The interviews led by Hepworth-Sawyer and Hodgson also addressed pathways to professional status, skill acquisition and how engineers make creative use of equipment and studio space. The authors explained, “we also spoke with mix engineers and craftsmen responsible for some of the more iconic mastering tools now on the market to gain a broader perspective on their work.” Of their 24 interviewees, I note that 20 offer dedicated mastering services. Hepworth-Sawyer and Hodgson’s book presents expansive and verbatim extracts from the 24 interviews that were conducted. They stated, “we have endeavoured as much as possible to ‘get out of the way’ in this book” (2). As such, the authors did not perform deep analyses on their data – they did however provide conversational reflections as concluding discussion. In these discussions, Hepworth-Sawyer and Hodgson did not interpret, conceptualise, theorise, critique or frame their data interchangeably with existing scholarship. I say this not to suggest that the authors should have done so or that their work does not form a crucial contribution to the field. Rather, I wish to convey how my own methods for exploring the creative culture of mastering have been different. I have chosen to engage deeper levels of academic analysis and I have drawn on ideas that relate to three key areas of scholarship throughout my interpretations of original interview data. I have compared and contrasted different opinions, reflections and revelations offered by different engineers. In doing so, I have shone a light on some understudied significances of contemporary mastering culture. Hepworth-Sawyer

and Hodgson's (2018) work will be examined again as part of my methodology chapter. There, I will discuss methods that Hepworth-Sawyer, Hodgson and I each have adopted to address our research initiatives.

I suggest that not enough attention has been paid to the creative and cultural aspects of working in mastering. What is needed are deeper and more informed understandings of issues such as identity, access and career development. Researching as part of a growing collective of interdisciplinary academics who are now focused on these sorts of issues,[1] I present a study that builds upon a foundation of existing scholarship to address a lack of connection between understanding 'how to master' through technical explanation, how to become a part of the mastering world, and the creative significance of mastering. There is no entrenched and recognised school of mastering. Bregitzer (2009: 183-184) said that mastering engineers do not follow "hard-and-fast rules", and Waddell (2013: 3) paraphrased this by explaining, "there is no standardized method of mastering" (see also Edstrom 2011: 198-9; Hodgson 2020: 226; Shelvock 2017: 14). Hepworth-Sawyer and Hodgson (2018: 2) stated that "if the interviews we've collected […] taught us anything about audio mastering, it's this: every mastering engineer works differently, and often using different tools, even if they pursue the exact same aesthetic goal, namely, producing the best record possible from the mixes they are given." Lastly, I stress through Shelvock's (201) wording, "human subjectivity informs the mastering process, and no two engineers sonically configure records in exactly the same way." In the face of all this, I maintain that it is of marked interest how no pathways to career access or specific degree-granting programmes have guaranteed vocations in the industry. I suggest that this would account, in part, for why outsiders perceive mastering careers and skills so unobtainable. Such conditions could be advantageous for engineers who aim to position themselves as experts and charge for services.

Thompson and Lashua (2014) offered practical advice for ethnographers who aim to conduct research in recording studios. In doing so, they tackled issues such as

[1] See: Braddock et al. 2020; Birtchnell 2018; Birtchnell & Elliot 2018; Collins et al. 2019; Hepworth-Sawyer & Hodgson 2018; Nardi 2014; O'Grady 2019; Shelvock 2017; Sterne & Razlogova 2021

barriers to access and other methodological limits within such environments. Thompson and Lashua also mapped the state of research within their strand of scholarship.[1] In doing this, the scholars reinforced that specialist mastering studios had been understudied, irrespective of these sites being considered for their cultural and creative significance specifically. In a paper that reassessed "the role of audio mastering in the art of record production", Nardi (2014: 8-9) reflected on findings garnered via field research in mastering studios. He also discussed "specificity of audio mastering in relation to EDM [Electronic Dance Music]". At this time, Nardi himself noted mastering to be "a phase of production that has been traditionally given scant attention." In a PhD that argued for mastering to be considered a musical competency, Shelvock (2017) identified how scholars regard the process to be "technical afterthought"; "a kind of data processing" as opposed to creative work.[2]

Bob Katz (2002: 11, my emphasis) defined the entire process of mastering as "the last *creative* step in the audio production process"; "your last chance to enhance sound or repair problems in an acoustically-designed room". As my research will show, this is telling of how many mastering professionals consider their day-to-day involvement with music. Though I am arguing for contemporary mastering to be understood as a creative process, I do acknowledge that engineers are also tasked with, amongst other things, the technical preparation of track metadata, the creation of disc description protocol images (DDPs), and the timing of spaces between mastered songs to be released on digital or physical playback mediums. These sorts of tasks are all performed in accordance with a variety of manufacturing or distribution format standards with which today's practitioners are expected to be especially literate (see Owsinski 57-59). I stand by Savage (2014: 250), who would nevertheless maintain that there are creative implications to some of these tasks. Savage (my emphasis) defined timing the length of silence between each track as "the last *creative* judgment to be made in preparing your master"; "a part of the overall aesthetic" that determines listener engagement and a sense of musical

[1] See: Bates 2008; Fitzgerald 1996; Gander 2011; Gibson 2005; Hennion 1990; Horning 2002; Kealy 1979; Meintjes 2003; Morris 1977; Morrow 2013; Porcello 2004

[2] Shelvock's (2017) work will be examined in greater detail through *Chapter 4: Researching Mastering*.

development over the course of an album. Effective spacing can help “clear the air” or “keep things moving”, Savage explained, and I observe that engineers do hold a degree of agency over this. Whilst some aspects of mastering are fundamentally technical and even procedural, I reason that specialist recording or mixing work is not deprived of practical demands that are also technical by nature. Thus, we should not be deterred from continuing to explore mastering as creative work.

Defining ‘Creative Mastering’

When it came to thinking about mastering as creative work, I began to establish how traditional views held by academics were at odds with opinions held by those who now master audio for a living. The expression ‘creative mastering’ emerged out of my March 2016 interview with engineer Darcy Proper, who operated out of *Wisseloord Studios* in The Netherlands at the time. During the interview, I made a conscious link between Proper’s turn of phrase, and narratives of creativity in mastering such as those given by Bob Katz. It was my feeling that Proper used the expression to illustrate a difference, perceived by her, other scholars and engineers, between modern practice in the studio and early ‘disc cutting’ work that offered foundation for the growing mastering specialty as it is recognised today (see Collins et al. 2019: 259-61). Disc cutting will be explained later in this section, and the meaning of ‘creative mastering’ will continue to unfold as I set out my arguments.

The *Oxford English Dictionary* (2022a, online) defines ‘creativity’ (noun) as “The faculty of being creative; ability or power to create.” The *OED* (2022b, online) defines ‘creative’ (adj) as “1. a. Having the quality of creating, able to create; of or relating to creation; originative.”; “b. Inventive, imaginative; of, relating to, displaying, using, or involving imagination or original ideas as well as routine skill or intellect, esp. in literature or art.” Hesmondhalgh and Baker (2011: 2-3) recognise that the terms ‘creativity’ and ‘creative’ “have been abused and over-used.” Nevertheless, these authors impart that the terms “still refer to issues of great importance concerning the potential value of culture in people’s lives.” Hesmondhalgh and

Baker have said, “To create is simply to bring something into being.” ‘Produce’, they said, “has a similar meaning but ‘create’ has strong implications of newness, invention, innovation, making something afresh.” Hesmondhalgh and Baker describe how the word ‘creative’ was “Originally applied to divine intervention”. The word was later applied to art, learning and thought. Csikszentmihalyi (1996) described creativity as “a central source of meaning in our lives for several reasons. […] First, most of the things that are interesting, important and *human* are the results of creativity. […] [W]hen we are involved in it, we feel that we are living more fully than during the rest of life.” I have hence figured that when ‘creative’ is used as in ‘creative mastering’, we should understand this form of audio post-production as one concerned with the inventive and imaginative use of tools to help bring a mastered project into being. The sonics of the project would bear signs of an engineer’s originality. Moreover, the mastering process is one through which an engineer may experience a sense of flow and a deeper meaning to their labour.

Whilst it is important to acknowledge that it could indeed have only been mastering engineers themselves who began to conceive of or construct their role as artistic and creative, my research will form part of a growing stock of interdisciplinary scholarship that has begun to uphold the legitimacy of these perspectives.[1] We might acknowledge that there are advantages to mastering being understood as a creative or even mysterious process. Earlier on, I cited Hepworth-Sawyer and Golding (2011: 241), who said that mastering engineers “enjoy a ‘dark art’ status”; “the guarded secret of mastering is kept behind closed doors in a cloak of mystery”. Likewise, Bregitzer (2009: 183-184) acknowledged that the so-called ‘dark-art’ of mastering “is most often shrouded in mystery” (see also Collins et al. 2019: 261; O’Grady 2019; Sterne & Razlogova 2021: 8). I suggest that these sorts of tropes could feed back into the notion of mastering engineers as creative experts.

Enough can be gleaned from existing scholarship to know that ‘disc cutting’ en masse emerged out of surges in demand for specialists to cut ‘master lacquer’ for vinyl. This involved transferring audio from the magnetic tape format that proliferated

[1] See: Braddock et al. 2020; Birtchnell 2018; Birtchnell & Elliot 2018; Collins et al. 2019; Hepworth-Sawyer & Hodgson 2018; Nardi 2014; O’Grady 2019; Shelvock 2017; Sterne & Razlogova 2021

around the mid-twentieth century (see Birtchnell 2018: 5-7; Collins et al. 2019: 259-261; Owsinski 2008: 4; Shelvock 2017: 29). 'Transfer engineers' or 'disc cutters' of Dubber's (2012: 18-30) so-called 'electric age' gave rise to today's mastering engineers, who began to enjoy that there were fewer creative restrictions at play when working with digital compact disc in the 1980s and then other affordant formats that developed later on in 'the digital age' (see Horning 2013: 71; 85; 111-114; Nardi 2014: 9; Owsinski 2008: 4-5; Waddell 2013: 143; 194-197). By its very specification, the digital audio domain provided a higher ceiling and wider scope for creative decisions that could be made not only by mastering engineers, but also by artists and producers. Birtchnell and Elliott (2018: 82) have said that "with the CD and MP3 player arising as ubiquitous, mastering engineers upscaled from routine workers in quality control to their present role where they command respect as creative professionals." Like early-twentieth century sound 'recordists' (see Horning: 17), specialist mid-twentieth century transfer engineers and disc cutters had been troubled by particular musical timbres and sharp transients causing the recording stylus (or cutter head) to, quote Horning, "jump the groove and ruin the take" (see also Shelvock 2017: 29).[1] Before the proliferation of digital format consumption on a mass scale, the entire composition of just a single popular song was often function to the physical limitation of 78rpm discs. This format offered a playback time of approximately four minutes (see Horning 2013: 21). Mastering engineer Eddy Schreyer (in Owsinski 2008: 247) declared vinyl a "totally unforgiving" format. He explained,

> […] the digital medium allows you to slam anything into it that you want, clipped or not, because it's not going to skip. In other words, you can almost do anything […] and get away with it. Left-right balance can be totally wrong, image can be totally wrong; it just doesn't matter because that CD will not skip.

Shelvock (2017: 29) described how, by the end of the 1950s, "audio transfer adopted more of an interventionist approach", and thus, "*cutters* were responsible for finalizing a record's sound parameters as a matter of course". The demand for a specialist figure who could understand physical format restrictions and oversee

[1] See *Appendix D* – 'Transients'.

effective transfers between recorded mediums through 'intervention' would still linger, as even digital protocols and format standards, though more forgiving, would impose their own creative limitations. I observe that a more recent resurgence in vinyl record sales has not left the practice of 'cutting a record' redundant. I also observe that it became and would remain useful to make sense of the mastering engineer as a knowledgeable conduit and critic; a "bridge" (Katz 2002: 11) or "gateway" (Nardi 2014) expert between processes of production and manufacture. I will now use theory set out by Pratt (1997; 2004c) to begin explaining why modern day mastering, though a creative process, may have been inappropriately associated with just the manufacturing territories of the cultural industries. I argue that this will account for historic and somewhat neglectful attitudes towards professional mastering culture as shown through academia and the mass media. This will also account for why it has proven difficult for mastering engineers and indeed wider industry professionals to offer up easy definitions or designations of mastering and post-production more generally.

Pratt theorised the production of culture into six 'moments' – 1) content origination; 2) manufacture; 3) reproduction and promotion; 4) exchange; 5) education and critique; 6) archiving. Pratt's second moment, manufacture, is explained by Gander (2011, my emphasis) as "the creation of materials used to create the work and the *prototypes* which will act as the *master* from which copies will be produced." Bob Katz (2002) and Owsinski (2008) used the term 'master' to denote the product of the mastering process. This is the 'master lacquer', compact disc, DDP or digital file from which all replications, duplications and disseminations are made. In a similar sense, Gander (2011: 190) outlined that the role of the mastering engineer is to "produce a master copy of the stereo recording suitable for broadcast on the radio and distribution to retail websites and manufacturing plants". This shines a light on how mastering processes have historically been correlated with notions of manufacturing in the cultural industries; the vernacular within professional mastering culture has mirrored the vernacular that academics employ to define manufacturing in the cultural industries. On the one hand, 'prototype' is a useful descriptor for a mastered product. It is consistent with some of the realities of mastering work, as practitioners are expected to be technically literate in the variety of formats used for distribution and they prepare projects accordingly. On the other hand, the

expression implies that the product of mastering is a mock-up. This deters from understanding mastering more as the critical and creative determination of recorded music's consistent timbre - this is what a collective of other scholars and myself are aiming to underline. It is worth stressing that in terms of their aesthetic and their utility, the spaces and tools that professionals use for mastering are also profoundly different to those used by manufacturing teams or digital distribution services. In chapters one and six, I will argue for mastering rooms to be examined more deeply as creative spaces. As such, they would be places set up for production, or 'content origination', rather than manufacture.

Be all this as it may, amateurs may admittedly carry out modern day mastering processes at a reduced cost. At a fairly basic level, mastering, like photography, can now be performed to a reasonable degree of success. It can be performed without a dedicated or specialist creative studio space, equipped with hoards of analogue signal processing hardware. What is more, a relatively new service named *Mix:Analog* offers paying users the opportunity to schedule real-time and remote access to real and costly analogue signal processing tools used for mixing and mastering. This service, still in its infancy, makes use of "high quality" analogue-to-digital and digital-to-analogue conversion, together with "lossless audio streaming" over the Internet (*KVR Audio* 2021, online). The company's roadmap implies that users will be able to use more than one piece of analogue equipment simultaneously in the future (see *mix:analog* 2021, online). Digital mastering can also be automated at a moderate fee through online services that are built around intelligent algorithm and machine learning. *LANDR* and *eMastered* are two prime examples, and I examine these services in *Appendix B: The Future of Mastered Audio in Society*. Right now, it is important to just observe that the results offered through automated services are a contentious issue amongst engineers, wider industry professionals and artists alike. I previously cited Shelvock (2017: 201), who stated, "phenomenological evaluation of a record's timbral and dynamic configuration informs every audio mastering session." To this, he added, "An exception may be LANDR's automatic mastering service. However, this service has yet to be accepted within elite production circles." Shelvock also added, "amateur recordists and musicians also avoid [*LANDR*], often commenting that humans simply do a better job" (see also Birtchnell 2018: 4). In *Chapter 1*, I will examine

existing paradigms and scholarship to contextualise mastering in the sphere of affordable digital multitrack production that formed over recent years. At present, cultures of non-professionals can operate powerful series of creative digital signal processing and monitoring tools from project studios, homes, bedrooms or from wherever laptop and user can work together (see Anderton, Dubber and James 2013: 64-65; Caldwell 2008: 157; Moorefield 2010: xvi; Wikström 2009: 43; 123-124). In short, current digital landscapes offer a wealth of opportunity for individuals who fall outside of established expert circles. These circumstances will of course raise questions as to why professional mastering remains in high demand or if professional mastering culture still maintains much of a mysterious aura. I suggest that if established engineers are still being hired, then this would reinforce notions of professional mastering as an important site for study and a creative endeavour that can surpass amateur efforts or present-day algorithm. I observe that there are a considerable number of engineers and studios who operate securely, whilst many jobs in manufacturing are being lost to machine learning and automation. As is the case, the success of today's engineer would also strengthen ideas of mastering as a process that is primarily concerned with creative 'content origination', rather than technical manufacture.

Although digital has helped raise the profile of the mastering process, bringing this creative practice to light amongst modern communities of amateur engineers and audio enthusiasts, I do suggest that high levels of unfamiliarity have still continued to prevail throughout particular academic cultures and popular music fandoms who observe the mass media. In a technical book for music production that addressed prospective and non-specialist audio engineering professionals, Bregitzer (2009: 183-184) maintained, "many inexperienced clients may not even know that mastering a recording is required" (see also Owsinski 2008: 4; Shelvock 2017: 2). This is a telling statement that implies a much wider sense of unfamiliarity with mastering, such that had occurred outside of popular music scholarship and within communities of musicians. In response to my third research question, I will now continue to explore the issue of unawareness for what mastering is and what creative significance mastering has in the context of recorded music production.

*

I have established that it would not be uncommon to address a room of media academics or professed music fans and realise a first-time explanation of the term 'mastering engineer' is required. Of course, first-time explanations may not be needed at *Audio Engineering Society* conferences or at *SAE Institute*, but within the disciplines of media and cultural studies, popular music studies and even social studies of sound, this would traditionally be necessary. In the past, scholars in these disciplines would have observed the mass media elevate numerous iconic 'producers' to creative stardom and cultural significance over the latter half of the 20th century and on into the 21st. They would have acknowledged figures such as George Martin, Rick Rubin, Quincy Jones, Brian Eno or Phil Spector all become household names. They would have observed the boundary between 'producer' and 'artist' became blurred to a point where the terms (and the roles) became almost synonymous. The relatively recent career highlights and activities of British record producer Mark Ronson are useful for demonstrating how these boundary shifts still endure. If you, the reader, are in touch with Western media landscapes, if you are an academic and claim to be a fan of music, then you would likely be familiar with Ronson's identity as a producer, musician and media figure. The mass media deemed Ronson's involvements as co-producer for the late Amy Winehouse's (2006) *Black to Black* to be crucial in the creative formula for the album's success.

> The tabloid press seemed almost as fascinated by [Ronson] as they were by [Winehouse]. […] The sound he minted on Back to Black and Version proved to be one of the most pervasive in modern pop – nearly a decade on, people are still making records indebted to it, not least Sam Smith and John Newman.
>
> (Petridis 2015, online)

The mass media also bestowed considerable attention and wove similar narratives around Mark Ronson's (2014) more recent single 'UpTown Funk!' – a song to which he contributed writing and production skills but that was sung entirely by *Bruno Mars*. UpTown Funk! went on to remain the "longest-leading hot 100 no. 1 of the 2010s" up until May 2017 (see *Wikipedia* 2017, online). Just these two examples are telling of how the boundaries between artist and producer continue to blur in the

context of popular music. Though mastering is said to have evolved into a creative process, I observe that the mainstream media offered no attention to the involvement of US mastering engineer Tom Coyne around the time UpTown Funk! enjoyed chart success. Coyne was not recognised or heralded as the figure credited for creatively and technically determining how, ultimately, UpTown Funk! would be heard on home televisions, gymnasium PA systems, on *YouTube*, through the airwaves or on whatever source is used to supply popular music in its ubiquity. A modest *Google* search made prior to May 2015 would validate my claim:

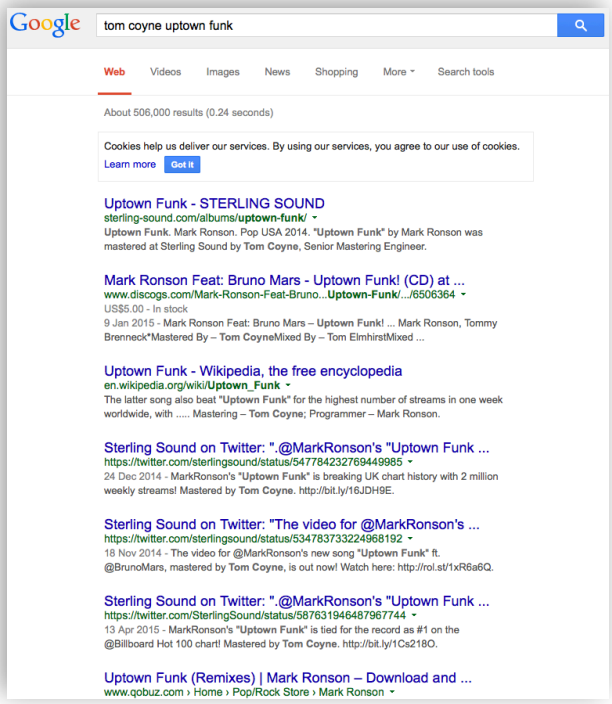

Fig. 1 Screenshot of *Google* search, Spring 2015, for the four words 'Tom Coyne Uptown Funk'. (*Google* and the *Google* logo are trademarks of *Google LLC.*)

Fig. 2 Uptown Funk thumbnail from Uptown Funk entry (*Wikipedia* 2015, online). Screenshot from Uptown Funk *Wikipedia* entry at https://en.wikipedia.org/wiki/Uptown_Funk licensed under Creative Commons Attribution-ShareAlike 3.0 Unported License

Google listed an entry by *Sterling Sound* in New York City - Coyne's place of work and also the professional home of Greg Calbi, who I would interview later on in

2015. After *Google*'s first listing came links to *Discogs* and *Wikipedia* pages that had offered Coyne a simple credit. Three tweets from *Sterling Sound* themselves led on to the more trivial of search returns. At no point did the likes of the *BBC* or any other major news outlet commend participation of a 'mastering engineer' as a creative practitioner in the production behind what would come to stay as the 'longest-leading hot 100 no. 1 of the 2010s' for over two years. But why should they have done? Such was an appropriate question to wrangle with, as even established awarding bodies associated with the recorded music industry restricted the range of opportunities available for mastering engineers, and others for that matter, to be celebrated as creative contributors. Continued research would expose that mastering personnel had limited opportunity for statuette award at the *GRAMMYs* – albeit more than in previous years. The official '*GRAMMY* Award Eligible Credit Definitions' document of the time had stipulated:

> All persons eligibly-credited on a GRAMMY-winning recording will be acknowledged with *GRAMMY* certificates. Only those eligible credited as producer and/or engineer, and per the rules for each category, will receive GRAMMY statuettes. […] A mastering engineer is not eligible for a GRAMMY statuette except in the categories of Best Historical Album, Best Surround Sound Album, Best Engineered Album Classical, Best Engineered Album Non-Classical, Record of the Year and Album of The Year. (Mastering Engineers are eligible to receive a Winner's Certificate for all winning albums.)
>
> (*NARAS* 2015, online)

To me, this echoed how the mainstream media and even professional music industry bodies had neglected to fully embrace that 20th and 21st century mastering engineers developed creative methods of working. My drive to raise the profiles of less-credited mastering engineers began to deepen, having also contemplated Anderton, Dubber and James' (2013: 64-83) linear interpretation of the entire production process as it came to be over the latter half of the 20th century; pre-production, tracking, mixing, mastering, through to manufacture (see also Waddell 2013: 1). At the start of this introduction to my thesis, I made a promise to address these so-called 'phases', and I suggest that they may also be

understood as cultures. Scholars Anderton, Dubber and James illustrated various specialisms and the flow of work in contemporary recorded music production as follows:

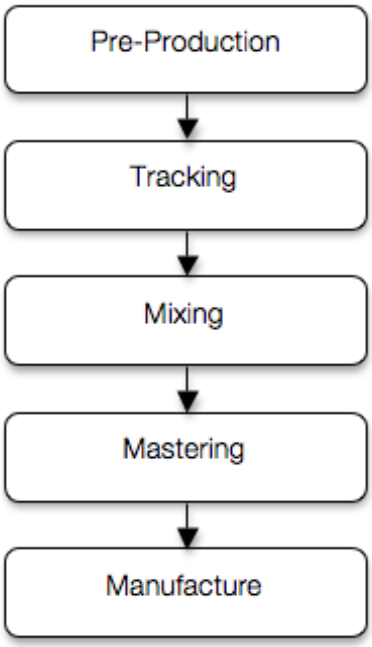

Fig. 3 Imitation of flowchart by Anderton, Dubber & James (2013: 67)

Taken at face value, I felt that their own diagram (akin to the imitation above) implied something of a balance between many aspects pertaining to each phase. I began to reason how, in reality, there are disparities between the durations of each process, capital invested and the number of personnel or locations involved at each stage. I deduced that potentially hundreds of label personnel, studios and engineers might be included in the pre-production or tracking of any one album; and then numerous in mixing. Furthermore, fast Internet connectivity and digital multitrack production had enabled patchworked, networked, remote and digital audio workstation-based approaches to production in all areas of the market (see Bregitzer 2009: 186-209; Edstrom 2011; Hawkins 2002; Théberge 2004; Wyner

2013: 9-13). Lengthy and costly efforts could be spread out over networks of tracking through to mixing. To me, it was interesting that, at the bottleneck, a sole mastering engineer operating from one location can be tasked to quickly and often much less expensively reshape these efforts. Ultimately this figure would be given official attribution for preparing the consistent sonic timbre across hit records. Echoing my perspectives, Hodgson (in Hepworth-Sawyer & Hodgson 2018: 272) impressed how "everything done during production is subject to mastering. Choices made in mastering affect every little choice made during production." I previously cited Zak (2001: 49; see also 107), who defined 'timbre', alongside 'musical performance', 'echo', 'ambience (reverberation)' and 'texture' as his "five broad categories that represent all of the sound phenomena found on records." Shelvock (2017: 10) reflected on Zak's work and explained that each of these categories "falls within the purview of various recordist agencies", including the mastering engineer. Shelvock (26) later said that "mastering engineers use signal processing to address five broad aural parameters: dynamics, timbre, loudness, stereo width and depth" (see also Cousins & Hepworth-Sawyer 2013: 54). I suggest that if effective mastering is necessary for the success of a record, then the lone engineer's swift action and creative responsibility in one of the final phases of the production process is still hugely undervalued and demanding of our attention.

I felt that the flow chart offered by Anderton, Dubber and James model could also be problematised in that, at face value, it does not illustrate how creative boundaries of each sub-process, or culture, will often blur in practice. I have already established that the boundaries of processes understood as production or post-production have remained ambiguous. A more thorough and considered view of the whole recorded music production process would offer nuance and open up a deeper understanding of there perhaps being more creative agents who engage in mastering than at first meets the eye. Though many musicians and label personnel can elect to not attend mastering sessions, "there are often", as Savage (2014: 254) acknowledged, "many stakeholders involved in the mastering process." That is to say, in any faction of the recorded music industry, feedback from mix engineer, artist or label (all of whom may impose demands for mastering) could in fact be regarded as a creative interjection to the mastering process. Moreover, if these parties 'sign off' mastered audio, I felt that this would hold the view of mastering

engineers as lone ‘gatekeepers’ between all that happens in the recording studio and all that is heard by the consumer somewhat questionable. In this sense, I reasoned that ‘mastering’ could even be thought of as a process through which artists or engineers make a decision to abandon production and begin to embrace their work as a finished product. Hodgson (in Hepworth-Sawyer & Hodgson 2018: 274) stated that, “the successful mastering engineer gains client approval for their work. That’s it. No one way is better.” Hodgson then proceeded to offer an analogy that framed mastering as a ‘musical competency’, to borrow Shelvock’s (2017) term. Hodgson added, “To insist otherwise is like saying Tony Iommi sucked at guitar because he didn’t play as fast or as clean as, say, Yngwie Malmsteen. Both are great guitarists. They just do different things with their tools and for different reasons.”

Though I ascertained that creative collaboration could sometimes transpire between mastering engineer, musician and assistant, my thorough investigations found no professed mastering ‘duos’ or ‘teams’ who market homogenous working relationships in ways similar to collaborative songwriting duos. Not until 2021, when *Sterling Sound* (2021, online) in the USA had announced: “Beginning in Jan […] Greg Calbi and Steve Fallone will share creative responsibilities on all projects”. The company explained this apparently unique undertaking through a video. Previously, I had learned that although professional relationships or feedback loops may develop between mix engineers and mastering engineers, and the engineers may even operate under the same ‘in-house’ service name or as part of a studio, I observed that these specialist practitioners would predominantly operate and receive credit under clear-cut roles. And so, whilst there may be numerous stakeholders in the process, I learned that there are clearly established and definitive professional specialisms that result in sole credit being offered to those who are paid to master a record. Both Hepworth-Sawyer and Hodgson (2018: 3) instill that mastering is “a stubbornly unique artistic practice, undertaken by critical artists who often prefer to work alone”.

On 12 April 2017, mastering engineer Tom Coyne passed away aged 62, following a private battle with multiple myeloma. News of his passing came to me not via the entrenched mainstream or tabloid media, but via those I had kept in touch with via

Facebook after spending two years journeying the globe to interview mastering engineers or conduct autoethnography. Two web articles made the rounds. The first was authored by *Music Business Worldwide* (2017a, online). This is a publishing company founded by ex-*Music Week* editor Tim Ingham in 2015, offering "a free, in-depth news, insight and analysis platform for the international music industry" (see *Music Business Worldwide* 2017b, online). The second article was authored by Miles Bowe for online music magazine *Fact*. This magazine ceased printing entirely as of 2008, and they were owned by independent enterprise *The Vinyl Factory* (see *Wikipedia* 2021a, online). Bowe (2017, online) presented screen captures of artist tributes made to their mastering engineer on social media. He also quoted journalist John Book for having tweeted, with my emphasis, "F*or anyone who read and concentrated on album credits and why they were there,* Tom Coyne was someone who many trusted for expertise and ears".

Chapter 1: Mastering and Creative Music Production Cultures

This chapter is formed of two sections. First, *Creative Studio Spaces*, and second, *Creativity in-the-Box*. In the first section, *Creative Studio Spaces,* I will introduce more existing knowledge to survey what is already known about the architecture, function and discourse of spaces that creative people occupy to record and produce music. I will use this knowledge to draw comparisons between the mastering studio and the conventional recording studio. In doing this, I defend the need for mastering engineers to be thought of as artists who produce work in a creative synergy with their studio space, rather than as workers who carry out a more procedural set of manufacturing activities. These comparisons will lay further grounds for me to tackle my first research question through *Chapter 6*. My first research question queries how professional audio mastering evolved into a creative practice.

We have reached a point in time where creativity – the "ability or power to create" (*Oxford English Dictionary* 2022a, online; see also Csikszentmihalyi 1996; Hesmondhalgh & Baker 2011: 2-3) - is easier to facilitate in alternative spaces and away from established locations. If high quality productions or post-productions can be created from near enough anywhere in the world, then I suggest this would have profound implications on how the culture of audio mastering is understood and how mastering studios are valued. It would change the way we think about learning to master, accessing the industry, operating as an expert and how professional engineers apply their creativity in studio settings. In spite of the modern digital milieu, and in spite of the fact that many in the Western world can learn to economically master stereo recordings from home, my research has shown that professional mastering remains competitive and in high demand. Nevertheless, through *Creativity in-the-Box*, I will begin to spell out various opportunities for today's amateur to engage in creative mastering processes, away from professionally equipped and established studio settings. It is important that we acknowledge how these opportunities are afforded through accessible digital platforms that facilitate

low-cost alternatives to hiring established creative practitioners. I touched upon these circumstances briefly in my introduction, and it is relevant for me to address them thoroughly if I am arguing for the creative significance of specialist mastering facilities and recording studios to be grasped in a similar sense going forward. The ever-increasing accessibility of digital affordances for music production does raise questions as to whether similar senses of 'place' or 'space' (see Augé 1995: 77-78; Bull 2000) can emanate from established professional studios and the growing number of project setups involved in chart record releases alike. Can the established studio and the comparably modest project setup be conferred with similar degrees of creative or cultural significance? Birtchnell and Elliott (2018: 78) have said, "[Artificial intelligence (AI)] for audio production work is still in its infancy, yet already there are profound ramifications for creative spaces and places." Through *Creativity in-the-Box*, I will focus more on creative tools that can be used within the digital audio workstation (DAW). I consider developments around AI and the ramifications of digital automation going forward through *Appendix B*.

Creative Studio Spaces

Moorefield (2010: xiii) indicated how musician and record producer Brian Eno framed the contemporary recording studio as "a musical instrument in its own right" (see also Eno & Bass 1979, online; Geels 2007: 1429; Marrington 2017: 85), and Horning (2013) documented early examples of discourse that would help to construct such widespread ideas. For example, Columbia's *30th Street* came to be regarded as the studio equivalent of a *Stradivarius* violin (90; see also Birtchnell & Elliott 2018: 82). In part, this impression is built on the view that recording spaces offer desirable and distinctive acoustic reverberances that engineers capture through tracking. Horning also explained that the former *Liederkranz Hall* in New York City garnered a reputation for its acoustics; that the facility placed "new emphasis on the sound of the studio, not just the music being recorded" (87). Despite all this, I stress that the principle of a sole mastering engineer working to craft the sonic timbre and continuity of modern projects in creative harmony with

one physical acoustic environment has not been celebrated in such a way or to the same extent by either the mass media or academics.

Attempts to scientifically control or enhance the acoustic properties of spaces used for creative sound recording became increasingly more sophisticated throughout the 20th century. Technical publications, pertaining to the fields of acoustics and psychoacoustics, describe how treatment is often installed in recording studios and production suites alike. This is done in an effort to alleviate undesirable reflections that can attenuate or reinforce certain frequencies within the spectrum of human hearing (see Alton Everest & Pohlmann 2009: 95-106; 135-149). Often, smaller rooms built to specific physical dimensions are constructed within larger rooms to produce "smooth room characteristics", or, "yield acceptable low-frequency room quality as far as distribution of axial-mode frequencies is concerned" (247). Rooms built to specific physical dimensions, perhaps with a floating floor, will typically feature tactful placement of objects such as angular wooden panels to control problematic frequencies and acoustic phenomena. In conventional recording studio design, a thick wall will divide the acoustically treated 'control room' and 'live room'. This wall will feature a soundproof window to enable eye contact between performer and engineer (see Horning 2013: 124). But just like the conventional recording studio, many of the lesser-studied professional mastering rooms of the mid-twentieth century onward will have also undergone architectural acoustic treatment. Katz (2002) and Owsinski (2008) were some of the early few to have exclusively described the design, function and make-up of the modern mastering studio from technical perspectives in a published volume. For mastering, I gleaned that architectural acoustic treatments are calculated with specific consideration given to how effectively a designed space will allow engineers to hear an accurate representation of a mixdown recording, so that they can perform their conclusive and creative adjustments. I have observed that when engineers and technicians speak of achieving perceived 'accuracy' in terms of their listening environment, this refers to building setups incorporating monitoring systems and room acoustics that deliver ideal presentations of sound. Their studios would allow them to hear music and perform critical listening in the most neutral way possible – uncoloured by the physical properties of certain spaces. Engineers would also hear balanced reproductions of the "sound stage" (see Moylan 2007: 50-5). I will expand on

matters of ‘accuracy’ and some of the technicalities of studio acoustics and listening environments at an appropriate stage in *Chapter 5*. For now, I wish to signify that these initial understandings had encouraged me to consider the extent to which numerous creative decisions in mastering are to be considered a function of the acoustic ambiance within the treated or untreated mastering room – this room also being a musical instrument in its own right. In *Chapter 6*, my findings do show that the creative and cultural significance of mastering rooms can be justified in this way and in other ways more generally.

To identify an acoustic space as a musical instrument is remindful of post-war mythologising and biography concerning the conditions under which recorded music was created. The recording process clearly shook its ‘lab coat’ image over the course of the 20th century (see Hull et al. 2011: 220). Discourses around reputable American studios, such as those explored by Cogan and Clark (2003), actively constructed renowned ‘temples of sound’, where alchemic creative practices were performed through the tracking and mixing stages of production. The mass media also established recording studios and geographical locations as creatively significant and iconic locations bound to artists or producers with star status – places “where the magic happens” (Anderton, Dubber and James 2013: 64-65; see also Horning 2013: 78-84; 120; 137; Massey 2015). The opening montage of Greg ‘Freddy’ Camalier’s documentary *Muscle Shoals* (2013) offers a relatively modern example of this sort of myth-making. *Muscle Shoals* commemorated the work of Rick Hall – founder of *FAME Studios* in Muscle Shoals, Alabama. Celebrated musician Jimmy Cliff described how even the city itself possessed “a field of energy”. Donna Jean Godchaux of the *Grateful Dead* proclaimed, “there was just something about that place” and, in the words of *U2’*s Bono, “magic is the word that comes to mind for me when I think of Muscle Shoals - it’s about alchemy.” Other televisual serial documentaries such as ‘Classic Albums’ (1997-2020), mentioned previously, offer these sorts of perspectives into recording studio culture, location, and the work of music producers directly involved or collaborating creatively with famed recording artists. In my investigations that led up to my research activity, I found no such documentaries or television series made and broadcasted in ways that focus on mastering specifically, or else on mastering

as a clearly defined creative contribution to the process of late 20th and 21st century recorded music production.

Incidentally, Meintjes (2012) used the term “iconicity” to denote the visual appeal or condition of 20th century recording studios as fetishably iconic, and costly architectural acoustics would become a key part of forming their mystical image. Aside from furnishings and fittings for controlling acoustics, prominent displays of technological hardware offering conceivably boundless creative potential to producers would also foster both the perceived iconicity of spaces used for recording and the creative aura of the recording process. Again, just like the iconic recording studio, today’s lesser-celebrated mastering rooms are also characterised by wooden panelling, irregular walls, sloped ceilings and such other design features that are put in place to control acoustics. They home similar displays of signal processing hardware units and loudspeaker technologies that resemble and function just like equipment used at the creatively involved tracking or mixing stages of production. I will continue to acknowledge the perceived iconicity of equipment used for mastering later on in this section.

In my introduction to this thesis, I conveyed that creative mastering processes are also mythologised. Mastering is often referred to as a ‘dark art’ (see Bregitzer 2009: 183-4; Collins et al. 2019: 261; Hepworth-Sawyer and Golding 2011: 241; Sterne & Razlogova 2021: 8). The mass media and the paradigms of scholarship I continue to address have rarely seemed to focus on such ideas. Despite the similarity of recording studios and mastering studios in terms of design, function and how these things are discussed, the cultural and creative significance of modern-day mastering rooms has previously been neglected. I argue that this owes somewhat to mastering engineers being perceived as a “bridge” (Katz 2002: 11) or “gateway” (Nardi 2014) expert between processes of production and manufacture. It would have long been considered unfitting, to a certain degree, for manufacturing facilities concerned with procedural disc duplication or even vinyl pressing to be historicised in details commensurate with the sorts of mythical ‘temples of sound’ used for recording in the mid-twentieth century and onward (see Anderton, Dubber and James 2013: 64-65; Cogan and Clark 2003; Horning 2013: 78-84; 120; 137; Massey 2015). Perhaps the only recent exception to this view arrived in the form of

Detroit's *Third Man Pressing* – opened by musician Jack White in 2017 (see Zlatopolsky 2017, online). I also argue that the cultural and creative significance of mastering remaining somewhat uncharted by academics or the mass media is correspondent with post-production involving less direct participation from more prominent creative figures. Celebrated musicians or actors can circumvent attendance and creative input when a record is mastered or a theatrical film is edited. In other words, and as existing literature has begun to reveal, the mastering studio is less connected with creative processes performed by central figures and household names in music. It is crucial, however, for musicians to attend tracking sessions in recording studios. Thompson and Lashua (2014) regarded access to recording studios as extremely limited; inessential personnel do not attend studio sessions. They also explained that professional recording studios are acoustically confined and most often private property. I assert that this intensifies the mysterious auras that emanate from conventional studio locations. I also assert that these barriers to access establish demands for the mass media or documentary filmmakers to let light in on creative processes carried out by cherished artists, who work closely with producers. Thompson and Lashua did not address matters of accessibility to modern mastering studios that conform to a similar degree of isolation, but that are less directly associated with musicians and their creative processes. I have established that although less collaboration or less direct collaboration transpires between mastering engineer and artist, the sonic outcome (mixdown) of the artist's works are now subject to creative mastering processes that, as my research will prove, can differ between each engineer. I argue that this entire premise has previously been overlooked and that if a broader collective of academics are to fully understand the personnel, locations and cultures that relate to the entire creative recorded music production process, then creative developments in mastering should be studied in a detail commensurate to work addressing other production specialties. This is what myself and a growing cluster of interdisciplinary scholars are striving for (see Braddock et al. 2020; Hepworth-Sawyer & Hodgson 2018; Shelvock 2017).

I have established that mastering studios feature signal processing devices and loudspeaker technologies akin to such that can be found in conventional recording studio settings. Whilst electronic circuit schemes and designs can often be bespoke

for mastering, the creative and technical skills required to operate and integrate mastering-grade signal processors or converters are however similar for the most part. For this reason, it is imperative for me to cite some existing scholarship that has explored the creative significance of recording studio equipment and its 'iconicity'. This will lead on to the second part of Chapter 1, *Creativity in-the-Box,* in which I outline how some digital developments have enabled better access to functions offered by tools that are found in spaces used for mastering and recorded music production more generally. In the second part of *Chapter 1,* I will also explore how the celebration of certain digital developments can impact on the extent to which established, cherished or heritage studio locations might be perceived as creatively significant.

*

Just like the acoustic spaces used for tracking performances, various pieces of signal processing equipment would also become vital components of a reputable 20th century studio's sonic emblem. My research findings will show how specific combinations and configurations of digital or analogue processors and converters are said to imprint a unique and audible 'colour' on signals that represent musical passages played out over time. Right now, I am focusing on how signal processing equipment itself, not what it does, can be perceived as distinctive and iconic in a visual sense - just like architectural acoustic treatment. Similar to digital and analogue signal processing units used for recording and mixing, hardware mastering processors and converters have often been built to ensure a precise fit into studio racking space. Typically, outboard signal processing equipment will have also featured knob caps for potentiometers, LED indicators and standout faceplate designs. Horning (2013: 128) likened the appearance of the recording studio control room to a pilot's cockpit. In control rooms new and old, likewise in the mastering room, light will emit from conveniently arranged signal processing hardware. Today, light will also emit from computer screens that exhibit complex skeumorphic GUIs for DAW environments and software plugin emulations of signal processing hardware alike (see Meintjes 2012: 271). I argue that the aesthetic allure of these setups would have helped foster two things. First, the iconicity of more prominently talked about recording studios, and second, the creative aura of the 20th century

recording process. The better studied and documented recording process will have also been perceived in a more enigmatic sense, if even the technologically informed onlooker is unable to fully account for creative choices made by perceived "studio 'wizards'" or "impresario-producers" in command of their technologies (Anderton, Dubber & James 2013: 65; see also Horning 2013: 275). Meintjes (2012: 275) described this sort of phenomenology from her perspective as a recording studio ethnographer in South Africa. Her narratives reveal how pieces of studio equipment can be observed as complex and mysterious gateways to a perceived abundance of creative possibility:

> This sonic world encoded in complex electronics is more extensive than the object within which it resides. It is invisible but sensed to be of enormous proportion. The mathematical and electronic processes that encode it are as sophisticated as the face of their component's casing is simple. This interior world – the extensive and ephemeral residing in the complex and mathematical, yet presented as the small, intact, and simple – imbues the technology with an affecting presence. Its presence is further enhanced by the complex user interface that surrounds it. The multiple steps required for its operation […] and the elaborate lexicon that accompanies them inhibits contact with the object by all but the specialist. Technical lexicons enshroud objects and already opaque processes in mystery.

If mastering engineers command signal processing devices and setups akin to those used in conventional recording studios, then these sorts of accounts are telling of how their work and the tools that they use would be perceived by the layperson. Were mastering studios featured more through documentary or through the media, I argue that observers would see engineers who appear to work in creative symbiosis with such equipment, and who operate in "the zone" – a flow-like mindset that Banks (2014) discusses in relation to creativity. When I explored definitions of creativity in my introduction, I cited Csikszentmihalyi (1996), who said that when people are involved in creativity, they feel that they are "living more fully than during the rest of life" (see also 1990). I now acknowledge that recording studios may only appear enigmatic to only those who are inexperienced with how to use the technologies inside (see Meintjes 2012: 278). This prospect would be

advantageous to practitioners who may seek out various ways of upholding their status as creative experts. Case in point, Rodgers (2012: 476) cited Katz (2004: 114-136), McCartney (1995), Peebles (1996: 12) and demonstrated how mythical constructions are to be observed in the way producers or musicians themselves describe their use of equipment - "DJs 'battle'; a producer 'triggers' a sample with a 'controller', 'executes' a programming 'command,' types 'bang' to send a signal, and tries to prevent a 'crash'." Rodgers explained that the parlance of electronic music production culture is characterised by these sorts of military, space age and atomic metaphors. I observe similar tropes to be rife in wider cultures of studio-based production more generally, and I contend that this can contribute to the somewhat mysterious constructions of other creative audio engineering cultures. I note that it was Rodgers' primary objective to frame such allegorical language as a gendered issue; these sorts of vernacular draw from linguistic registers that are also shared with cultures and fandoms considered to be predominantly populated by those identifying as men (see also Keightley 1996).

Through this first part of *Chapter 1,* I have explored existing scholarship and concepts to make a case for studying the creative significance and meaning of architectural acoustics, as well as hardware equipment used in all creative stages of professional recorded music production – this including mastering. In drawing comparisons between the make-up of the mastering studio and the conventional recording studio, I have defended a need for more academics to study professional mastering as a creative culture of post-production. I will now dedicate the second part of *Chapter 1* to exploring ideas around digital developments that facilitate amateurs with better access to creative tools that can be used for the purpose of mastering, or else for recorded music production more generally. Here, I will also begin to problematise strands of discourse that commend all that is sonically, creatively and financially possible when operating away from established studio spaces, or strictly within DAW environments – 'in-the-box', as it is referred to colloquially (see Hawkins 2002). All this will serve as a useful way into my subsequent chapter. In *Chapter 2*, I will begin by examining issues of access to professional mastering, but this time in the context of cultural industries scholarship.

Creativity in-the-Box

In the introduction to my thesis, I explained that fast Internet connectivity and digital multitrack production has enabled patchworked, networked, remote and 'in-the-box' approaches to production in all areas of the market (see also Bregitzer 2009: 186-209; Edstron 2011; Hawkins 2002; Théberge 2004; Wyner 2013: 9-13). I also explained that potentially hundreds of label personnel, locations and engineers may now be involved in the pre-production or tracking of any one album; and then numerous in mixing. Théberge (2004) regarded modern recorded music production to be well networked, and he described recording studio setups as 'nodes' within such a network. Anderton, Dubber and James (2013: 65) later noted how, according to Leyshon (2009), the music production industry had disintegrated vertically. The node sits within an often so-termed 'democratic' landscape made up of many other nodes. Understanding this landscape justifies myself and others focusing on the mastering engineer as a sole agent who makes creative use of their dedicated studio and equipment for the critical reshaping of often globally dispersed, lengthy and cooperative efforts in tracking through to mixing (see Braddock et al. 2020; Cousins & Hepworth-Sawyer 2013: 54; Hepworth-Sawyer & Hodgson 2018; Shelvock 2017: 10; 26; Zak 2001: 49; 107). My research findings will show how familiarity with a physical acoustic space and monitoring setup still remains a high requisite for success through mastering. Under all these circumstances, I suggest that each song, track, take or overdub that pertains to a patchwork project will still share in a common thread that relates to the physical space used for mastering. Moreover, entire discographies can share in a common geographical relevance through mastering. In face of all this, it is valid to delve deeper into how accessibility to low-cost digital multitrack production has extended its way into mastering (see Collins et al. 2019: 261-262; Savage 2014; Turnidge 2012: 7-8). In a climate of low-cost digital multitrack production, the need to source mastering work from a well-established facility might be considered somewhat less essential. This prospect would apply more in the context of modern independent music and from the perspectives of those artists who reap lesser portions of music industry revenue.

Anderton, Dubber and James (2013: 64-65) addressed the fact that “amateurs” or “non-specialists” are now able to access creative recorded music production tools without the need to seek specialist help and often without paying fees (see also Moorefield 2010: xvi; Wikström 2009: 43; 123-124). First-hand, I have observed how ‘project studios’, supported by powerful computing hardware and network infrastructure, have been deemed sufficient for carrying out creative signal processing and producing high quality music at lower costs. Access to numerous instructional publications, online forums, communities, podcasts and video-sharing channels has supported the shift. Various social spaces and their gurus are legitimising and empowering amateur activity through participatory Internet environments. Rather than identifying these spaces, cultures and figures at the present, I will do so as part of my primary research in *Chapter 5.* There, I will theorise my autoethnographic reflections on continuing to develop professionally as a mastering engineer in the field. This self-reflection on my own mastering training and learning through online resources will offer first-hand and modern-day insight into professional mastering culture at points of skill acquisition, career access and development. My autoethnographic reflection will also show how particular routes into mastering can manifest in different approaches to creative decision-making, technical operation and professionalism.

Banks (2010: 315) stated that society is becoming increasingly “utopian/dystopian” in that the “workstation” is gradually beginning to substitute the traditional “workshop”; “music [and] post-production techniques have become largely possible to coordinate by an individual using a laptop” (see also Caldwell 2008: 157). I consider Banks’ outlook to be a useful entry into making sense of the sorts of ideals that underpin much of the marketing behind affordable technologies that allow mastering and creative music production techniques to be performed within ‘the box’. According to Fox (2004: 14), “mainstream marketing and packaging […] may contextualize digital propensities in a fashion that makes emulation of mainstream/professional media form and content (with the goal of someday becoming the next Spielberg) the brass ring of amateur producers.” I observe that these sorts of principles are also woven into discourse and industry media that continues to empower the amateur who seeks to engage with creative music production. These strands of discourse often commend all that is sonically,

creatively and financially possible when operating away from established studio spaces, or strictly within DAW and software plugin environments.

It is common knowledge amongst amateurs that the 'sonic signatures' of equipment, engineers and celebrated reverberant spaces have been digitally emulated to facilitate creative work within plugin environments. 'Sonic signature' is a term often used in a variety of ways when discussing the audible footprint a person or process can have on music. Sterne (2012b: 174) stated, "The material's sonic signature is […] crucial to the story", and this was amidst his discussions around phenomenological perceptions of music and sound in MPEG listening tests. Burgess (2014: 89) stated that British music producer and engineer Joe Meek (b. 1929, d. 1967) had "developed a distinctive lo-fi sonic signature reliant on heavy compression and reverb, optimizing his productions for listening on a transistor radio to AM radio." Zak (2001: 104) also used the term after making a statement that would encapsulate and inform some of the arguments I will set out most thoroughly through *Chapter 6*. Zak said:

> On the other side of the glass, in the control room, too, the quality of the sound image presented by the monitor loudspeakers is affected by the acoustical character of the space. The acoustical requirements here, however, are quite different. Just as the recording space affects the sound of a musical performance, the control room's acoustical character impinges on the perceptions upon which compositional decisions are based. But while a recording space's unique "sonic signature" may add a desirable distinctive personality to the performances recorded in it, mixing requires an acoustic environment whose character is as neutral as possible.

On the one hand, I suggest that if 'real world' studios or pieces of equipment are used to model and market digital plugin emulations, then this might feed back into the perceived creative significance of physical locations or hardware signal processing devices. Appreciation and recognition might also grow around the engineers who lend their skills for preset modeling. On the other hand, however, to endorse such activity would suggest that engineers believe a reverberant physical location or hardware signal processor can be emulated faithfully, and the meaning of outsourcing mastering to an established engineer at an established and

professionally equipped facility may thus diminish. A distinguished example of this paradox can be observed through the online promotion of a commercial plugin collection, developed by *WAVES Audio* in collaboration with *Abbey Road Studios.* This example also demonstrates how pro audio advertising promotes amateur engagement and empowerment, with the promise of users being able to creatively emulate the aesthetic, or 'sonic signature', of historic recordings. The following marketing excerpt offers a demonstration of these ideas, in addition to those set out by Fox (2004; see also Horning 2013: 78; 64-95; Doyle 2005).

> Developed in association with Abbey Road Studios, Waves' Abbey Road Collection features a lineup of exquisite plugins that meticulously model the fabled studios' legendary microphones, consoles, tape machines and signature effects, as heard on countless historic recordings and pop masterpieces.
>
> The Abbey Road Collection includes plugin models of the studios' famed REDD and TG12345 consoles, as well as RS56 Passive EQ ('the Curve Bender'), J37 Tape, Reel ADT, the King's Microphones, the Abbey Road Reverb Plates, and the one-of-a-kind Vinyl plugin which models Abbey Road's vinyl cutting and playback gear.
>
> - Recreates the inimitable sounds heard on many historic recordings and pop masterpieces
>
> - Modeled on the original, rare and often exclusive Abbey Road Studios hardware
>
> - Legendary sound, in-the-box and live on stage
>
> (*WAVES Audio* 2018, online)

For creative use in the context of both recording and mixing, *WAVES Audio* (2018b, online) claim to have produced "meticulous models" of reverberation plate characteristics that were originally developed by technicians at the famed studios over the latter half of the 20th century. *WAVES Audio* allude to the cultural significance of replicating these characteristics through their '*Abbey Road* Reverb

Plates' plugin, stating, "*Abbey Road* plates have been used on countless seminal pop, rock, classical and film recordings over the years, and continue to be used in all kinds of audio production to this day". Similarly, the '*Abbey Road* Vinyl' plugin enables its users to route their audio through digital emulations of the studios' historic disc cutting and playback equipment. This signal path emulation offers the option of routing audio through a simulation of *EMI*'s 'TG12410' mastering console for it to receive a mock inscription the console's sonic character (see *WAVES Audio* 2018c, online). Likewise, the 'J37 Tape' plugin enables the mock inscription of "the very machine used to record many of the greatest masterpieces in modern music" (see *WAVES Audio* 2018d, online). The 'RS56 Passive EQ' that also comes as part of the '*Abbey Road* Plugin Collection' is modeled on another piece of equipment used by the studios over the later 20th century to prepare mixes for disc cutting processes that gave way to wider forms of mastering, as it is understood today (see *WAVES Audio* 2018e, online).

I have offered *WAVES Audio's* 'Abbey Road Collection' as an example of how the promotion of digital plugin emulations could paradoxically accentuate and also mitigate the cultural significance of a famed studio complex. Another distinguished example of this paradox can be observed through the online promotion of 'Ocean Way Studios' - a commercial "dynamic room modelling plug-in", developed by *Universal Audio* in collaboration with studio owner and producer Allen Sides (see *MusicTech* 2013, online). There are other manufacturers who raise similar paradoxes. These manufacturers have developed and marketed digital plugin emulations with a more predominant focus on equipment or established practitioners. Speaking from the perspective of the amateur, I argue that these developments and marketing activities could legitimise the decision to avoid hiring a professional engineer. *Universal Audio* (2021, online) promote a series of plugins that are modeled on more recently engineered pieces of analogue mastering equipment. I observe that this cherished analogue hardware often retails upward from approximately £2500 per unit, and regularly features in professional mastering facilities, such as those operated by the engineers interviewed for my research. Sometimes priced at around two or three percent of the listings for their real world counterparts, *UA* offer economically attractive emulations of the *Chandler Limited* 'Curve Bender Mastering EQ', *Dangerous* 'BAX EQ' and *Shadow Hills Industries*

'Mastering Compressor'. *UA* also emulate the *Manley* 'Massive Passive EQ' and 'Variable Mu Limiter Compressor'. Software manufactures *iZotope* (2015, online) asked *Sterling Sound*'s esteemed 'Senior Mastering Engineer' Greg Calbi to develop and contribute a series of 'Greg Calbi Mastering Presets' for their 'Ozone' mastering plugin. The presets, "available to all Ozone users to help elevate their mixes to professional-sounding masters", are also described as having been "designed for [Calbi's] own projects". This marketing implies that the presets capture an essence of the engineer's skill, thus making Calbi's creative approach more accessible for amateurs to implement on their projects (see Collins et al. 2019: 258; see also Birtchnell & Elliott 2018: 80). *IK Multimedia* began to offer another mastering-oriented software plugin that also epitomised the sorts of paradox I have outlined. *IK Multimedia* developed 'Lurssen Mastering Console', also operable as a standalone application, in association with mastering engineers Gavin Lurssen and Reuben Cohen of *Lurssen Mastering* in Los Angeles. Like *iZotope*'s series of 'Greg Calbi Mastering Presets', Lurssen Mastering Console is designed to emulate the expertise and workflow of the established practitioner. In addition to this, and like the series of *UAD* plugins I referenced previously, the software is also modeled on costly mastering hardware used in the field. I suggest that the messages embedded in *IK Multimedia*'s promotion of Lurssen Mastering Console are evocative of those that emerge out of *iZotope*'s promotion of Ozone; that engineering expertise can be digitally emulated for wider audiences to access:

> Lurssen Mastering Console is a groundbreaking new mastering tool for either iPhone, iPad or Mac/PC that puts a lifetime's worth of professional mastering experience at your fingertips. […] It puts you at the controls in the studio with all of the secret tools, settings and techniques that have made the Lurssen sound so sought after by the world's top-tier recording artists and producers.
>
> [Lurssen Mastering Console] provides a complete emulation of the entire mastering processing chain used by world-renowned mastering engineers Gavin Lurssen and Reuben Cohen and their team. This chain includes tube equalizers, solid state equalizers, limiters, de-essers and solid state compressors. […] Lurssen Mastering Console models and recreates the

> interactions between the individual processors in its chain down to the actual gear hookup schematics themselves. This approach effectively gives you access to decades worth of knowledge in the form of workflow secrets, special techniques, signal chains and technical know-how.
>
> [Lurssen Mastering Console] comes with 40 unique mastering templates, called "Styles," that custom tailor its mastering processing chain for hip-hop, hard rock, heavy metal, country, Americana and more. These templates eliminate all the hard work of the mastering process; Gavin and his team have set everything up for you from the signal flow to the individual settings of each processor. […] Lurssen Mastering Console can help you achieve amazingly professional results even when a trip to Lurssen Mastering in Los Angeles just isn't in the budget.
>
> (*IK Multimedia* 2019, online)

Plugins such as those offered by *Waves AUDIO, Universal Audio*, *iZotope* and *IK Multimedia* make up just a scattering of the abundant mixing or mastering emulations competing for custom and positive discussion through online forums, communities, podcasts or video-sharing channels. Moreover, these emulations are up against a wealth of accessible open-source or freeware alternatives that will unquestionably repress economic barriers to engaging in creative mixing and mastering processes. I observe that discussion around these sorts of emulations began to proliferate in conjunction with the improvement of processing power in 21st century home computers. Pro audio industry media also found ways to highlight the positive prospects of utilising project setups, away from familiar or famed studio locations. At the turn of the century, reportings began to emphasise what could be achieved through subverting the established norm and adopting more networked or nomadic approaches to production in the digital age. Various interviews would indicate that established practitioners began to follow suit, and I will now show how coverage of these sorts of patterns would extend its way into mastering. These more networked or more portable approaches to professional practice occurred in the face of a longstanding ethos still fostered by professionals - to operate only in familiar spaces and with known monitoring setups. To quote Hepworth-Sawyer (in Hepworth-Sawyer & Hodgson 2018: 273), "It's getting to

know the speakers and the room inside out that takes investment – personal investment. Only with that investment comes confidence. Confidence means results." I will explore this ethos for effective practice more thoroughly via *Chapter 6*.

Back in September 2015, I studied a 12-year-old article and discussion featuring British mastering engineer Jon Astley of *Close To The Edge.* The article and discussion had been authored and conducted by Jonathan Miller (2003) of *Audio Media* magazine. I read this prior to my own interview with Astley that took place in the same month. Through Miller and Astley's discussions, I learned that American singer-songwriter Tori Amos had requested the Twickenham engineer to master 'From the Choirgirl Hotel' (1998) off location at *Martian Engineering* in Cornwall; an approach Astley, quote Miller (2003), "has been only too happy to repeat ever since". Also in *Chapter 6*, I will explore how Astley's attitude toward such manners of working had changed somewhat by 2015. Similarly, challenging the mastering status quo in terms of sticking to one location was a prevalent theme in Mandy Parnell's interview with Sam Inglis (2012, online) of *Sound on Sound*. "The mastering engineer's role is changing", wrote Inglis. This statement was made in regard to how the London-based engineer had assisted singer-songwriter Björk Guðmundsdóttir complete her studio album 'Biophilia' (see *Björk* 2011) in Iceland. In the interview for *SoS,* Parnell revealed that her staple signal processing chain for mastering had been transferred to *Ö&Ö - Addi 800*'s studio in Reykjavik. Yet, Parnell would use *Ö&Ö*'s resident *Barefoot* MM27 studio monitors and *Genelec* subwoofer when mastering the project in the city. Whilst Parnell described how she "realigned Addi's *Barefoots* listening to lots of references while tweaking, so that they felt closer to [her] listening environment in [her] studio", the concept remained at odds again with the purported requisite for effective professional practice in mastering - to operate only in familiar spaces and with known monitoring setups. Parnell's approach to mastering Biophillia garnered additional publicity from equipment manufacturer and software designer *SADiE* (n.d., online), who used the story as a promotional vehicle for marketing a "box of tricks" the engineer had assembled with the support of the *Prism Sound* team. This box of tricks comprised of a *Prism Sound* Orpheus audio interface and "the latest *SADiE* 6 software."

I will conclude this chapter by reiterating that my findings will prove how professional mastering expertise, equipment and established studios all remain in high demand. This is in spite of discourse commending all that is possible through fast Internet connection and digital technologies that facilitate low-cost opportunities for amateurs to engage in creative mastering processes. This is also in spite of industry media fetishising the novelty of more networked or nomadic approaches to production and post-production in the modern era. It has been my resolve to shine a light on these challenges through the second part of *Chapter 1.* I now suggest that fast Internet connectivity and digital multitrack production may be considered as benefits, rather than just threats to the professional mastering community. Digital and networked technologies began to offer mastering engineers ever-increasing means through which they could project or engage with expertise. These technologies are also used to transfer large digital files. Sterne and Razlogova (2021: 8) have recently offered a telling reflection. They said, "Though hardware and software existed for DIY mastering, it remained largely a practice done by specialists, or not at all. […] Mastering presets in software were more successful (probably because the software was less expensive and widely pirated) but still did not fully bring mastering into the DIY world, at least not compared with audio engineering or promotion."

Before moving on, I do wish to spell out how problematic it would be to conceive that recorded music production has only recently, for the first time in history, become a more accessible convention. Horning (2013: 61-63) informs that even the early home 'recordist' would operate on an amateur level using their own equipment prior to the post-WWII boom of independent recording studios that subsequently embraced multitrack-recording. By 1932, home recording rose to a level of popularity that made "*Radio-Craft* [publishing] *Home Recording and All about It*" justifiable (see Saliba 1932). At this earlier point in time, manufacturers of disc-recording equipment targeted the amateur market. Out of all this, the demand to seek expertise had similarly endured. Nevertheless, it is logical to state that although amateur production should not be considered a recent convention, the ability to inexpensively create what are considered to be 'high quality' productions or post-productions from non-specialist locations is relatively new. But Eric Wenocur (in Fox 2004: 15) seemingly took a stand to the notion of technical and

creative expertise being easier to facilitate in alternative spaces. In the context of video post-production, this audio and video professional implored:

> It is one thing to use Final Cut Pro to circumvent professional routes of top-down media production; quite another to think that owning a desktop editing system entitles or qualifies one to seek employ, and thus professional status, within the mainstream/professional media structure.

These are the types of industry attitudes that support further study into the cultural and creative significances of professional mastering engineers, their equipment and studio space. It is important to know about such attitudes, as they feed into debate regarding whether high levels of quality and creativity can be generated at lesser costs and away from established locations. Attitudes such as Wenocur's might construct practices of production and post-production as creative endeavors that should be learned only through members of the established culture offering hands-on experience and closer degrees of mentorship.

Chapter 2: Mastering as Creative Labour in the Cultural Industries

Research around creative labour in the cultural industries has supported my view that mastering is a creative practice, and it has also helped uncover some key issues that professionals may contend with in their working lives. The first purpose of this chapter, after I have contextualised mastering as creative labour, is to highlight issues of precarious work and career access. I do this in the first section. In the second section, *Culture and Economics*, I establish further understandings of professional mastering work from cultural and economic perspectives. I will begin to theorise how various forces and industrial tensions can bear influence on creative approaches to the day-to-day mastering of recorded music. In the third and final section, *Agency and Digital*, I will use mastering and the so-called 'loudness war' to draw further attention to issues of creative agency and professional autonomy. This highlights a relationship between digital technologies, capital, the political economy of the cultural industries and creative aesthetics in mastering. All this will show how, as is the case with other cultures of production or post-production, creative autonomy can be defined by the affordant qualities of certain digital technologies and how capital might flow within the wider media industries. I suggest that if creativity is defined aggressively by such forces, then this could work against efforts to achieve much broader appreciations of mastering engineers as sole agents who make creative use of their studios and equipment for the critical reshaping of often globally dispersed, lengthy and cooperative efforts in tracking through to mixing.

As a whole, *Chapter 2* lays theoretical groundwork for *Chapter 5*, where I draw on original interview and autoethnography data to explain how mastering careers are accessed, how mastering can be learned and how engineers operate as creative experts in the wider music industries. *Chapter 2* also lays theoretical groundwork for *Chapter 6*, where I examine creativity in mastering and how engineers make creative use of studio space and tools. My work in all of these chapters addresses my second research question. My second research question queries how the study

of professional mastering culture can aid a better understanding and theorising of creative labour in the cultural industries.

Precarity and Access

Hesmondhalgh (2007: 12-15) positioned "the music recording and publishing industries" as a collective that deals in the production of culture to deliver "social meaning". That is; industry output is intended to connect with consumers and their emotions. If mastering forms part of the creative recorded music production process, then Hesmondhalgh's logic would frame mastering as a sub-process in the production of 'social meaning'. In order to compartmentalise institutions that are set up to deliver cultural or social meaning, Hesmondhalgh expressed a preference for the term 'cultural industries' over 'entertainment industries', 'media industries' and 'creative industries'. However, I observe other scholars will regularly use these terminologies synonymously and interchangeably. As is the case, I argue that when Deuze (2007: 1-44) located the 'creative industries' and 'media work' in a so-called 'sphere' of characteristically precarious and unstructured labour, then by definition, the realities of this sphere became applicable to Hesmondhalgh's collective of cultural industries – such that would encompass mastering.

Deuze (2007) built upon a framework set out by Bauman (2005), who presented a concept of contemporary 'liquid life'. This is a life in which contract deals are short, fixed salaries or hours are no longer conventional, and there are blurred boundaries between life, work and play. Deuze drew parallels between circumstances in his own precarious sphere and Bauman's (2005: 1) depiction of circumstances in a "liquid modern society"; "the conditions under which [people] act change faster than it takes the ways of acting to consolidate into habits and routines". Deuze (45-83) also described his sphere as one in which workers will lack autonomy, if exposed to "external pressures, influences and constraints" (82). In *Creative Labour: Media Work in Three Cultural Industries,* Hesmondhalgh and Baker (2011) surveyed numerous cultural industry workers. These workers offered accounts that were

illustrative of the precarious and fluid conditions set out by Deuze.[1] Harking back to Hesmondhalgh's (2007) earlier work, both authors of *Creative Labour* explained that their title term denoted "creative work in the cultural industries" (see Hesmondhalgh & Baker 2011: 9).

Each source I have cited so far has achieved high esteem in the field and fields related to the broad Media and Cultural Studies paradigm. Still today, I suggest that these sources offer a valuable way into forming scholarly understandings of professional culture in mastering, when this is recognised as creative labour. Furthermore, *Creative Labour* (Hesmondhalgh & Baker 2011) offers insight into the broad lifestyles and not simply the professional lives led by practitioners who operate in the cultural industries. In turn, my exploration into the understudied cultures of professional mastering will enrich this scholarship and other fields related to the Media and Cultural Studies paradigm. I argue that making sense of a mastering engineer's work and livelihood will significantly inform understandings of creative labour at the point where production and consumption intersect. This is important because whilst some careers are traditionally associated with technical labour and manufacture, there might in fact be some distinct creative elements of post-production that impact greatly on the sensory aspects of end products.

Hesmondhalgh and Baker (2011) also explored how present-day demand for employment in creative fields of work will tend to outweigh opportunity for access. This is of particular concern to aspiring practitioners. Furthermore, junior worker salaries are seldom generous, and low-paid or voluntary internships often form obligatory beginnings of pathways to professional status. Hesmondhalgh and Baker (2011: 158) framed such obstacles as class barriers. They stated, "the need to do long periods of unpaid work to get access to rewarding and fulfilling employment means that people from working-class families are unlikely to gain access". If my research shows that engineers hoping to gain traction in the mastering industry were met by these sorts of conditions over the latter half of the 20th century and on into the 21st, then this scholarship may offer some inklings into the socio-economic make-up of accomplished aspirants who operate in and amongst today's culture of professionals. When mastering is understood as creative labour, this scholarship

[1] See also: Hesmondhalgh ed. 2006; Hesmondhalgh 2007; Krikortz, Triisberg & Henriksson 2015

also frames the field as one in which today's culture of processionals could 'self-actualise' and carry out stimulating work, were they to eventually maintain stable careers (see Hesmondhalgh & Baker 2011: 33).

Historic discourses and political fundamentals have worked to differentiate men's and women's working lives, in addition to their social lives and capabilities. As a consequence, gendered issues will have also presented as barriers to accessing paid creative work in cultural industries of the Western world (see Hesmondhalgh and Baker 2011: 147; Willis and Dex 2003: 124-131). Mavis Bayton (1998: 7) expressed that feminist musicians were troubled by the scarcity of "women technicians" in their industry. *Women's Audio Mission* (2021) calculated the degree of this scarcity today, stating that "women/gender non-conforming (GNC) individuals" make up fewer than 5% of the audio industry workforce. I referenced the work of Rodgers (2012) in *Chapter 1.* Rodgers found that the sorts of allegorical dialects employed in technological discussions of modern audio production draw from linguistic registers that are also shared with cultures and fandoms considered to be predominantly populated by those who identify as men (see also Keightley 1996). Again, this is scholarship that may help us to form understandings around the socio-economic make-up of accomplished aspirants who operate in and amongst today's culture of professionals.

Having breached matters of dialect, I will now draw from Porcello's (2004) research to consider how there might be vernaculars that we can associate with two particular stages of professional development in mastering. The first stage being one where engineers would hope to gain access to a career, and the second, closely related, being one where engineers are educated and propelled further towards expert status in the field. I suggest that access to mastering and the subsequent attainment of expert status through education are matters that would both be influenced by a developing engineer's ability to draw from specific registers of professional and technical vernacular in practise. These abilities would be socially defined. Porcello drew conclusions from his own analyses of practitioner behaviour within a Texan recording studio, between the years 1993 and 1994. The studio was operated as an educational recording space by day, and as a commercial recording space by night. Porcello identified the extent to which an audio engineer is

perceived capable as something inextricably bound to “competence with multiple linguistic resources” when acting in the professional setting. His study also identified that more experienced practitioners will adjudicate the suitability of a student engineer’s professional and technical dialect for their subsequent integration into the workplace. Porcello concluded, “learning to be a sound engineer must be thought of in great part as a process in learning to speak like one” (734-735). Porcello arrived at this assumption after his research demonstrated there to be tense generational divides between older and more experienced engineers on the one hand, and younger students on the other. Porcello recognised that tension occurred as a result of there being differences in the characteristics of professional and technical vernacular that each generation put into practise. He found that senior practitioners would challenge junior practitioners for using newer linguistic conventions. Porcello (736) acknowledged the “partial demise of many independently owned recording studios” – such that transpired toward the end of the 20th century. He qualified that this demise happened as a consequence of developments in digital audio equipment design, alongside increased computing efficiency and affordability. With these developments came an upsurge, he noticed, in US colleges granting specialist audio engineering degrees throughout the 1980s and onwards. Hence, Porcello explained, academic institutional training models began to replace traditional models of access through apprenticeship. Through Porcello I have gleaned that institutional training might have better facilitated ‘language acquisition’, whereas ‘language socialisation’ transpired through older and more vocational training models (740). Those subject to institutional training might have conveyed sonic phenomena through association or reference; those older employed metaphor or onomatopoeia.

Ultimately, I felt that Porcello’s study raised a series of important questions that underlined the importance of studying mastering as a creative profession. First, I did question whether prospective clients or those acting as gatekeepers to paid mastering work would value practitioners who had engaged in particular training models and who had involved themselves with particular pathways to professional status. Were this true, we could hypothesise that such outlooks might impact on how mastering services are advertised publicly. Having understood that varied approaches to learning are thought to be manifest in the vernaculars adopted by

engineers, I began to also question whether varied approaches to learning professional or technical practice are audibly manifest in an engineer's creative output. This particular question will be addressed via my autoethnography findings set out through *Chapter 5*. I note that Porcello's observations were made prior to 1994, and whilst they are still valid, I have observed newer pathways to accessing knowledge become more accessible throughout digital and Internet landscapes. Prospective engineers are now commonly exposed to more fluid conditions of learning, whereby knowledge gained in formal education will complement processes of learning to be an audio engineer through assistantship, self-direction or starting out alone. These are matters and pathways I will also address via original research findings set out in *Chapter 5*.

If today's aspiring mastering engineer engages in mixed approaches to access and learning, then I argue this to bode well for their practise. This is because creative mastering, as existing literature has helped us understand it up until now, will require that workers employ a mix of technical skill and tacit knowledge in the field.[1] Referring to the work of 'recording engineers', Horning (2004) explained that technical ability is typically developed through formal training, whereas practise-based experience will sharpen one's tacit skills. Horning deemed formal training, "necessary for the operation of technically complex equipment" (703); tacit knowledge a requisite for "the art of microphoning, aural thinking, and the ability to negotiate with artists and producers in the studio" (721). As microphone technique is of lesser use to mastering engineers in practise, I propose an equivalent skill that that is relevant to their specialty - deciding which equipment to use when gain staging. Broadly speaking, 'gain staging' refers to how analogue signal processing equipment may be used and placed into circuit thus introducing components such as valves and transformers, each of which offer a distinct sound. Adjustments might only be made to the equipment's input and output voltage parameters. Adjustments are not necessarily made to other parameters such as equalisation frequencies or

[1] The term 'tacit knowledge' is used to signify the conceivably intuitive and fast implementation of refined skill to good effect, but without common means of conveying process or rationale (see Horning 2004; Polanyi 1958; 1966). Patel (2018: 14) cited Dreyfus and Dreyfus (1986), who upheld that expertise permeates the everyday. The authors expressed that the conceivably complex work of 'everyday' experts is something the experts themselves carry out with ease (see also Boyd & Addis 2010).

compression speeds. Gain staging can also be performed in the digital domain. As I intend to explore gain staging as a creative process later on in my thesis, it will be relevant to consider tacit knowledge as a requisite for creative mastering. Furthermore, like tracking and mixing, mastering is a practice that may encompass the tacit proficiencies of 'aural thinking' (creativity) and 'the ability to negotiate with artists and producers in the studio' (professionalism).

Culture and Economics

I will now establish further understandings of professional mastering work from cultural and economic perspectives. In the previous section, I embraced 'cultural industries' as Hesmondhalgh's (2007: 12-15) preferred term to collectivise a variety of organisational terrains that would include, in his terms, "the music recording and publishing industries". 'Cultural industries', Hesmondhalgh reasoned, "invokes a certain tradition of thinking about [...] relationships between culture, economics, texts and industry, meaning and function". In contrast to Hesmondhalgh, political economist Patrik Wikstrom (2009: 12) felt that "the contemporary music industry", his expression, "is best understood as a 'copyright industry'." And he explained, "the most common way to define an industry is to refer to the output from the industrial activity" (46-7). For Wikstrom, the definitive output of recorded music production is not culture, but the copyright protected commodity; "copyright legislation is what makes it possible to commodify a musical work" (17). Wikstrom cited Negus' (1992) view of the music industry essentially serving to develop "musical content and personalities"; all this can then be licensed to earn money through protection offered by copyright legislation.

I have established that mastering should be more widely studied and appreciated as the critical and creative determination of a recording's sonic timbre and aesthetic. Despite mastering being important in this way, it is not typical for mastering engineers or studios to collect royalties via unit sales (see Waddell 2013: 163). As is the case, a mastering engineer's payment structure will differ from the payment structures of other figures who are credited for their creative involvement in the

whole recorded music production process – songwriters, 'producers' et cetera. Mastering engineers or studios will usually invoice a fixed duty charge, and value will relate more to the amount of time or labour necessary for carrying out a variety of services. Without an agreed royalty payment structure in place, a mastering engineer's fee, a project's chart success and its economic yield will not directly correlate. That is, an early-career mastering engineer might charge a small, one-time fee to master a record that would ultimately enjoy chart successes and high payouts from unit sales or royalties. If motivations to secure mastering work cannot be attributed to the prospect of earning money from records that triumph greatly through copyright exploitation, then this calls for us to explore social and cultural capital – two out of three capital forms outlined by Bourdieu (1986). We might also consider how mastering engineers are motivated to work on projects or genres that they themselves enjoy and that represent their own musical tastes. In *Chapter 5*, I will explore credits and other non-financial assets that can help identify engineers as creative experts. With all this being said, it would be wrong to dismiss the potential for mastering to be considered an economically lucrative career choice. We must not also assume that economic incentives would fail to motivate professionals whatsoever – engineers need to pay their overheads and high-profile clients will likely pay higher hourly rates or higher fees on a per-track basis. Whilst income models may differentiate mastering engineers from other creatively involved recorded music industry personnel, charging fixed fees for mastering is not necessarily dissimilar to how payment is requested by other professionals in the wider creative and cultural industries. As with other forms of service in these industries, I suggest that establishing a fee or value (often per song, per album or by the hour in mastering) is made complicated if the worker is understood as an expert performer of tacit knowledge and creativity ("displaying, using, or involving imagination or original ideas" *Oxford English Dictionary* 2022b), rather than simple or technical procedure.

Just previously, I set out two definitions offered by Hesmondhalgh and Wikstrom; the 'cultural industries' and the 'copyright industry'. When thinking about the contrast between these definitions and their implications, I had been reminded of conflicting attitudes that can uphold or deny capitalist and profit-maximising

agendas will constrain autonomous labour and creativity.[1] Some will assert that 'authentic' practices are inhibited through environments governed by commerce and extreme profit-driven motives. Addressing this notion, Hesmondhalgh and Baker (2011: 26-27; 182) drew from a series of what I have perceived as Marxist standpoints. From these standpoints, one might view capitalism to be the cause of creatively restricted and compliant output; the practitioner is, in Marx's terms, 'alienated' from their authentic manners of working (see also Christman 2009, online; Marx 1959/1844: 30; Ryan 1992). As I progress through this section, I will begin to dissect ways through which external motives of profit-maximisation could manifest in varying approaches to creativity and professionalism through mastering. If an engineer's creativity is defined or controlled aggressively by external motives of profit-maximisation, then this may work against efforts to achieve broader appreciations of this figure as a sole agent who makes creative use of their studio and equipment for the critical reshaping of recorded music.

Before I begin to explore the relationship between profit-maximisation and creativity in mastering, it will be useful for me to first frame these issues in the context of wider recorded music production. The recorded music industry is recurrently portrayed as an 'oligopolistic' structure, in which a small number of major record labels thrive through focusing on the success of their profit-maximisation strategies and fulfilling mass consumer demand (see Bishop 2005). On the contrary, large numbers of independent labels are said to promote contrasting ideologies. They are also said to focus less on profit-maximisation and hence recoup fewer royalty payments through aggressive exploitations of copyright (see Anderton, Dubber & James 2013: 6-7).[2] Whilst these popular narratives will often depict major record labels as institutions that sacrifice creative 'integrity' and social meaning in order to generate profit via the mainstream, I argue that the realities and the political economic conditions are less likely to be so clear-cut. In the context of mastering, I discourage from adopting a hard view that engineers operate either with complete

[1] In whatever capacity, these dynamics are addressed or surface through: Adorno 1941; Adorno & Horkheimer 1979; Banks 2007; Becker 1951; Frow 1997; Hesmondhalgh & Baker 2011; Negus 1992; Negus & Pickering 2004; Ray & Sayer 1999; Slater & Tonkiss 2000; Smulyan 1994; Wikstrom 2009: 28

[2] See also: Gander and Rieple 2002; Krasilovsky & Shemel 2007; Negus 1999: 62; Wall 2003: 119- 22; Wikström 2009: 12

creative autonomy, or else under total governance via a client's uncompromising profit maximising strategy. Moreover, various other media institutions are stakeholders in and have influence over particular creative aspects of popular music output. I propose that relationships put in place between smaller record labels and larger media corporations may engender influences over approaches taken by those operating in creative roles within record production. These sorts of influences may be subject to a range of different agendas. I am saying that any number of interrelated media industries can impose a variety of demands that have the potential to govern the creative or economic strategies of record labels and how they request work to be completed by mastering engineers. I suggest that this understanding can be grasped through the work of political economist J. Mark Percival (2011).

Percival challenged the popular assumption that commercial radio stations and record labels form essentially synergetic relationships, where the balances of power are equal (see Wall 2003: 141-8; Hutchinson, Macy & Allen 2010: 168-9). He also explained that commercial radio stations recoup by means of offering audiences to paying advertisers, and that sparse numbers of radio playlist slots across daily broadcast schedules are met with a vast reserve of new and catalogue recordings competing for space. With the need to attract listeners in order to thrive, stations are dominant forces of power in selecting, approving or rejecting content. Stations are also in a position to influence, according to Percival (2011: 455), "the production of popular music recordings (the actual sounds on the records)". Percival (468) also explained how, from the radio industry's perspective, "there is ambiguity about whether it is the song or the mix of the song that is actually 'great'." From all this, I assert that the aesthetics bestowed through mastering could be influenced, in part, by the radio programme director's concept of 'radio friendly sound' for retaining audience tune-ins (see Katz 2002: 271-4). I argue that Percival's perspectives help to expose just one facet in a complex web of cultural industry forces that might have helped shape a mastering engineer's close and creative work with popular music, in addition to how professional mastering cultures have operated more generally. His concepts would also discourage an understanding of mastering engineers as exclusive and autonomous gatekeepers between all that happens in the recording studio and all that is heard by the consumer (see Hodgson 2010: 190).

It is, at this stage, valuable to acknowledge the essential politics of a so-called 'loudness war' phenomenon that has often been attributed with the mastering engineer. Through Katz (2002: 86-132; 185-196), Milner (2010: 237-292) and Vickers (2010), I observed that the term 'loudness war' emerged to describe how recorded music industry personnel began exploiting the affordances of digital audio to ensure new music releases competed, in terms of perceived loudness or level, when played alongside earlier releases or other releases contesting for chart space and attention in passive listening environments. I suggest that this is a useful and non-deterministic framing of the phenomenon; it does not render individuals in society as incapable of deciding how they respond to technological developments (see Anderton, Dubber & James 2013: 17). Competitive leveling has involved the aggressive narrowing of a recording's programme loudness or 'dynamic range'; the RMS average difference in amplitude between loud and quiet signals that represent musical passages played out over time. Most crucially, this processing is said to transpire in mastering and sometimes against the will of the engineer. The processing is also claimed to sacrifice 'fidelity' - a deeply problematic term, as identified by Devine (2012; 2013). Levitin (2006: 69-70) defined those who consider dynamic range as a key aspect of high quality recordings as "critics" (see also Devine 2013: 164-5). Discourses surrounding the issue of loudness in mastering indicated that the supposedly positive and creative contributions of mastering engineers were being held in question. Thus, efforts originated to start raising public awareness of the purported 'issue' that was excessive loudness brought about through mastering. These efforts continue to be shown through formal industry conventions, organisations, the ongoing development of technical 'standards' and formal white papers to encourage changes in professional practice. Mastering engineers themselves are also known for contributing to or problematising the anti-loudness campaign.

The loudness war phenomenon has proven that various forces and institutions within the cultural industries have influenced a mastering engineer's creative agency in their work with recorded music. Mastering engineers have offered telling accounts of how external pressures can encroach on autonomy in day-to-day practice when it comes to achieving a desired level of perceived loudness.

Speaking with former *BBC Radio 1* DJ Zane Lowe, mastering engineer Scott Hull (in Lowe et al. 2013, 3m47s) said,

> producers' instructions come to me... [...] "I want this to be one of the loudest records that's on the radio this year. We've recorded it that way, we produced it that way, we mixed it that way, we want it mastered that way."

Mastering engineer Kevin Metcalfe (in Davies 2010) implied that his peers could risk losing custom if they were to defend creative agency and discard client requests.

> You can say that it will sound better if you don't [push up the levels], but at the end of the day if you don't do it [clients] could go somewhere else that will.

My research will prove that respected engineers demonstrate substantial levels of emotional investment in their creative output. I suggest that many engineers would wish to continue pushing against what are often seen as requests that could have a negative impact on the perceived integrity of recorded music. It is important we note how efforts to raise public awareness of excessive loudness in record production could be understood as just one way of mastering engineers signalling their expertise and emotional investment in music as a form of creative expression. This is not to suggest, however, that mastering engineers have no sincere investment in the creative or emotional integrity of their output. Rather, as we can garner through a series of interviews previously conducted by Owsinski (2008), mastering practitioners do typically express an enthusiasm for delivering what Hesmondhalgh (2007: 12-15) termed "social meaning" through sonic excellence. A mastering engineer's reflections on day-to-day labour might be compared with similar reflections offered by songwriters, who operate from the opposite end of the recorded music production chain. Barber and Long (2014) examined how songwriters describe that their work often derives from an ability to take genuinely held feelings and articulate them into song. These sorts of narratives feed back into the identity of the workers in question and allow them to self-actualise. Barber and Long established that "the core of [songwriting] deals in emotion, attempting to articulate feelings in recognizable, tradable form." Through the series of interviews conducted by Owsinski (2008), mastering engineers explained their efforts to

embrace and enhance meaning embedded within this form. Greg Calbi said, “I just go with the spirit of what was given to me” (161). Bernie Grundman stated, “the music really has to tell you where to go”; “the real question is whether it’s really communicating better musically? Emotionally?” (190). Grundman also said that an engineer should “be willing to open [themself] up to wherever it is that the artist is trying to go with their music or whatever he’s trying to communicate” (196). Mastering, he concluded, “is more than just knowing how to manipulate the sound” (197). I argue that these sorts of discussions establish the mastering engineer’s understanding of day-to-day labour as meaningful creative practice (see also Collins et al. 2019: 266).

In the face of all this, it is still important to remember that engineers might be motivated by capital gain to support livelihood or maintain studio assets. Hesmondhalgh and Baker (2011: 95) addressed the motives of ‘producers’, and they offered a useful reflection on Bourdieu (1996). Hesmondhalgh and Baker stated, “there will be producers who are oriented towards restricted audiences, […] emphasising autonomy”; “there will be other producers who are oriented towards larger-scale production”. Cultural industry workers such as producers, and I suggest mastering engineers, may not simply and wholly identify with one out of these two clear-cut divisions. I assert that the orientations or motivations of cultural industry workers are likely to be more fluid, shifting in accordance with the times and situations at hand. Earlier in their text, Hesmondhalgh and Baker (2011: 40) had advised that no professional life may truly be autonomous; that professional life may vary in the degree of autonomy imposed upon it. The authors also referenced the work of Negus and Pickering (2004), who suggested three perspectives on the relationship ‘art’ may hold with ‘commerce’; the third, in Hesmondhalgh and Baker’s terms, “a sociological position that commerce and creativity have become so inextricably bound together as to be indistinguishable” (85). An additional perspective to consider is that capitalist and profit-focused institutions might in fact grant agency for creatives to perform with enough stylistic individuality to thus ensure a variety of musical works are not made overly similar or standardised (82-84; see also Ryan 1992). Matters of money aside, Hesmondhalgh and Baker’s (214-8) research conveyed that creative workers can be motivated by the prospect of reaching out to a substantial audience base; projects that score high chart

positions or sales figures may allow them to self-actualise and validate their creative development through named credit.

The scholarship I have cited throughout this section helped me to identify professional mastering as a culture exposed to similar economic tensions and driven by the similar sorts of motivations described by workers more widely deemed 'creative' in the recorded music industry. I have shone a light on the impact of media industry culture and its economic structures on approaches to mastering sound. I will now use mastering and the so-called 'loudness war' to draw further attention to issues of creative agency and professional autonomy.

Agency and Digital

Milner (2010: 290) documented the loudness war phenomenon as part of his written history of a social quest for excellence through 20th and 21st century recorded music production. He regarded the loudness war as "a very American phenomenon – like Tardon Feathered says, capitalism rules". As I expressed previously, the loudness war arose out of a belief that recordings with lower RMS average differences in amplitude (dynamic range) would be heard more prominently and thus receive greater attention in passive or more sonically polluted listening environments. Many industry figures and artists alike also assumed that recordings with lesser dynamic ranges would correlate with increased unit sales. All this was based on the premise that peak output levels would always be consistent - the gradual lessening of RMS average amplitude through mixing and mastering escalated prior to the mass integration and development of algorithmic 'loudness normalisation' in software and services such as *iTunes* or *Spotify.* These sorts of algorithms will essentially adjust the consistency of playback level for each release being played or streamed, and this is proposed to result in more stable perceptions of loudness across a selection of recordings. Without playback normalisation, recordings that are subjected to methods of dynamic range processing for the aggressive lowering of RMS average amplitude are often perceived to sound better in certain situations but for an initial period of time only. When people listen to

recordings with a substantially lower RMS average amplitude for a more prolonged period of time this is said to induce 'listening fatigue' (see Katz 2002: 86-132; 185-196; Mayfield 2006, online; Rowan 2002, online; Vickers 2010: 8-10). Vickers (2010) presented further evidence that would outline the loudness war phenomenon as a threat to auditory health. He quoted mastering engineers Bob Ludwig and Bob Speer, hinting that the loudness war could actually spark further recorded music industry decline (13-15). Competitive leveling began to surface as a manifestation of profit-maximisation strategies that would focus on quick, short-term capital gain. Still today, I observe that these sorts of strategies are seen as a threat to the perceived 'quality' of recorded music; the sphere of media work, as portrayed by Deuze (2007: 82), is still recognised as being marred with "external pressure, influences and constraints" that threaten autonomy.

I have already established that digital formats and the digital audio domain, by their very specification, afforded greater freedom for creative decisions to be enacted by wider cultures of artists, producers and mastering engineers alike. Prior to the rise of digital and compact disc, other physical formats had posed limitations on the sonic possibilities that could be explored and translated into a medium for playback. When mastering engineer Eddy Schreyer (in Owsinski 2008: 247) explained that the digital audio domain enables engineers to "almost do anything […] and get away with it", I felt that he had captured an essence of how contemporary music production in the digital age is still understood by various groups of recording enthusiasts and popular music fans alike. As with the studio hardware described by Meintjes (2012: 271), I observe that DAWs are likewise perceived as a gateway for boundless creative potential; a "sonic world […] more extensive than the object within which it resides." But in something of an ironic twist, professional engineers still often feel pressured to exploit the affordances of a tolerant digital domain by aggressively lessening dynamic range for the production of digital recordings that are perceptually 'louder' when played alongside competing releases at consistent playback levels and without playback normalisation. I suggest that this alienates them from some of the autonomous ideals of digital and whatever degree of freedom they might otherwise have over shaping loudness phenomena in the digital domain.

As mastering engineers saw the 20th century give way to a new millennium, their scorn against digital did not seem to emerge as regular disdain for the economic hit of piracy and peer-to-peer (P2P) file sharing. For one thing, digital music piracy and P2P file sharing would have more direct financial consequences for those who yield royalty earnings via copyrighted unit sales. Rather, in the face of society's most recent digital developments, strings of conventions, organisations, standards and formal white papers arose partly out of the mastering community and as a way of raising levels of public awareness concerning loudness, together with the issue of aggressively lowering the RMS average amplitude (dynamic range) across recordings.[1] I observed that the practice of aggressively lowering RMS average amplitude in digital mixing and mastering would eventually be dubbed as 'hypercompression'. The common tools that could be used for this lowering of RMS average amplitude and the engendering of hypercompression across a recording will be introduced in my next chapter. This forms part of my explorations into how creative practices and processes in mastering might influence social responses to everyday music. For now, I feel that it is essential to simply acknowledge the fact that professional engineers began developing anti-loudness campaigns, loudness standards and calling for changes in professional practice through avenues such as industry convention or online fora.

At the turn of the 21st century, Bob Katz (2002: 189-191) put forward the 'K-System' standard, whereby mastering engineers would perform their work in accordance with one of three metering calibrations pertinent to various musical genres. Both the K-System and an alternate metering system recommended by *European Broadcasting Union* (2011; see also 2020) were integrated for optional use as part of *Pro Tools 11* – a former major version of what I had observed to be heralded as an 'industry standard' DAW (see Avid 2013, online). Katz also cooperated in founding *Music Loudness Alliance* (2014) – a group set up to explore the possibilities of loudness normalisation and its implementation in playback

[1] See: Bitran 2012, online; Camerer 2010, online; Dynamic Range Day 2014, online; *European Broadcasting Union* 2011; 2020; Jones 2005, online; Katz 2000; Katz 2002: 189-191; Music Loudness Alliance 2012, online; Music Loudness Alliance 2014, online; National Public Radio 2009; Pleasurize Music Foundation 2014, online; Rowan 2002, online; Southall 2006, online; Turn Me Up! 2014, online; Unofficial Dynamic Range Database 2014, online; Vickers 2010: 19-22; Wolters, Mundt & Riedmiller 2010

devices. The annual '*Dynamic Range Day*' (2014, online) was organised and is still upheld by British mastering engineer Ian Shepherd, who more recently collaborated with *MeterPlugs* to develop software plugins 'Perception' and 'Dynameter'. Perception was developed for engineers to use within DAW environments. It would allow for objective 'A/B' comparison of processed signal and original 'source' (unmastered) audio. Comparisons were objective in a sense that both processed signal and source audio would be level matched (see *MeterPlugs* 2020, online). Dynameter, also for use within DAW environments, would help engineers achieve what Shepherd termed "optimal" dynamic range in a recording, together with "competitive loudness for online streaming" (see Shepherd 2021, online). These sorts of efforts and interventions will regularly call into play and bring to the fore some of the more banal, technical and less creative aspects of mastering. However, such efforts and interventions are put forward by engineers who convey vested interests in the enhancement or preservation of meaning and emotions embedded within mixdown recordings. Practitioners such as Katz and Shepherd will promote their ideals of sonic excellence.

Though developed with the best of skill and put forward with the best of intentions, there are some who might take a critical stance in the face of certain suggestions that have emerged to address issues of excessive loudness. By their very nature, some recommendations are constraining in a sense that they can limit the engineer's creative freedom to perform certain dynamic range adjustments within the digital domain and in accordance with what they feel is suitable for the music, rather than the means of playback. Furthermore, the digital domain has afforded the radical lowering of RMS average amplitude in audio long enough for 'loudness' to have characterised the sonic architectures of various artist recordings and genres from inception through to dormancy from the mainstream. Efforts to apply dynamic range processing for the radical lowering RMS average amplitude have irrevocably ascribed original late 20th century and early 21st century discographies with a sense of era.

I have observed fast Internet connections, social networking services and online fora offer spaces through which professionals may assert their arguments and proposed solutions with respect to the loudness war. These spaces may also allow

for debating and critiquing the work of other engineers. Key industry protagonists who contribute regularly to discussions around loudness might use video hosting services, such as *YouTube,* to present visual appraisals of professed loudness war successes and catastrophes. These appraisals would help draw attention to issues of excessive dynamic range processing in a way that is coherent and accessible to the layperson. The *Unofficial Dynamic Range Database* (2014, online) website was set up and still continues to function as a dedicated platform for evaluating dynamic range across entire releases mastered historically and recently. In order to evaluate dynamic range, the *Unofficial Dynamic Range Database* makes use of statistical 'DR' values that denote only the loudest points within an entire audio file. For an album, this value would be taken from the average loudest moments across each song. Words courtesy of *Pleasurize Music Foundation* (2009: 2), "the DR value is the difference between the peak [maximum] and the top 20 RMS [average amplitude] measurements (top 20 RMS minus Peak = DR)". Back in 2012, *Unofficial Dynamic Range Database* proposed the following descriptors for each value; 1-7=bad; 8-13=transition; and 14-20=good (see Fig. 4; Bitran 2012, online):

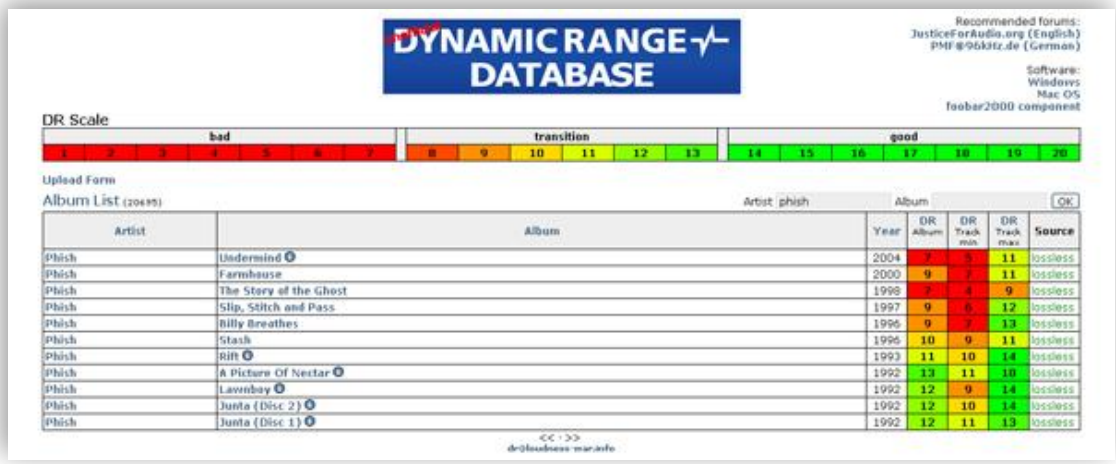

Fig. 4 Image of *Dynamic Range Database* taken from Bitran (2012, online). Reproduced under the fair dealings of the CLA license (for education).

At this stage of my discussion, it is important to acknowledge that numerical representations of dynamic range might not always correlate with how loudness

phenomena can be perceived. An *Audio Engineering Society* paper authored by Boley, Danner and Lester (2010) specified, with my emphasis, "that none of the tested [algorithms for calculating dynamic range] accurately predict the *perceived* dynamic range of a musical track". As part of my work in *Appendix B: The Future of Mastered Audio in Society*, I have chosen to explain an alternative and now more prevalent way of scientifically gauging perceived loudness. I do so in a way that helps us understand the relevance of mastering engineers going forward. I observe that this alternative way of gauging perceived loudness became more prominent since the inception of *Unofficial Dynamic Range Database*. The key point I wish to make right now is that visual and statistical exhibits that have long been hosted on *YouTube* and *Unofficial Dynamic Range Database* have in the past encouraged critique. Yet, these exhibits might not have been successful in qualifying or drawing obvious attention to any underlying contexts and forces that bore influence on creative agency in mastering important records. It has been my resolve to bring about deeper understandings of these forces and how they might have had an impact on mastering engineers through this chapter. Case in point, Emily Lazar (in Gonsalves 2012: 21m45s) reflected on some negative reception given to a major US noise pop album released in the early 2010s. This reception focused particularly on how the record sounded after being mastered by herself and another mastering engineer in the States. Critics might have given little thought to how the source material sounded pre-mastering, or to any motives that could have been imposed by recorded music industry personnel. Lazar explained,

> There'll be a lot of conversations about what mastering engineers do to things and people talk about this online as if they have a clue about what it sounded like before and they don't. […] I myself like quieter, undistorted records but my job in that particular instance was to give the client what they wanted.

Milner (2010: 237-9) described a similar case whereby a mastered recording was given an exceptionally negative reception but with seemingly little consideration for how the source material may have sounded pre-mastering, or to any motives imposed by recorded music industry personnel. The recording was *Red Hot Chili Peppers'* (1999) 'Californication'. The negativity focused on how the record

sounded after being mastered in the US by Vlado Meller - a key figure in *Chapter 5*, where I offer autoethnographic reflections on my degree-level Music Technology training, attending the *Vlado Meller Mastering Workshop Series* in September 2016, and continuing to develop professionally in mastering from then onwards. Michael Fremer (in Milner 2010: 298), an esteemed audio critic and expert in vinyl records, felt that another release mastered by Meller, 'De-Loused in the Comatorium' by *The Mars Volta* (2003) was "a great recording", but that Meller "squeezed the dynamics out of it." In a brief interview excerpt that Milner had cited, Fremer did not consider any underlying contexts that might have governed Meller's creative approach to mastering 'De-Loused in the Comatorium' for the digital age. Moreover, I suspect that it is unlikely Fremer would have had access to the source (unmastered) audio as a base for comparison.

From the engineer's perspective, it is important to consider that mastered audio can be met with positive as well as negative reception. Maintaining a positive reputation as a mastering engineer would certainly be important if this industry is affected by the precarious and fluid conditions of creative work in the cultural industries. Blair's (2001) research into British film industry labour propelled me to consider reputation and familiarity as two key bases on which creative workers might be hired; "you're only as good as your last job". I suggest that this industry adage for career success could well be applied to mastering. While defending himself and Californication, Meller (in Milner 2010: 291) presented a telling justification for lowering the RMS average amplitudes (dynamic ranges) of records he masters for everyday listening:

> It doesn't matter if it's an audiophile, a kid who's fourteen, or someone who's fifty-nine. The louder will sound better. […] [CDs] are for the listening enjoyment of people who are driving cars, who have MP3 players, who are jogging. Some of them have stereos at home, but what's the setup? The dog is barking, the wife is banging dishes in the kitchen, the kid is crying in the bedroom. Are they worrying about dynamics?

I suggest that it is vital to consider Meller's perspectives as evidence that not all mastering engineers have balked at the prospect of applying creative processing for the drastic lowering of dynamic range across digital recordings. I argue that it is important to acknowledge perspectives given by the likes of Meller, whilst other

mastering engineers have become influential in the development of practices, systems and tools that might encourage the preservation of dynamic range or a certain degree of loudness standardisation. Engineers, like Meller, would help us to form more nuanced understandings of recorded music industry politics and responses to the loudness war. Engineers might seek out or call for the development of digital technologies that offer a powerful means of lowering RMS average amplitude. If engineers are influential in such ways, then research around the mastering engineer's relationship with equipment would inform scholarship that exhibits the concept of users as agents for technological development. Pinch and Bijsterveld (2004: 639) reflected on Akrich's (1992) suggestion of technology having "users' scripts embedded within them".[1]

The significance of a mastering engineer's relationship with their equipment was expressed through an interview that Milner (2010: 289) conducted with famed producer Rick Rubin. Rubin explained that Vlado Meller lauded the importance of signal processing equipment in achieving a particular aesthetic through mastering. Rubin explained that he himself might submit any one project to several mastering engineers. Engineers could each then agree to perform a test master, and Rubin would ultimately hire just one engineer to finish an entire project. This decision would be based on Rubin's own phenomenological judgment of which test master sounded better. Meller, to quote Rubin, "wins nine out of ten times, and [Meller] claims it's not him". Rather, as Rubin described, Meller praises the tools he uses for mastering. The producer described this technology as "a 2 million dollar mastering suite that other people don't have." Engendering the conception of mastering as a dark art, Milner had queried Rubin's statement by stating, "a magical room where records go through some sort of alchemical hotness process?" By 'hotness', Milner had referred to the increased degree of superficial loudness brought about through lowering the RMS average amplitude across a recording.

*

Here in *Chapter 2,* I began by considering issues of precarious work and career access in the cultural industries. I later addressed some of the wider cultural and

[1] See also: Barber 2012; Jones 1992: 75; Kline & Pinch 1996; Oudshoorn & Pinch 2003; Théberge 1997

economic issues that can bear influence over day-to-day labour, creativity - the ability to bring into being “things that are interesting, important and *human*” (Csikszentmihalyi 1996), as well as autonomy in mastering. I propose that if mastering engineers are to be more widely understood as creative participants in production, then cultural industry theory will continue to play a useful role in examining these sorts of issues. In the third and final section of the chapter, I used mastering and the so-called ‘loudness war’ to draw further attention to issues of creative agency and professional autonomy. This highlighted a relationship between digital technologies, capital, the political economy of the cultural industries and creative aesthetics in mastering. This relationship shows how creative agency and autonomy can be defined by the affordant qualities of certain digital technologies and how capital might flow within the wider media industries. I have said that if creativity is defined aggressively by such parameters, then this could work against efforts to achieve much broader appreciations of mastering engineers as sole agents who make artistic use of their studios and equipment for the critical reshaping of often globally dispersed, lengthy and cooperative efforts in tracking through to mixing. This chapter also brought forward the significance of mastering engineers maintaining positive reputations in the field, and this is an idea I carry into *Chapter 5*. The final stages of this chapter shone a light on the notion of users as agents for technological development.

Chapter 3: Mastering and the Cultural Significance of Sound

Through this chapter, I explore the social significance of mastered audio and mastering aesthetics in society. I will also address some neurological and psychoacoustic models of understanding how sound is perceived, in addition to how creative practices in mastering might influence how we respond to music. This is in alignment with my third research question, which queries the ways in which professional mastering culture is significant to wider social understandings of popular recorded music production. It is important for me to declare that I am not an expert in the field of or fields related to neurology. However, I have recognised that authors such as neuroscientist and record producer Daniel Levitin (2006), who wrote *This Is Your Brain On Music*, have made accessible some complex and scientific ways of understanding how human brains respond to music (see also Ball 2010; Sacks 2007). Publications by these qualified individuals have empowered the layperson and scholars in other disciplines to contemplate and explore their brain or body's connection to music. They have offered bridges of insight between sophisticated levels of science and more regular appreciations of sound. These insights have served as a foundation on which to probe a little further, if I felt that doing so would help outline the relevance of studying mastering culture and creativity. Exploring the social significance of mastered audio and how creative practices in mastering might influence our brain or body's response to music have underscored the need for further examination into the understudied culture of mastering. It is after all the mastering engineer who will act as the 'gatekeeper' between all that happens in the recording studio and the end product heard by listeners as they go about their lives.

In the first section of this chapter, *Loudness and Noise,* I locate mastering as an important site for examination through the broader discipline of Sound Studies. I then examine some broader discussions around issues of loudness and noise in society. This calls attention to the wider significances of loudness in mastered audio and post-production. Through section two, *Rhythm,* I explain some technical

fundamentals of signal processing that is often performed through mastering. If we are to fully understand mastering as creative work, then it is important to grasp some of the technical basics; my subsequent chapters will also assume a rudimentary knowledge of them. Through *Rhythm*, I suggest that particular signal processes can manipulate our sense of temporality, rhythm and timbre across entire mixdown recordings. In the third and final section, *Frequency,* I will continue exploring the sonic and perceptual implications of signal processing carried out through mastering. I will show how signal processing can manipulate tone, timbre, harmonic and spatial phenomena across recordings. I will conclude *Chapter 3* by examining further discussions that concern how humans connect with music cognitively, neurologically and emotionally. If sound and music has the potential to be altered in ways that affect our human experience of the world, and these alterations happen through mastering and signal processing, then it is important for scholars in much broader fields to explore deeply into how cultures of audio post-production operate.

Loudness and Noise

Academics in the field of Sound Studies have long focused on the cultural significance of sound and everyday sonic phenomena. In Sound Studies, music is often considered as a creative vehicle for the articulation of human emotion. Music can also tell of numerous social issues. Sterne (2012a: 2-3) conveyed that Sound Studies scholars should "think sonically" about the world, society and culture. I have noted that these scholars adopt analytical approaches to digesting the sonic, timbral or aesthetic quality of music and the wider sonic landscape. According to Attali (1985/2009: 3), the world is "audible" rather than "legible". Like Attali, Sound Studies scholars have often taken issue with the over-privileging of the visual domain in methods of analysis employed by academics who engage in social and cultural studies. Sound Studies scholars have expressed that the aural domain is equally capable of conveying varied information about the world and society (see Bull 2000; Bull & Back 2003; Hall, Lashua & Coffey 2008). Idhe (2012) offered a

study that located the visual and aural domains in a more correlate way. His 'region of sight', with its horizon of invisibility, relates inextricably with his 'region of sound' and its horizon of silence. He also suggested that 'translations' occur between these regions. I have so far signified that there are relationships between creative practices in mastering and the political economy of the wider media industries. These relationships would be relevant to Sound Studies scholars, who strive to explore how indications of power, hierarchy, emotion, ideology and class all exude through sounds, music, speech and 'noises' that populate the horizon of silence (see Back & Drever 2005; Bijsterveld 2001: 38; Sterne 2012a).[1] Given that Sound Studies scholars embrace all this, I consider it striking that the meaning of mastered audio, the aesthetics of mastered audio and the professional cultures of mastering are topics that have been understudied in their field. I argue that if Sound Studies scholars were to consider the social significances of creative recorded music production, then mastering would be relevant to their endeavours.

I will now examine some broad and historic discussions around loudness and noise that are relevant to the Sound Studies discipline. This will help to convey the wider social significance of mastering and the need to understand its culture, particularly in light of a 'loudness war' that I introduced in *Chapter 2*. Futurist Luigi Russolo (2004/1913: 6) offered a manifesto through which he expressed a demand for "bigger acoustic sensations" in music. Back in 1913, Russolo conveyed that larger acoustic sensations would have been more symbolic of the din and cacophony brought about by the industrial revolution. It seems that in Russolo's view, the sonic landscape of the industrial revolution had consumed Europe's horizon of silence. 100 years later, in a *BBC Radio 1* programme that presented contemporary issues of loudness in recorded music, Devine (in Lowe 2013: 55m29s) positioned louder recordings as a "straightforward reflection of an increasingly louder world". I conclude that, for a century, listeners have demanded new musical aesthetics, or creative approaches in music composition and production, should represent their current sonic and social landscapes (see also Bijsterveld 2001: 56). In his manifesto, Russolo often used the term 'noise' to connotate sound of greater complexity, as opposed to sound of greater intensity. Almost 100 years on, Devine (2012: 4)

[1] These notions also surface through: Attali 1985/2009: 12-13; Back and Drever 2005; Bailey 1996: 49; 55; Chion 2012; Hine 2008: 260; Ihde 2012; Kahn 2001; Kendall 2002; Pinch & Bijsterveld 2004: 637; Porcello 2004

suggested that “not all noise is loud, and not all loudness is noise”. Nevertheless, he observed, “loudness and noise are often used as synonyms for each other”. Devine added that “loudness doesn't always fit the everyday definition of noise as unwanted sound, or its anthropological definition as sound out of place”. Overall, Devine has demonstrated that complex dialogues have existed between society and concepts of ‘fidelity’, ‘loudness’ or ‘noise’ within the context of high fidelity sound reproduction (see also 2013). Chion (2012: 50) aptly stated that “language we employ as a matter of habit suddenly reveals all its ambiguity”. Chion also said that “in speaking about sounds[, people] shuttle constantly between a sound’s actual content, its source, and its meaning.”

I have attributed the marginalisation of mastering to the fact this creative process has often been understood as a more technical bridge between production and manufacture. Furthermore, mastering engineers do not strictly require direct involvement or collaboration with more celebrated figures in creative recorded music production – producers, mix engineers and musicians. I now submit that broader social struggles involving the use of language to interpret sound might have also acted as barriers to making sense of creative work performed via mastering. Case in point, I have observed simple and phenomenological interpretations of a mastering engineer’s work with mixdown recordings arrive in the form of, “they sound louder”. Interactions with laypeople via my own mastering practice have spawned such feedback, when in reality, mixes underwent much more complex changes via creative signal processing.

Drawing attention back to broad societal issues of loudness and noise, I will now focus more deeply on scholarship conducted by Bijsterveld (2001: 39), who concentrated on “the history and anthropology of [the] symbolism of sound and its relation to technology”. Bijsterveld offered extensive accounts of noise abatement movements and campaigns that proliferated in the 20th century. Via these accounts, I suggest that we can situate modern efforts to prevent the excessive lowering of RMS average amplitude through mastering as part of much larger metanarratives that have to do with issues of noise in our world. I previously cited Vickers (2010: 13-15), who recounted evidence that would frame ‘loud’ masters as an auditory health concern. Bijsterveld (2001: 40) noted that preventative measures to

safeguard against industrial hearing loss were considered more seriously around the 1970s. The timing of these considerations can be attributed to 1928 being when the 'decibel' unit shifted into wider use. I pose that scientific measurements, such as the decibel, would have emerged as useful props for those attempting to highlight the threat of noise or loud sounds. Today, I note that *Unofficial Dynamic Range Database* uses quantitative and statistical 'DR' values in order to evaluate dynamic range in mastered audio.

Bijsterveld's meticulous work has verified that complex relationships do exist between society, loud sounds and noise. Like Bailey (1996) and Goodman (2010), she acknowledged noise as being crucial to warfare. Multiple historic accounts (circa 19-20th century) positioned noise as "unwanted sound", "nerve-racking" and symbolic of "indifferent", "irrational" and "barbarous" masses; a threat to the "civilized", the "intellectual elite" and to societal order (Bijsterveld 2001: 38-39; 42; 46). Bijsterveld (2001: 42) also recognised different accounts that, like Russolo's, espoused loud sounds as signifiers of strength, power, masculinity, progress, prosperity and control (see also Dembe 1996: 195; 203; 211; Corbin 1999: 159). Noise and loudness were thus regarded as positive attributes in particular technologies or situations, and indications of these sorts of regard could be seen through decisions made in home appliance and vehicle manufacturing. Despite the technological feasibility of developing a "relatively silent vacuum cleaner", Bijsterveld (2001: 41; footnote 16) explained how consumers would be wary of its strength and suction power. In a later study, Bijsterveld (2010: 191) identified how vehicle owners would demand a contrast of sonic qualities in a car; gear changes must remain silent whilst exhausts must emit harsh noises.

These understandings help us towards more theoretical appreciations of how loudness and noise phenomena might be considered in the context of marketing and discourse related to professional audio equipment designed for audio post-processing, mastering, radio broadcast, and creative production more generally. This marketing and discourse has often made clear that, when it comes to processing sound, the end-user can demand a mix of sonic properties. Equipment designed for these sorts of uses may be advertised as being capable to, for example, "win any loudness war without ever sounding harsh or edgy". In their

marketing copy, *Telos Alliance* (n.d., online) also stated, "rock stations love the amazing competitive loudness" offered by their 'Omina ONE' audio processor for multicast broadcasting. When seeking out a product to be used for digital-to-analogue or analogue-to-digital conversion in mastering however, the end-user may demand high 'signal-to-noise ratios', sonic transparency and the facility to faithfully reproduce signals whilst avoiding obvious 'colouration' – a term I will unpack at a more logical stage in this chapter. These sorts of desirable sonic attributes were discussed through the 'Convert Or Die' episode of *Square Cad: The Mastering Podcast* (see Gonsalves 2010a).[1] Quite appropriately, Bijsterveld (2001: 38) suggested that "research into [the] symbolism of sound can […] enhance our understanding of the responses to technology-related changes". This reasoning offers further justification for considering the professional mastering engineer as an agent for technological development in pro audio and digital algorithm design going forward.

Via research cited in this section, I have deduced that people may render loud sounds as signifiers of power or threat, and quieter sounds could be interpreted in numerous other or opposing ways. Recorded music pervades the sonic landscapes of civilization and mastering engineers are the figures most creatively engaged in a final say when it comes to the overall aesthetic qualities of recorded music. Through mastering, music can undergo drastic changes in terms of dynamic range or perceived loudness, and these aspects of the process have been sufficiently promoted via loudness war debate. I have said that in Sound Studies, music is often considered as a creative vehicle for the articulation of human emotion. Music can also tell of numerous social issues. I cited Devine (in Lowe 2013: 55m29s), who positioned louder recordings as a "straightforward reflection of an increasingly louder world". These contexts have drawn further attention to the wider social significances of audio post-production. They have advanced the need for us and other scholars to understand the creative culture of mastering and how it engages with recordings that pervade our sonic landscapes.

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[1] Mastering engineer Adam Gonsalves hosted *Square Cad* from 2010 through to the conclusion of the series in 2013. The objective of the series was to "focus on topics of interest to engineers through interviews and discussions" (Gonsalves 2010b: 0m15s). In *Chapter 5*, I will identify other podcasts that are currently active and that offer both technical and professional guidance for mastering career start-up or development.

Rhythm

Reflecting on Alperson (1980: 408), Negus (2012: 483-484) considered music and various compositional building blocks of music as a function of time. Negus argued, "temporal organization is fundamental to [music's] creation and reception". He also explained, "Music unfolds in time, and is performed, played back, and engaged with as an 'art of time.'" Negus' essay focused much on lyrical narrative and the sense of nostalgia this evokes over 'clock', 'lived' and 'cosmic' time - classifications set out by Ricoeur (1991). I suggest 'temporality' as an appropriate term to describe how music can radiate an obvious sense of *rhythm* and *metre* against the clock. Neuroscientist Daniel Levitin (2006: 71; 111) defined these parameters, along with *loudness, tempo*, *pitch, key, timbre* and *harmony* as factors that structure sound into music played out over time. Levitin conveyed that when these various musical factors are in states of obvious and controlled flux, then a listener's expectations would be challenged. A listener will form an emotional response to the music by means of their neurology (see also Ball 2010: 281-282; Pribram 1982; Milner 2010: 249; Serrà et al. 2012; Vickers 2010: 6).

I suggest that the 'temporal organisation' of recorded music can be manipulated through creative processing that is performed through mastering. That is to say, the mastering engineer and their tools can affect our perceptions of some of the musical factors that structure sound into music played out over time. *Loudness* and *timbre* are phenomena that we distinctly experience and decode through prolonged exposure to a sound source. This sound source might be a recording subjected to creative methods of signal processing that will be identified through this chapter. For this section of *Chapter 3*, it will be particularly relevant to understand that the brain can detect *meter* through its ability to interpret diverse sound intensities in organised and rhythmic patterns (see Ball 2010: 209-210; Levitin 2006: 172). When thinking about our temporal perceptions of music, it is also important to remember that mastering engineers are those who determine the lengths of any silence or crossfades between songs on a record. Savage (2014: 250) would regard this as a "creative judgment" and one that contributes to "a part of the overall aesthetic" of

an album. Of note to this, Bijsterveld (2001: 43) said that "a symbolism of sound is incomplete without knowledge of the symbolism of *silence*".[1]

The musings I have so far set out through this section had inspired deeper engagement with discourses that focus on some wider social significances of sound and music. Sound and music, I learned, can be used to bring about cognitive and emotional change, healing and access to higher planes of perceived consciousness (see Berendt 1983; Chaudhary 2020; Ehrlich 1997; Ingram & Mishlove 2021, online). This idea underscored the need to form much richer understandings of creative mastering culture and the effect mastering has on recordings. Seminar 'Music as Medicine: The impact of healing harmonies', delivered at *Harvard Medical School*, argued for music to be met with greater appreciation for its impact on patients who suffer with physical or mental illnesses (see Wong et al. 2015). In this seminar, speakers drew from tests that explored to what ends music can positively influence athletic or mental performance, memory, mood and IQ. In the seminar proceedings, Dr. Anthony Komaroff (2014: 4), *Harvard Medical School*, responded to a question addressed to him. The question read, "Dear Doctor K: I believe music helped my mother recover after her stroke. Is there a connection between music and health?" In his response, Komaroff drew immediate attention to the ancient Greeks, who "certainly thought so". Komaroff said, "[The Greeks] put one god, Apollo, in charge of both healing and music. Recent medical studies seem to confirm what the Greeks thought." It is important to recognise how such statements could lead us to at first render various correlations between music, sound, health, healing and accessing higher states of consciousness as pseudoscientific or pseudospiritual.

Storr (1997) saw music as having the provision of drawing human beings closer together, and Sacks (2007: 244-6) suggested rhythm as a means for doing this. Rhythm could synchronise human movement and minds on a neurological level. In the 'Music as Medicine' seminar proceedings, Komaroff (2014: 4) also honed in on the idea that music "works its magic through its rhythms"; "our heartbeat, breathing, and brain waves are all rhythmic", he explained. Kotlyar and Morozov (1976) studied the receptiveness of listeners to the emotional state of vocal performers who

[1] Bijsterveld drew substantially on Peter Burke's (1993: 123-141) historical analyses of the social history of silence.

employed a range of musical devices, such as loudness variation, over the course of time. Loudness variation, something mastering engineers have a large degree of agency over, is key to inducing a clear sense of rhythm and meter in performances. In Kotlyar and Morozov's study, listeners were often able to guess the emotions that performers intended to convey, and diversities in amplitude within a performance would play a crucial role in the success of the listeners' guesses.[1] The following statement by EDM scene veteran Rick Snoman inspired me to take these understandings a step further. It also highlighted the cultural significance of rhythm and temporality to genres of electronic dance music (see also Fassbender 2008: 15):

> Dance2Trance and their first track labelled "We came in Peace" is considered by many to be the first ever 'club' trance music. […] It laid the basic foundations for the genre [trance] with the sole purpose of putting clubbers into a trance-like state. The ideas behind this were nothing new; tribal shamans had been doing the same thing for many years, using natural hallucinogenic herbs and rhythms pounded on log drums to induce the tribe's people into trance-like states.
>
> (Snoman 2009: 251-252)

Negus (2012: 483) expressed how music can induce an "acute feeling of time passing; of giving oneself up to the moment; of existing within memories; of losing all sense of measured clock time". If an obvious sense of rhythm and meter would contribute to this change in state, and if shared listening can attune those who occupy the same space, then I reasoned it would be important to consider how creative approaches to mastering and dynamic range processing can impact on rhythmic and metric qualities in recorded performances.

I found that Snoman's ethos of trance music was also evocative of scientific concepts that underpinned a 2011 collaboration between English ambient musical trio *Marconi Union* and the *British Academy of Sound Therapy,* who together released an eight-minute track named 'Weightless'. In an interview for *The Telegraph* (2011, online), Lyz Cooper (*BAST*) had revealed that their study deemed

[1] I became aware of this study through Sundberg (1982: 143-4).

Weightless, later released by *Marconi Union* (2012) as 'Weightless Part 1', "the world's most relaxing song", as tested by *Mindlab International*. Cooper explained that the composition of Weightless draws on numerous musical principles, "shown to individually have a calming effect", she said. Weightless begins at a rhythmic tempo of 60bpm, slowing down by 10bpm over eight minutes and at a rate the human heart is said to follow by way of 'entrainment' – the synchronicity of physical heartbeat in accordance with external stimuli. Via Cooper, readers of *The Telegraph* were led to understand two things. First, that the heart's entrainment to Weightless Part 1 could lower blood pressure. Second, that a lack of melodic repetition would prevent the brain from calculating reoccurring patterns. The specific intent to manipulate the human condition through Weightless Part 1 was subjected to decisions made by mastering engineer Guy Davie, who escaped media attention for his involvement in the project (see Discogs 2021a, online). Davie may or may not have been aware of intents that *Marconi Union* and the *BAST* had adopted.

It is now appropriate for me to spell out the technical basics of typical mastering processes and the effect that various processes will have on audio. If we are to fully understand mastering as creative work then it is important to make sense of these things. Each subprocess in mastering has a potential to impact on our neurological, psychoacoustic or emotional perceptions of audio, and just a basic understanding of these relationships would validate the significance of mastering to those who enjoy music on a daily basis. Through prior observations, existing literature and scholarship, I learned that modern approaches to mastering audio would typically involve any of the analogue or digital signal processing phases I have detailed in the simple list below. Most phases and their order of flow have been more or less rendered optional, depending on the setup (see Bregitzer 2009: 184; Katz 2002: 25-26; Shelvock 2017: 27; Owsinski 2008: 13-14; Waddell 2013: 8; Wyner 2013: 35-36).

-Digital-to-analogue conversion / analogue-to-digital conversion
-Equalisation (EQ)
-Transient shaping
-Dynamic range compression / expansion (inc. de-essing)
-Saturation / excitation (distortion)

-Stereo-field processing (inc. elliptical equalisation)

-Clipping / limiting

-Dither / noise shaping

Ordinarily, 'dither' and 'noise shaping' would happen after all other processes. They are performed in the digital domain and are, for the sake of argument, non-creative and fundamentally imperceptible processes that engineers apply to reduce errors resulting from changing the bit depth of a digital audio file (see Waddell 2013: 94-95).[1] Transient shaping, (multiband) dynamic range compression or expansion, clipping and limiting are processes that can be applied to manipulate the RMS average amplitude of recordings. I suggest these are also processes that can be used to creatively accentuate, moderate or shape the perceived sense of rhythm, meter and sound intensity in recordings. It is significant to remember that the brain can detect meter via its ability to interpret diverse sound intensity in timed rhythmic patterns. I add that in detriment to our perceptions of meter, the human auditory system may group together sounds of similar intensities (see Ball 2010: 142-4; Deutsch 1982: 119; Levitin 2006: 81). Whilst aggressive applications of dynamic range processing can lower RMS average amplitude, it can also exaggerate timbre, given through the rapidly fluxing amplitudes of changing harmonic content. This may account in part for the initial appeal of 'louder' recordings. We should note that Vickers (2010: 4) considered the appeal of louder playback volumes, and this is supported by the scientific research of Fletcher and Munson (1933). There have also been indications that high intensity sounds can stimulate portions of the brain associated with pleasure and the release of endorphins (see Blesser 2007: 5). Levitin (2006: 71) said, "loud music saturates the auditory system, causing neurons to fire at their maximum rate. When many, many neurons are maximally firing, this could cause an emergent property, a brain state qualitatively different from when they are firing at normal rates." In the following section of this chapter, I will shine some more light on the sonic and perceptual implications of creative signal processing carried out through mastering. I will identify further ways by which timbre, in addition to tone, harmonics and spatial depth can be manipulated in the process of preparing recordings that will stir our emotions.

[1] See *Appendix D* – 'Bit depth', 'Sample rate'.

Frequency

Mastering engineers can use equalisation (EQ) to adjust the amplitudes of tonal, timbral and harmonic frequencies (spectral content) across recordings. Adjustments are predominantly made to frequencies that fall well within the ranges of human hearing - considered to be between 20Hz and 20kHz.

> Any frequency up to ~25Hz may be considered 'subsonic';
> 'bass' ranges from ~25Hz to ~120Hz;
> 'lower midrange' from ~120Hz to ~350Hz;
> 'midrange' from ~350Hz to ~2kHz;
> 'upper midrange' from ~2kHz to ~8kHz;
> 'high frequency' content from ~8kHz to ~12kHz;
> 'air' from ~12kHz upwards
>
> (see Waddell 2013: 84-86)

These designations offer us a useful provision if we are to grasp a fundamental understanding of how and why EQ is used. These designations were lifted from Waddell's instructional and technical publication on mastering. Whilst useful, I should point out that Waddell's designations do depict just how practitioners might employ their own linguistic conventions to define what they themselves perceive as suitable classifications for various bands of frequency that sit within the ranges of human hearing. Other engineers might embrace different perceptions and thus take issue with Waddell's representations - there are, after all, no "hard-and-fast rules" in mastering, according Bregitzer (2009: 183-184); "there is no single correct way to master a record", according to Hodgson (in Hepworth-Sawyer & Hodgson 2018: 270; see also Edstrom 2011: 198-9; Hodgson 2020: 226; Waddell 2013: 3).

Specific tools for mastering are also said to impart signal 'colouration'. For the most part, mastering engineers discuss this idea in the context of analogue signal processing. Waddell (2013: 25-26) explains, "selecting and understanding the equipment […] is a part of what makes studios unique. […] Some studios seek a balance between *color* processors and *clean* processors." I will now borrow an

ideal explanation given to me by celebrated mastering engineer Ray Staff in his interview conducted at *AIR Studios* for this research. Back in 2016, Staff had clarified 'colour' as a term to denote *'that kind of sound you can't create with [equalization]. It's that, you know, some sort of form of irregularity in the response, some change in the distortion characteristics'*, he'd begun to explain, having stated, *'going from one piece of equipment to another […] will add colour, tonality, character, some sort of sonic change'*. Having myself observed the phenomenon of signal processing hardware bringing about an audible colouration, I extend that these sonic shades of difference are a function of electronic circuit scheme, component design and how electrical load is shared across devices. When audio passes over to the analogue domain, it will receive a cumulative imprint of all equipment and interconnections before it is typically converted back to digital (see Turnidge 2013: 8). Vacuum tube-based equipment can be 'patched in' to analogue processing loops and used for the distortion of signal, thus bringing about the perceptually favorable effects that arise out of having generated harmonic content from the source. This can enhance the timbre of a recording (see also Owsinski 2008: 15-16; 27; Wyner 2013: 22-24). 'Gain staging', a term brought forward in *Chapter 2*, can refer to the patching in and careful arrangement of analogue equipment for creative signal colouration. My research in *Chapter 6* will show that gain staging is a defining aspect of professional audio engineering and mastering discourse. I suggest that this aspect has previously been overlooked through some of the more accessible examples of technical mastering literature. Little has also been published regarding the creative and sonic significances of analogue mastering tools. This would be a significant oversight if certain pieces of mastering equipment are used habitually and in ways that change the sonics of mixdown recordings before they reach the ears of listeners.

Stereo-field processing would typically involve digital stereo imaging plugins and different forms of hardware or software equalisation, referred to as 'elliptical EQ'. These tools can alter how chosen bands of frequencies are distributed across the stereo spectrum of hearing. Before mastering for digital formats, engineers would use hardware elliptical equalisers and essentially 'sum' any sub-bass or lower bass frequencies to mono. This would help ensure cutter heads and playback styluses did not skip when working with cutting lathes or when playing from vinyl (see

Owsinski 2008: 88; 257; Waddell 2013; 143; 194-197). When mastering for digital formats, today's engineers could adjust the stereo image in any chosen frequency band to alter the sense of space or depth in a recording. "Low frequencies are usually localized by the listener from every direction", explained Bregitzer (2009: 200). "The higher the frequency, the more we can perceive directionality." Thus, any creative application of stereo widening or narrowing might have greater impact on the listener's spatial perceptions at higher ends of the hearing spectrum.

When discussing a mastering engineer's creative agency over stereo-field frequency distribution, it is important to acknowledge that public adoption of consumer headphones, earphones and ear buds propelled considerably over the course of the late 20th and early 21st century (see Neate 2013, online; Shelvock 2017: 34). For the remainder of this chapter, I will continue to adopt 'headphones' as a term to encompass all three of these devices. It is crucial we acknowledge the proliferation of consumer headphones usage at the same time I address methods of stereo-field processing. This is because discourse around costly and quality headphones has placed a growing emphasis on the sense of space and the depth of field that the devices themselves are said to offer by design. Headphones will often be acoustically designed to block out external noise and ensure both left and right signals are equally distributed at fixed distances from the listener's ears. Whether at home, in the car or elsewhere, I observe that today's music fans are seldom hearing music through a high fidelity stereo system, in an acoustically isolated space and whilst upholding the audiophilic dogma of ensuring equal triangular separation between themselves, the left speaker and right speaker. Whilst consumer headphones and loudspeakers might both be marketed or discussed chiefly in terms of their capacity to handle the amplitude of frequencies that fall within the spectrum of human hearing, I have found that discussion around consumer headphones will more willingly focus on how design can affect the perceived distribution of frequencies. Discussion will also hone closely in on how particular designs can affect the perceived sense of space and so-called "sound stage" (Moylan 2007: 50-55) that is most deeply sensed through headphone listening. Bull (2000: 186) argued that, with headphones, music listeners construct "their own personal soundscape placed directly between their ears"; that headphone listening on-the-go offers command over auditory aspects of the wearer's spatial and

environmental reality, and they construct their own soundtrack to their lives (see also Pinch and Bijsterveld 2004: 644). Using stereo-field processing tools, the mastering engineer can adjust the perceived the sense of space within 'soundscapes' that are developed through mixing. There are many who would argue that these soundscapes are appreciable more when heard via headphones. With the increased public adoption of headphone listening, we might justly question whether mastering is now less often or less exclusively performed using dedicated loudspeaker monitoring setups. This is a question that will be informed through my work in *Chapter 6* and also through research set out in *Appendix B*, where I focus on some emerging standards and concepts for immersive audio.

With different forms of stereo-field and frequency processing in mind, and having also considered the mass proliferation of headphones usage, it felt relevant to examine discourses that had previously developed around 'binaural beats'. These are auditory illusions brought about through dichotic stereo playback (hard left and right separation) of two constant sine waves that each fall below 1500 Hz and that vary from each other in pitch but with no less variance than 40hz. If both frequencies each remain consistent for a time, then listeners hear their frequency disparity as a series of undulations in volume, perceived to "beat" at a steady rate. This effect is considered to be experienced best through headphones (see *Wikipedia* 2021b, online). There have been controversial disseminations of carefully crafted binaural beats that exploit this psychoacoustic illusion via dichotic audio indented for headphone listening. *I-Doser* is a software application that was designed to load and play binaural audio content for the purported manipulation of mental state. This manipulation would occur by way of brainwave (neural) entrainment. This form of entrainment was said to happen through prolonged exposure to specific frequencies that are determined as a result of careful calculation. Commodified 'digital doses' were named after recreational and medicinal drugs. These names indicated the alleged side effect of each particular dose, and an online report from *Washington Post* staff writer Monica Hesse (2005, online) read as follows:

> A March incident in Oklahoma prompted a new wave of concern. The Mustang public school district learned that kids were i-dosing and sent a

> letter home warning parents to be on the alert. Since then, tech blogs and media outlets have debated the riskiness of the practice, and the software used for playing one company's i-doses was downloaded nearly 29,000 times last week -- more than quadruple what it was a few weeks ago.

12 years on, I observed that composer and record producer Hans Zimmer (2017) met with praise for a slightly different application of frequency to engender sonic illusions through the score for the film 'Dunkirk'. Zimmer used "Shepard tones", named after cognitive scientist Roger Shepard, in order to accrue tension over the course of the film. Unlike with 'digital doses', it was not considered necessary for viewers to use headphones for Zimmer's application of an auditory illusion to be experienced successfully (see Haubursin 2018, online). Research engineer and sound designer Dr. Ir. Stéphane Pigeon authored 'Shepard Madness' - an online binaural shepard tone generator to demonstrate the sort of illusion exploited through the score of Dunkirk. Though Daniel Levitin (in Hesse 2015) questioned the impact of *I-Doser*'s 'digital doses' on cognitive state, Pigeon (2017, online) cautioned users of Shepard Madness: "this sound can cause anxiety and panic attacks. If you suffer from either of these conditions, do not listen to this sound generator".[1]

Discussion around such phenomena would be informed by greater understandings of the fact that, as with *Marconi Union*'s 'Weightless', specific intent to manipulate cognitive state through music and sound could ultimately be subjected to a mastering engineer's signal path. I have already begun establishing that mastering engineers are motivated to enhance or preserve meaning and emotions embedded within recordings (see Paton & McIntyre 2009). Any of the creative signal processing techniques I have outlined through this chapter could be employed by the likes of Patricia Sullivan, who mastered the official soundtrack for Dunkirk (see Discogs 2021b, online). I have, through this section, explained that mastering engineers can readily adjust frequency and how various bands of frequencies are distributed within the stereo field. These understandings would be relevant to anyone studying the effects of binaural or frequency phenomena in recorded audio (see Baracskai & Finn 2013).

[1] 'Shepard Madness' can be accessed at: https://mynoise.net/NoiseMachines/shepardAudioIllusionToneGenerator.php

A wide and collective demand to understand or discuss cognitive changes induced through sound, music and frequency is made further evident through some broader areas of scholarship and social discourse. I suggest that the sorts of discussion and understandings I draw from next could lead to the assimilation of more esoteric, mystical, spiritual or metaphysical ways of explaining our connection with sound and music – music, of course, being the creative medium that the mastering engineer will perform adjustments with on a day-to-day basis.[1] The 'Music as Medicine' seminar I mentioned previously had offered its thinkers a space to delve further into the wider implications of humanity's relationship with music (see Wong et al. 2015). In the seminar proceedings, songwriter and neuroscientist Mark Jude Tramo (in Cromie 2015) is quoted for having said, "music is in our genes." Tramo added, "Many researchers like myself are trying to understand melody, harmony, rhythm, and the feelings they produce, at the level of individual brain cells." At around the same time as this seminar was held, I myself became interested in 'cymatic experiments' that demonstrated how particular sound frequencies can induce vibrational patterns to occur and be observed through mediums such as water – that which is said to make up approximately 52-63% of the human body (see Devlin 2018: 199-200; Lote 1982/2012: 2; Perlman 2016, online). St-Onge (2013, online) encapsulated a popular theory that is embraced by some modern new age thinkers - how, despite introduction of the 440Hz tuning standard, 432hz is said to "[vibrate] with the universe's golden mean, Phi, and unifies the properties of light, time, space, matter, gravity, and magnetism with biology, the DNA code, and consciousness" (see also Devlin 2018: 186-8). Long (2014: 165) set out that the musical octave "corresponds to a 2 to 1 ratio frequency, just as hydrogen does to oxygen in the water molecule."[2]

I began sensing that conundrums relating to humanity's connection with sound, frequency and music had often been pondered in ways similar to distinct issues that pertain to a longstanding quest for fidelity through record production and sound reproduction (see Milner 2010). Discussion around such issues suggested that boundless truth-seeking missions are functioning in the realms of music and audio. I

[1] See: Berendt 1983; Chaudhary 2020; Ehrlich 1997; Ingram & Mishlove 2021, online

[2] Long's (2014) 'The Psyche as Interaction: Electromagnetic Patterns of Conscious Energy' examined neurophysiology, religion, music, psychology, physics and mathematics to draw connection between these fields.

had observed people draw upon science to better understand how recorded music is reproduced and also perceived. On the other hand, I had observed people convey certain ideas that resonated suitably with statements put forward by editors of the Music as Medicine seminar proceedings. These editors expressed that "biological explanations and clinical observations may not do full justice to the effect music has on man and his world". They added, "fortunately, poets and philosophers can fill in the gaps" (*Harvard Health Publications* 2015: 18). As someone who had carried out various roles in the wider music industries, I enjoyed participating in some informal and philosophical discussions regarding people's emotional connection with particular record production techniques and high fidelity sound. The words offered by editors of the Music as Medicine proceedings reminded me of some profound and mystical though perhaps sensationalised sentiments on which I had observed many discussions settle. For me, the compelling essences of these sorts of discussion might duly be captured through words popularly attributed to the late inventor Nikola Tesla (b.1956, d.1943). "Our entire biological system, the brain and the earth itself work on the same frequencies", said Tesla (source unknown). "If you want to find the secrets of the universe, think in terms of energy, frequency and vibration." This quote alone is made interesting in light of the fact that frequency and audio frequency adjustment falls distinctly within the purview of a mastering engineer.

Editors of the Music as Medicine proceedings had also cited US author Garrison Keillor (see *Harvard Medical School* 2015: 22). The editors agreed with Keillor, who had, I felt, tendered an example of the profound sorts of perspectives shared with me by musicians, engineers and music fans who attempted to draw connections between humanity and music. Keillor said, "to sing […] in the company of other souls, and to make those consonants slip out so easily and in unison, and to make those chords so rich that they bring tears to your eyes. This is transcendence." The term 'transcendence' relates to the term 'trance', which I suggest can be used to describe how music listening induces, in Negus' words (2012: 483), "an acute feeling of time passing; of giving oneself up to the moment; of existing within memories; of losing all sense of measured clock time". I submit that the ideas popularly attributed to Nikola Tesla are enlightened further by a quote connected to the late Indian monk, guru and yogi Paramahansa Yogananda (b.1893, d.1952).

Yogananda is attributed for saying, “Sound or vibration is the most powerful force in the universe. Music is a divine art, to be used not only for pleasure but as a path to awakening” (source unknown).

Hearing music described as a divine art, I am reminded of the crucial role songs play in religious ceremonies. Music, in live or recorded form, may be considered as a technology through which people access higher states of spirituality or perceived consciousness. I have observed that original music and lyrics can be explained as art that is ‘channeled’ to the composer from a transcendent place. Via my own pathway to professional status as a mastering engineer I worked with a Brazilian group whose original ‘medicine songs’ were inspired partly by music related to the *Santo Daime* church native to their country. Followers of the syncretic and now more internationally recognised *Santo Daime* religion, together with members of *União do Vegetal*, embrace the ‘plant medicine’ Ayahuasca as a sacrament and divine teacher in their ceremonies, or ‘works’. Those in ceremony have what are described as profound religious and purgative experiences that are all together accompanied by rhythmic music and lyrics. Rick Snoman (2009: 251-252) made reference to ways by which shamans had helped induce states of trance in others. This was done through the administering of “hallucinogenic herbs and rhythms”. The musical *Santo Daime* religion draws influence from shamanism as it has traditionally been practiced in the Amazon. My own creative approach to mastering the Brazilian group’s recordings (see *Canto dos Curandeiros* 2021) had been performed with a dedicated effort to understand the music’s context and purpose. I attempted to decode the artist’s musical intentions and understand any teachings embedded within their songs. Through these experiences, I sensed even more that thorough and nuanced understandings of the mastering engineer must be encouraged. The job of mastering is one that involves but also transcends the observable manipulation of frequency and sound. Mastering engineers are driven to help realise artistic visions, and they do so by forming a broader sense of recordings, their distinctive contexts and meanings.[1]

[1] For more about the *Santo Daime* church, *União do Vegetal*, Ayahuasca and the music involved with these cultures I suggest the following sources: Harris 2017; Kilham 2014; McLean 2018; Narby 1998; Nemu 2019, online; Pinchbeck & Rokhlin 2019; Polari de Alverga 1999/2010

Over the course of my research programme, another insight into the deeper implications of music and recorded audio had come not only to my attention, but also to the attentions of many. On 23 September 2016, *Decca Records* released Ted McDermott's (see Songaminute Man 2016) cover of 'You Make Me Feel So Young', formerly recorded by Frank Sinatra (1956) and Ella Fitzgerald (1959). McDermott had been diagnosed with Alzheimer's disease in 2013. The mixing and mastering of the charity single at famed *Abbey Road Studios* came after McDermott and son's "carpool karaoke" videos went viral via *YouTube* (see Bishop 2016, online). The videos demonstrate how those living with the disease seem to remember and respond to an extensive amount of recorded music, whilst their aptitudes for recalling other information might be in decline. Around the same time, I observed other instances of these particular experiences begin to permeate from various mainstream news outlets, and I tuned in as McDermott consequently received a 'Pride of Britain Award' for 2016. Through all this, I was reminded that emotional or neurological responses to music might not be determined only by the fluctuation and organisation of various musical factors such as rhythm. The context in which music and lyrics are heard and the nostalgic feelings they evoke might also influence these sorts of responses. It struck me that engineers are often hired to 'remaster' catalogues of cherished music and perform further creative adjustments on the distinct tonal, spatial and dynamics attributes of what have been long established as socially significant and sentimental recordings.

Meier (2011: 399-400) presented a study that offered me another way into underscoring the wider significance of understanding aesthetics and creative processing in mastering. The study would also broaden my grasp on the relationship sonic phenomena has with human emotions and everyday life. Meier observed the extent to which recorded music is "aggressively deployed across audio-visual mediascapes and commercial spaces". Sterne (1997: 25) had previously argued that "programmed music in a mall produces consumption because the music works as an architectural element of a built space devoted to consumerism". To me, this idea was suggestive of notions that have been tackled sufficiently through the discipline of Sound Studies. Music and sounds are symbolic of our world, and both form the sonic architectures of our society (see Thompson 2002). Meier's study helped me grasp the extent to which a mastering engineer's

work and their sonic signatures would permeate environments where people are obliged to hear music.

"Sonic branding", Goodman's (2010) term, involves the careful selection of recorded music in order to construct a sense of identity around products or brands. I had observed examples of sonic branding through televised adverts produced during the 2010s. Adverts broadcasted in the run-up to Christmas were often set to sentimental sonic backdrops of reappropriated popular song. Reflecting on Marks (2002: 114) and Wenzel (2004), Bijsterveld (2010: 202) had suggested that 'experience societies' respond to "how appliances feel, smell, or sound and how that fits the buyer's identity" (see also Howes 2005: 293; Schulze 1992). In an experience society, recorded music can offer 'sponsoring brands' (see Meier 2011: 399) a degree of emotional leverage. After a record has been produced and mixed down to stereo, the mastering engineer can perform any of the creative processing techniques I have introduced in this chapter. Through paying close attention to various examples of sonic branding, we may deduce that music is chosen to represent brands partly on the basis of how it sounds as a result of its time with a production team – including the mastering engineer. It could be said that loud-sounding recordings help signify power, quieter-sounding recordings something else, and production aesthetics as a whole can engender certain feelings around products when music is used for marketing. Meier's study also outlined some political economic factors at play in the modern recorded music industry, whereby professionals may rely increasingly on licensing as a source for revenue and promotion, with brands "in a position to set the terms, the rules and the price" (402).

Here in *Chapter 3,* I have outlined some key significances of mastered audio in society. This has presented answers to my third research question. My work has also offered further justification for broader disciplines of scholarship to make greater sense of professional mastering culture and creativity. Mastering is a process that can be studied in order to expand our awareness of the emotional implications and social significances of sound.

Chapter 4: Methods of Researching Mastering

In this chapter, I will sketch out the methods I adopted to carry out original studies that answer my research questions (see page 13). Applying my methodology allowed me to explore deeply into a new culture of 'Creative Mastering'. In this chapter, I will also explore how others have researched mastering. For my own studies, I constructed a multimethodology that comprised of mixed qualitative approaches to collecting data. The first approach was semi-structured interview, and the second was autoethnography - a method of empirical data collection that often comprises of text-based explanation and illustration through critical reflection. It is worth noting that interview is quite commonly recognised as a component of ethnography and autoethnography (see Hobbs 2006: 101; Willis and Trondman 2002). I chose to regard and define 'interview' as a separate aspect of my research, owing to my extended use of interview-based observations and interpretations alongside autoethnographic reflection.

I will outline and justify my adoption of each research method under separate headings – *Semi-structured interview* and *Autoethnography*. I will also assimilate ethical considerations that are subject to each approach. Before moving on to explore further into how others have researched mastering, I offer a more general substantiation of my ethical approach and approach to managing data. The key researchers I discuss under the heading *Others Researching Mastering* are Shelvock (2017), Hepworth-Sawyer and Hodgson (2018). I have chosen to make further mention of their methods for a number of reasons. First, I recognise that their research into mastering was recent at the time of me writing this thesis - their research was published after I had initially interpreted and theorised much of my own original interview data. Second, I feel that their research topics, methods and aims in particular were highly relevant to my own. Finally, I recognise that we share similar perspectives on the still present disparity between the quantity and breadth of scholarship that has addressed mastering versus the quantity and breadth of scholarship that has addressed other phases of production. I will establish how my

own research activities offer new and original contributions to our understandings of mastering.

Semi-structured Interview

Adams (2015: 493) outlined that 'semi-structured interviews' are "conducted conversationally with one respondent at a time." At the start of 2015, I planned to conduct a series of semi-structured interviews with 20 mastering practitioners and capture each of these as audio recordings. These interviews would occur separately and they would be staggered over the course of just over three years. In my initial planning, I had established that semi-structured interview would yield sufficient qualitative data for interpretation, comparison and contrast. Though a more structured interview format might have also gathered sufficient qualitative data, I felt that semi-structured interview would promote a more open-ended series of conversations. Ayres (in Given 2008: 810) had described the semi-structured interview as "a qualitative data collection strategy in which the researcher asks informants a series of predetermined but open-ended questions." To this, she added, "the researcher has more control over the topics of the interview than in unstructured interviews, but in contrast to structured interviews or questionnaires that use closed questions, there is no fixed range of responses to each question." I thus felt that this approach was essential for gathering rich and original data that would cultivate varied opinions, insights and conversational trajectories (see also Edwards & Holland 2013: 2-3; 29; 54). My decision was further founded in Adams' (494) assertion that semi-structured interviews are valuable in contexts he described as follows:

> - If you need to ask probing, open-ended questions and want to know the independent thoughts of each individual in a group
>
> - If you need to ask probing, open-ended questions on topics that your respondents might not be candid about if sitting with peers in a focus group

- If you are examining uncharted territory with unknown but potential momentous issues and your interviewers need maximum latitude to spot useful leads and pursue them

I decided to select and contact each engineer via email and with a view to gather contrasted understandings and interpretations of professional mastering in a cross-section of the recorded music industry. Adams advised, "rather than making a 'cold call', researchers should send a short letter of introduction in advance" (495). When choosing whom to send an introductory email, it was my intention to aim for a fairly mixed bag of research subjects. The participants would be varied in terms of their discography, the genres they tend to work with, experience, location, and historic recognition through award. I also chose to target practitioners who were clearly able to secure regular mastering work; an approach that would align with the methodology undertaken by Shelvock (2017) via his doctoral thesis, *Audio Mastering as a Musical Competency*. Shelvock drew on already published interviews with "those who master records professionally" (12). From this, readers might assume that Shelvock had considered the opinions and teachings of practitioners who operate on a full-time basis. I would agree with Shelvock's assessment that "it would be misleading to base […] discussion of audio mastering on the perspectives of recordists whose work is not readily available, or heard by few." For his thesis, Shelvock chose to "consider the perspectives of engineers whose work has been *peer-reviewed*, as it were, by the recording industry […] above those working in relative isolation."

Those who were willing to be interviewed for my own research into the creative culture of mastering are listed in *Appendix A*. My Director of Studies had historic personal and professional affiliations with mastering engineers Schmidt and Astley, who agreed to be interviewed in the early stages of my research. Some of the engineers who agreed to interview in the early stages would become "sponsors" (see Walsh 2004: 231). By this, I denote that they would encourage me to speak with other specific engineers and that they would often help arrange for the connection to be made. Their referrals would help break down initial barriers to access. I observed that issues of access, membership, trust and authenticity had been understood and widely documented as common obstacles to performing

qualitative research successfully. I thus followed advice that was contained in much of the literature that had addressed such issues.[1] I paid particular attention to advice concerning the adoption of appropriate communication and interpersonal skills. This enabled me to arrange and conduct interviews successfully over the course of my study. I noted that Johl and Renganathan (2010: 50) had identified strategy, planning, flexibility and adaptability as key preconditions for accessing qualitative research opportunities successfully.

Ayres (in Given 2008: 810) advocated that researchers plan a "written interview guide" for semi-structured interviews (see also Adams 2015: 496-500). Ayres said that this should contain a series of questions, prompts or cues. I ensured that questions or cues in my own guide were constructed in view of relevant information gathered largely through review of extant literature and scholarship (see chapters one to three). I also ensured that my interview questions were established in view of my allotted research questions. I performed broad online and offline research into the careers of each engineer where possible. I also drew inspiration from my own academic and industry experiences to date. All this resulted in a broad series of general and career-specific questions or cues. "Once developed", Adams (2015: 499) wrote, "the interview guide [should] be considered a work in progress. It remains subject to change for this reason: in the field, as feedback quickly begins to accumulate, adjustments will need to be made" (see also Galletta, 2013). I embraced this perspective and sought to refine my questions and cues as I worked my way through each interview, whilst at the same time forming deeper theoretical insights via ongoing engagements with secondary sources.

I aimed to eliminate pre-supposition or framing questions in ways that imply I harbour my own assumptions of what the subject's answers are likely to reveal (see Silverman 2010: 197). Ideally, in order to yield authentic responses to questions, my own research participants would not be foreshown or told the specific literature and strands of academic scholarship that I might later be using to theorise and interpret their discussions. Yet, participants could be offered a brief of the research, its aims, and an appraisal of how their participation might benefit themselves and society. If

[1] See Anderson 2011 361-3; Feldman et al. 2003; Hammersley & Atkinson 2007: 75; 1997: 54; Harrison, MacGibbon & Morton 2001; Hine 2008; Johl & Renganathan 2010; Okumus et al. 2007; Thompson & Lashua 2014; Widding 2012

requested however, the areas of academic scholarship I would use to analyse participant discussions could be explained to the interview subjects.

The interviews would be conducted either in person or via *Skype* conference call. I would follow guidance offered by Adams (2015: 493), who suggested that semi-structured interviews should last approximately one hour, so to "minimize fatigue". Many discussions exceeded this time, as shown in *Appendix A.* I would also follow Anderson's (2011: 366) advice that had been offered as part of his recommendations for good ethnographic research practice. Anderson said, "ethical practise would require that the presence of [a] recorder be made known". I would ensure that practitioners offered clear verbal consent for their interview to be recorded as audio. The audio would be transcribed, parts quoted in the manuscript, and I would send practitioners a selection of their direct quotes I include and draw from in the working thesis draft, along with the key contexts set out. This would be prior to the thesis and thus my scholarly interpretations of these quotations being submitted (see Adams 2015: 501-502). I would send these quotes via email. In receiving these quotes, practitioners would have chance to request anonymity, changes or exclusion in any particular instance. This would help to ensure participants (or other parties they mention such as artists or mix engineers) cannot be identified by their name, institutional affiliations or involvements. Having taken this approach, I knew it would be counterproductive to include full interview transcripts in the appendices of the thesis. *Dulcie Barnes Audio Transcription Services* provided professional transcripts of the interview recordings. The service's terms and conditions aligned with my own ethical considerations and methods of safely managing data that I present later in this chapter:

> In the current climate of prolific computer viruses, all incoming emails, files or disks will be scanned. However, even after scanning, I will still not open unsolicited attachments to emails or emails which contain no message alongside the attachment.
>
> Audio files are deleted upon payment of invoice. Back-up copies of transcripts are kept for a period of six months only. After that time, they will be deleted.
>
> (Barnes 2015)

Hall et al. (2008: 1026) posed the question: “in what ways might background noises and incidental sounds, audible context and interference, lend character to the interview and aid analysis?” They later said, “noise may well interrupt or disturb; but we do not see that this need be a problem for the qualitative researcher – it may even be an opportunity” (1036). Thus, and in line with ideas set out by recording studio ethnographers Thompson and Lashua (2014: 2-3), who acknowledged the “richness and repeatability of video and audio”, I analysed all 20 transcriptions whilst listening to their corresponding recordings (see also Forsey 2010: 561). This better ensured that the meanings I derived from the transcripts matched with the meanings suggested through words that had been spoken. The interview discussions were studied en masse, and this allowed me to discern any common or contrasting themes. The discussions were also studied in terms of how they might impact on understandings I had garnered through review of extant scholarship and knowledge. The clear and crucial themes that arose through interview helped guide me through ongoing engagements with various strands of scholarship. The pervasiveness of particular themes helped determine the headings and subheadings that I have now used to logically compartmentalise my research set out through all remaining chapters of this thesis.

I adopted a constructionist model of identifying and considering how responses to interview questions might be “actively constructed ‘narratives’” (see Silverman 2010: 189-191), or a “reality jointly constructed by the interviewer and interviewee” (Rapley 2001; 2004). ‘Elite’ interviewees might hold academic interview in a similar regard to media communications; they might offer controlled responses and speak less openly about their practices. Interviewees working for larger or more widely known businesses might also be required to respond to questions in accordance with company values, policy, privacy, mission statements or codes of conduct. I anticipated that some of my own interview participants would request copies of written interview guides and questions prior to speaking. Though fulfilling these requests might engender more considered and less intuitive responses, I would be obliged to respect them. In light of these epistemological issues, I knew I needed to maintain careful and critical analyses of the data before making sense of each revelation as an authentic reality. By including an autoethnographic component into my methodology, this would help to supplement understandings garnered via semi-

structured interview. Conducting autoethnographic research would allow me to gain, in Anderson's (2011: 351) terms relative to ethnography, "a member's understanding of what and how things are done in the membership as well as the values attached to those practices." Thus, autoethnography would ultimately lead to a broader grasp of professional mastering culture and its creative significance to popular music.

Autoethnography

Marrington (2016: 267-77) argued, in Shelvock's (2017: 6) terms, "that educators must possess songwriting skills in order to teach songwriting" (see also Toft 2010: viii). I myself suggest, having already associated the creative work of the songwriter with the creative work of the mastering engineer, that researchers who focus on mastering might similarly do well to develop their artistic and technical skill for a better understanding of the discipline. I have resolved to develop creative and professional mastering expertise over the course of my study. This activity would form part of my autoethnography. Whilst Shelvock advocated some 'practice-centered' research methods that I will outline later, I felt that autoethnographic fieldwork could offer an appropriate vehicle for me to demonstrate a degree of practical understanding. I will continue to circumstantiate my adoption of autoethnography and each element of this approach. I will first clarify my understandings of the originating field of ethnography.

Carter (2013: 90) cited Hammersley and Atkinson (2007) for having identified the "complex history" of ethnography and how this complex history could hinder attempts to clearly define the term. Ethnography can involve, according to Hine (2008: 261-2), "making strange things familiar by deploying sociological or anthropological concepts to interpret what might otherwise seem radically different cultural practices." Willis and Trondman (2002) described their view of ethnography as "a family of methods involving direct and sustained social contact with agents and of richly writing up the encounter, respecting, recording, representing at least partly in its own terms the irreducibility of human experience." Similarly, in Hobbs'

(2006: 101) view, ethnography is "product of a cocktail of methodologies" – a cocktail that includes interview and participant observation, as identified by Carter (2013: 90). I previously conveyed having chosen to regard and define 'interview' as a separate aspect of my research, owing to my extended use of interview-based observations and interpretations alongside autoethnographic reflection. Anderson (2011: 351) defined 'ethnography' as "the writing of culture", and Willis and Trondman (2002) denoted "the centrality of 'culture'" as one of its distinguishing characteristics. Anderson (2011: 351) also stated, "in its appropriation by communication, [ethnography] has come to mean any outsider's analysis of any membership that organizes itself across discourse and performance." To all this, I add that an ethnographer will bring forward an understanding of practices, behaviours and cultural phenomena through spending time in the field (see Matthews & Ross 2010: 134-135; Willis and Trondman 2002: 400).

Classically, ethnographers will adopt objective approaches to their fieldwork - they uphold clear boundaries between the participants they are researching and themselves who are observing. Whilst traditional forms of ethnography have been deemed suitable for investigating and observing creative music production,[1] I note that they can present difficulties (see Thompson and Lashua 2014). Bates (2008: 16) identified that ethnographers in recording studios are met with problems that relate to having limited scopes of access whilst they attempt to document their observations of tacit engineering work. "There is a disjuncture", he explained, "between the nature of *appearance* of the work at hand (an outsider's impression of a human interface between technology and art) and the *actual* work involved in producing recordings." I contend that these sorts of difficulty would stem from the traditional 'fly-on-the-wall' nature of ethnography and, in Reed-Danahay's (2017) terms, "the persistent dichotomies of insider versus outsider, distance and familiarity, objective observer versus participant, and individual versus culture". I also contend that these 'dichotomies' might arouse wider issues related to access, membership, trust and authenticity. Such issues often arise when planning for ethnographic

[1] See: Bates 2008; Fitzgerald 1996; Hennion 1990; Meintjes 2003; Porcello 2004

research.[1] It was during the early stages of my research design that I recognised I would become better placed to overcome issues of access, membership and trust if I could demonstrate willingness and drive to develop creatively as a mastering engineer throughout my course of study. I would thus "blend in with the community" (Shenton & Hayter 2004: 225-230). With increased creative audio engineering skill, I would also be able to employ "studio etiquette" (Thompson & Lashua 2014: 12-13), "locally specific humour and language" (Hine 2008: 259, in the context of 'virtual ethnography'). Developing appropriate strategies for communication would enable me to better negotiate membership within the professional culture of mastering (see Porcello 2004; Thompson & Lashua 2014: 7-9; Widding 2012). I recognised that being an active and aspiring member of the professional mastering community would also mean that I could devote my own subjective interventions and experiences to strengthen the research. I felt that deviating from a strictly objective approach would allow for more varied and authentic insight into themes that emerged out of existing literature. It would also allow for more varied and authentic insight into practices discussed through semi-structured interview. As Shelvock (2017: 201) stated, "human subjectivity informs the mastering process". For these reasons, I explored a reflexive and autoethnographic approach to conducting the fieldwork described later on in this section.

'Autoethnography', as Reed-Danahay (2017) acknowledged, is a term that has been discussed and debated by academics (see also 1997: 3-4; Ellingson & Ellis 2008: 449). Reed-Danahay identified that academics might use the term to describe either "the use of personal narrative in ethnographic writing", or "the ethnography of one's group" (see also 1997: 5). In either sense, autoethnography has embraced perspectives and agencies of the self; it has valued the researcher's inside membership, investment or collaboration within the culture in question (see also Adams, Jones & Ellis 2015; Reed-Danahay 1997: 1-17). Ellis (2004: xix) defined autoethnography as "research, writing, story, and method that connect the autobiographical and personal to the cultural, social, and political". In this logic, autoethnography does not render the researcher as an "objective outsider". Nor does it refrain from examining the researcher's own experience and agency (Reed-

[1] See Buchanan et al 1988; Feldman et al. 2003; Hammersley & Atkinson 2007: 75; 1997: 54; Harrison, MacGibbon & Morton 2001; Johl & Renganathan 2010; Okumus et al. 2007; Thompson & Lashua 2014; Widding 2012

Danahay 1997: 6). In her introduction to a collection of essays that presented "important contextual histories to the trends associated with [autoethnography]", Reed-Danahay (2017) also expressed that the research method has generally combined three forms of 'critical reflection' and 'narration':

- Portraits of a social group the author-anthropologist is affiliated with

- Life writing or other autobiographical acts that incorporate ethnographic description of their social group

- Anthropological writing that includes reflexive descriptions of research experiences during ethnographic fieldwork

Ellingson and Ellis (2008: 449) stated, "whether we call a work an *autoethnography* or an *ethnography* depends as much on the claims made by authors as anything else." My research encompasses all three of Reed-Danahay's designated forms of critical reflection and narration. I offer reflective accounts of my research processes, in addition to personal and anecdotal experiences relative to my creative and technical development as an aspiring member of the professional mastering community. I also engage with methods of critical reflection and narration, and these methods are applied to specific instances of fieldwork that will be discussed in the remainder of this section. 'Autoethnography' is thus an appropriate descriptor for the methods of research I adopted via fieldwork conducted alongside semi-structured interview.

Though much of my fieldwork is definitively autoethnographic, there are some instances and passages in my thesis where I may convey more objective and categorically ethnographic perspectives. Though ethnography and autoethnography are not necessarily interchangeable terms, I suggest that both qualitative research methods are closely associated in so far as the theoretical and epistemological underpinnings of autoethnography are a by-product and adaptation of those underpinning traditional ethnography. I have adopted 'autoethnography' to imply a style of carrying out ethnographic work. I have embraced my subjective agency and self-reflexivity, in addition to personal or anecdotal experiences, as valuable supplements to traditional and objective means of observation. I have already cited Reed-Danahay (2017), who recognised that autoethnography can be interpreted as

"the use of personal narrative in ethnographic writing." She also stated, "[autoethnography] reflects a view of ethnography as both a reflexive and a collaborative enterprise" (see also 1997: 2; 5). Ellis (2004: 31) regarded authoethnography as "a form of ethnography". In a similar sense, Maréchal (2010: 43, my emphasis) defined autoethnography as a method involving "self-observation and reflexive investigation *in the context of ethnographic field work and writing*".

In the second part of *Chapter 5*, I will theorise my personal reflections on historic and degree-level Music Technology training, attending the *Vlado Meller Mastering Workshop Series* in September 2016, and continuing to develop professionally in mastering from then onwards. Meller's workshop took place over three days. There, I assumed an active role as one of four student-mastering engineers. I declare once again that self-reflection on my own mastering training and learning through online resources will offer first-hand and modern-day insight into professional mastering culture at points of skill acquisition, career access and development. My autoethnographic reflection will also show how particular routes into mastering can manifest in different approaches to creative decision-making, technical operation and professionalism. In line with my second and third research questions (see page 13), my reflections will illuminate how creative and professional practices might now be influenced by teachings offered through formal curricula, assistantship or other cultures of learning afforded through contemporary digital landscapes.

After attending Meller's workshop series, I engaged in a series of equipment testing sessions throughout 2017 and 2018 at Lewis Hopkin's *Stardelta Mastering*. These research opportunities developed separately and these engineers were not associated professionally. Something of a close mentorship developed between Hopkin and me, and that this occurred subsequent to our interview in 2016. This would differentiate Hopkin from the other interview participants, who have remained largely at critical distance. Hopkin became a key guide and mentor who has been crucial to my continued formation of creative expertise and membership understanding (see Anderson 2011: 363). There was a clear reason why I decided to reflect on my engagement in equipment testing sessions at *Stardelta Mastering* and offer this as a brief supplement to my interpretations of original interview data. These reflections would aid me to more fully establish the cultural and creative

significances of equipment used and often selected on phenomenological bases for mastering. These are concepts addressed through *Chapter 6*.

As I explained in my introduction, issues related to the future of mastered audio in society were beyond the scope of my core research. Nonetheless, via *Appendix B*, I offer some considerations of how mastering and mastering engineers may retain significance going forward. Some of my final observations draw from autoethnographic reflection on having spoken and having observed others speak in London at the 2018 inaugural mastering conference held by the *AES*.[1] I decided that by attending this conference not only as a speaker but also as an observer, I would be better disposed to discern the importance of mastering engineers maintaining cutting-edge expertise whilst digital technologies and innovators help give rise to a series of emergent codecs, concepts and standards. Through *Appendix B*, I explain how research and development teams who support the growth of modern formats and standards are appealing to the professional mastering community for feedback. In this way, we can understand mastering engineers as agents for technological change. Through performing autoethnography and observation at the conference, I would be immersed in and able to draw insight from another aspect of mastering culture.

At an earlier stage of my research, I had decided to use other aspects of fieldwork reflection to supplement findings and interpretations brought forward via interview. This additional autoethnographic work has helped me to more thoroughly unpick and interpret a variety of concepts. I have conducted interviews in some famed studio locations. Drawing draw on my experiences and feelings of having done so has contributed broader perspectives that have helped establish the cultural and creative significances of mastering.

Junker (1960) brought forward a concept of there being four possible positions that ethnographers might adopt through fieldwork (see also Hine 2008: 261-2). These positions can be used to explain the degree to which research subjects might be aware of the researcher, and the degree to which researchers themselves have agency in the field. In the early stages of planning my research, I felt that Carter

[1] See *Appendix C* for a full conference schedule.

(2013: 94) had offered a useful summary of these positions in his doctoral thesis, which presented an amalgam of ethnographic and autoethnographic research concerning fan production in Euopean cult cinema. I have constructed an original table to depict Carter's summary of Junker (1960) as follows:

Position	Involved	Covert
Complete participant	✓	✓
Complete observer	✗	✓
Participant as observer	✓	✗
Observer as participant	✗	✗

Fig. 5 Carter's summary of Junker

Carter had also cited Hammersley and Atkinson (2007: 57), who suggested the importance of declaring oneself present as an active researcher at the site of study, thus avoiding "deception". In spite of their assertions, the authors acknowledged how epistemological difficulties might well occur when researchers announce their presences in particular contexts. Carter continued to cite Walsh (2004), who had made specific reference to ethnographies conducted by Holdaway (1982) and Chambliss (1975). In Carter's terms, these crime researchers "had no other option but to conduct their research covertly." It was clear to me from the outset, that there might be instances in my own proposed research where complete transparency may negatively impact upon the authenticity of how members of the culture would perform in a given context. Yet, I also recognised the potential for entirely covert research to be considered exploitative in particular instances where information being discussed is private, considerably harmful, questionable or unfavorably attributable to particular individuals and institutions. Where necessary in this regard, I rationalised that it would be fair and ethical, after theorising particular autoethnographic elements of my data into a coherent draft, to run specific material past the relevant contact or contacts. Again, this process would be completed via email and prior to me submitting the thesis. The relevant personnel or institutions would have time to request anonymity, changes or exclusions. There would also be

time to ensure participants (or other parties they mention such as artists or mix engineers) cannot be identified by their name, institutional affiliations or involvements if requested. Where relevant or necessary, participants could also be offered another brief of the research, its aims, and an appraisal of how their participation might benefit themselves and society. Again, if requested, the areas of academic scholarship I would use to analyse participant activity could be explained to each subject. Whilst my position as a researcher undertaking a doctorate to explore the culture of mastering would always be made known to each of my subjects, these steps could be carried out with the personnel and institutions that would feature through richer or more reflexive aspects of my research. Carter (2013: 106) had described his own choice to maintain contact with specific subjects in his ethnographic and autoethnographic research by "sending them drafts of work". This was in an attempt to "involve participants in the process […] in order to avoid exploiting them" (see also Jenkins 1992). Carter's research into fan production in Euopean cult cinema touched on controversial topics such as piracy.

Like Carter, I felt that the position I would adopt through most cases of conducting observation fieldwork straddled between 'complete participant' and 'participant as observer'. Carter cited Matthews and Ross (2010: 258), who did not regard the positions set out by Junker as being "separate". Rather, they accept them as "points on a continuum". I suggest three further points are to be made in light of all this, and also in light of my planned ethical approaches to semi-structured interview detailed previously. The first point I will make is that the ethical and epistemological implications of research into the creative culture of audio mastering cannot be compared with the ethical and epistemological implications of research into, say, crime or piracy (see Carter 2013; Chambliss 1975; Holdaway 1982). The second point I will make is that my intentions for conducting this research were and would remain wholly positive. Whilst adopting critical and suitably academic approaches to my writing, and whilst interpretations would be generated through the lens of my own understanding, this research would ultimately uphold that mastering is to be more widely recognised and studied as a positive and creative contribution to the production process. I would be arguing that if broader collectives of scholars are to fully understand the personnel, locations and cultures that relate to the entire recorded music production process, then creative developments in mastering

should be studied in a detail commensurate to work addressing other production specialties. The third and final point I will make is that I have ultimately sought to exclude any dialogue and reflection that I felt could be threatening to reputation, custom or employment. Carter (2013: 105) cited Hammersley and Atkinson (2007: 222), who termed this approach as “self-censorship”.

All anonymous attendees at the *Vlado Meller Mastering Workshop Series*, and also Meller himself, would be made verbally aware of my general research interests and aims. However, I rationalised that stating my intent to observe the social dynamics of each session would undermine the capacity for those involved to be at ease and thus authentic in the learning environment, even when they remained anonymous. All who were involved in equipment testing sessions throughout 2017 and 2018 at Hopkin’s *Stardelta Mastering* would be made aware of my research. I would thus be assuming the ideal position of ‘participant as observer’ in these instances. Meller and Hopkin ultimately received drafts of work that reflected on and theorised experiences I gained through attending their studios for extended periods of time. Having agreed to present in London at the 2018 inaugural mastering conference held by the *AES*, prospective attendees would also be made aware of my general research interests and aims through my listing in the conference schedule. Though I would be covert in my efforts to observe and thus reflect on this event, I would only be reflecting, much like an industry blogger, on social interactions, technical demonstrations and exhibitions of intellectual property that are presented in the public sphere. Moreover, the *AES* planned to film each paper, presentation and discussion for their own succession of content to be dispersed publicly and via the Internet.

In instances where I would be visiting a studio, observing the experience of conducting an interview and reflecting on any feelings that arise, I grasped that my position would straddle very much between ‘complete participant’ and ‘participant as observer’. This is because, in line with my approach to conducting semi-structured interview, participants and institutions would be made aware of my overall research brief, its aims, and my intended use of dialogue being captured. They would not be made aware of my intent to reflect on some of the subjective sensory information related to the interview experience and setting. I have already

indicated that, in instances where information being dealt with is private, conceivably harmful, questionable and unfavorably attributable to particular individuals or institutions, it would be deemed both fair and ethical, after theorising autoethnographic elements of data into a coherent draft, to run specific material past the relevant contact or contacts. I also made two further points. The first being that my intentions for conducting this research were and would remain wholly positive. I said that whilst adopting critical and suitably academic approaches to my writing, and whilst interpretations would also be generated through the lens of my own understanding, this research would ultimately uphold that mastering is to be more widely recognised and studied as a positive and creative contribution to the production process. I would be arguing that if a broader collective of scholars are to fully understand the personnel, locations and cultures that relate to the entire recorded music production process, then creative developments in mastering should be studied in a detail commensurate to work addressing other production specialties.

In the context of planning for ethnographic research, Anderson (2011: 366) had stated that “the effort of participation is lost without adequate field notes.” Anderson denoted ‘field notes’ as “narratives”, and thus, I would capture my autoethnographic undertakings predominantly through reflective narrative in writing. Anderson had also argued that “writing is the third pillar of ethnography along with observation and participation”; “field note writing calls on the analyst to gather all the resources for understanding what went on and then to bring that understanding into a textual form.” As an autoethnographer, I would reject Anderson’s guidance to “become the observer of you, the participant” – a premise more pertinent to ethnography. Rather, my subjective agencies, feelings and lived experiences would take greater precedence. Adopting a reflective approach to generating field notes would enable me to understand a) what skills, experiential knowledge or language I acquired; b) how and why particular actions were carried out in the context; c) what was or was not understood and what yielded further questioning. Through my reflective writing, I would also document conversations, places and reminders. I would catalogue or archive, in Anderton’s terms again, “pictures, artifacts, texts, measurements, new vocabulary, ways of speaking and acting and other observations that were noteworthy.” Knowing that I would also develop a collection

of self-mastered audio at the *Vlado Meller Mastering Workshop Series*, I decided that my source audio and mastered exports should be archived. This audio would help me to reflect on my processes of learning. In short, I intended to collect any relevant or helpful data, provided it would help make better sense of creativity in mastering (see Hammersley & Atkinson 2007: 3; see also 133). With an awareness of obstacles to producing real-time fieldwork notes whilst operating in studio settings (see Thompson and Lashua 2014: 16-17), I would always type-up my findings with immediacy after each session, interview or event had taken place. Anderson (2011: 357) advocated the naming of an 'auditor' to act as someone who "will critically evaluate the writing [or field notes] for the strength of its evidence." The elected supervisory team for this research project would be nominated to assess all reflective writing that would be included in the final draft. After tackling some of the ethical implications I have outlined throughout this chapter, it became clear that to include full copies of my raw and original field notes in the appendices of my thesis would also be counterintuitive. Likewise, I decided it would be counterintuitive to capture certain elements of fieldwork via audio or visual means (see Thompson & Lashua 2014: 16-23).

Before I finish this section by offering a more general substantiation of my ethical approach and approach to managing data, I wish to review and make more explicit some limitations of interview and authoethnography as methods of qualitative data collection. I also wish to review and make more explicit some of methods of research I rejected – focus group and survey. Limitations of interview are often to do with certain power dynamics associated with the interviewer-respondent relationship (see Kvale 2006: 484). In the first instance, interview candidates may refuse to participate. They might feel that other methods of data collection could offer them a greater degree of anonymity and also flexibility in terms of scheduling. Successful interviews rely on respondents and researchers both being available at the same time and for a long enough period of time for rapport to be established. Subjects must not be pushed for time if they are to open up, feel comfortable and offer considered responses to questions. Whether or not rapport has been established is an opinion held by the researcher. A successful interview and establishing a good rapport relies on the interviewer being competent in their methods – knowing when to remain silent is a crucial component.

Making oneself available for interview comes at a cost to both respondents and researchers – both parties have to sacrifice substantial amounts of time and expense. If research subjects would otherwise be earning money and working on their craft then there is a degree of opportunity cost that must be weighed before deciding to participate on a set date and at a set time. Researchers themselves can incur travel expenses and these might threaten access to particular subjects that could otherwise participate via other methods such as survey questionnaire. During semi-structured interview, respondents could unknowingly present incorrect information or concepts – they would be in less of a position to verify facts or spend time recalling detailed information as they would be before committing a survey response. Focus groups can allow 'fact checking' to take place by group consensus. Respondents in a semi-structured interview could also and unknowingly misunderstand questions. If these same questions had been presented to them in a survey then they would have had more time to understand them. If interview questions are misunderstood then, unbeknownst to the researcher, the respondents' answers may not always be valid.

Researchers often have to trust that interview respondents are presenting honest and authentic details about their daily lives and behaviours. Respondents may not find it easy to translate what it is that they themselves do for work into words, and I have already alluded to how participant observation and including an autoethnographic component to my research would engender more complete and credible understandings of mastering as creative work. Autoethnographers, like interviewers, have to be mindful of their own biases, judgments and emotional involvements that may not appear so intrusively via other methods such as survey. Autoethnography has, as acknowledged by Wall (2016), "been criticized for being self-indulgent, narcissistic, introspective, and individualized." Méndez (2013) has said, "the personal and emotional involvement of the researcher in autoethnography contrasts with the distant and objective role of researchers' goals in a positivist stance." I suggest that good autoethnography relies on the researcher adopting an honest approach to their reflective writing, their documentation of experiences et cetera.

I rejected using survey questionnaires or focus groups as alternative methods of data collection for a number of reasons and in spite of some clear advantages that could have been enjoyed. One advantage that surveys and focus groups both have over interview and participant observation is the potential for saving time and money. A focus group can take less time to conduct than separate semi-structured interviews with the same sample. Surveys have the potential to save even more time, as the researcher does not have to be present with participants. Whilst focus groups can allow 'fact checking' by group consensus thus mitigating erroneous information, they may impede participants from being fully open, confident and candid about their individual practices, behaviours and work. Focus group participants can remain reticent or less eager to share information that they would otherwise share willingly away from peers. Participants may suppress information due to them being conscious of talking over others. In a focus group, each participant will be more restricted in terms of the amount of time they have to discuss their work, in terms of the degree to which they can steer a conversation and in terms of the level of depth they can go to in order to explain various concepts. These restrictions would only increase with larger sample sizes, and to restrict sample sizes in a focus group would engender less true a representation of the culture being studied. Ensuring that a sufficient and appropriate sample of participants from different parts of the world can all be available at the same time for a lengthy focus group discussion is an ambitious feat.

Surveys can allow researchers to reach a much larger sample size, and participants may elect to remain anonymous. While surveys can also mitigate travel costs, while they can be completed in each individual participants' own time and while they can allow participants the time to fully digest a series of questions, they fundamentally promote controlled responses and bias. Surveys would not encourage a degree of open-ended conversations that could be compared and contrasted for more varied understandings of mastering culture. Open-ended conversation via semi-structured interview allows participants to answer a researcher's questions, and it also allows them to raise further questions that they themselves feel should be asked.

Prior to designing and carrying out the multimethodology I have outlined in this chapter, I chose to develop an understanding of the ethical principles and practice

policies relevant to my institution at the time of initiating research. I chose to also make myself fully aware of the obligation and responsibility to, where necessary, protect and respect participants by law and in accordance with policy (see Bertrand and Hughes 2005: 15). As an autoethnographer or visiting interviewer I would strive, if or when required, to make full sense of any policies (including health and safety), mission statements, codes of conduct, or values that are imposed exclusively by various practitioners and organisations (see Anderson 2011: 363). As appropriate, I would also ensure that my activity guaranteed the safeguarding of all relevant parties. If I perceived that particular working conditions, actions or conversation conflicted with state and country laws, or company policies, then I would ultimately seek to exclude dialogue and reflection that I saw as threatening to reputation, custom or employment. I would carry out best efforts to ensure research activity does not affect the positive reputations, relationships or rights of participants and institutions, or any associated parties. All parties would be within their rights to withdraw from the research at any time prior to my submission of the manuscript. In the interests of respecting intellectual property and authorship, I would also carry out best efforts to ensure the proper attribution of all primary and secondary source material. Secondary sources would be acknowledged via Harvard style referencing. I would likewise carry out best efforts to ensure an accurate reporting of data and findings overall. My own copies of research drafts and data would be digitised and then securely archived on a password encrypted hard drive or flash drive. These devices would be kept in locked private premises, and I would also continue to ensure that all ICT I used for conducting and storing research inside or outside of my academic institution benefited from updated anti-virus systems. Emails involving participants would also be sent via accounts assigned secure passwords, and these could be changed regularly.

Others Researching Mastering

Through his doctoral thesis, *Audio Mastering as a Musical Competency,* Shelvock (2017: i, his emphasis) aimed to interpret “core practices” in mastering as “*musical*

endeavours". Like myself, Shelvock aimed to illuminate, in his terms, "the creative nature of audio mastering". Shelvock pledged to demonstrate audio mastering as a musical competency and he would do this "by elucidating the most significant, and clearly audible, facets of this competence". This elucidation was ultimately offered through 'practice-centered' and 'creative scholarship' research methods that he would relate to an emerging 'music production studies' paradigm (see Frith & Zagorski-Thomas 2012). Shelvock (12) chose to broaden his practical mastering expertise and deem this "an integral component" of his study. For Shelvock, this involved being attentive to creative mastering techniques described through published interviews that featured engineers with reputable standing in the field. To then demonstrate mastering as a musical competency, and making his research unique in comparison to my own, Shelvock presented case study audio examples, illustrations, text-based explanations along with interpretations of "the musical ends to which records require audio mastering before they are considered complete." Like Shelvock, I also chose to hone creative and technical mastering expertise over the course of my study. Setting my research apart, I have reflected on these developments via some theoretical understandings of popular recorded music production, creative labour in the cultural industries, and social studies of sound specifically. My reflections will advance our appreciations of audio mastering culture, its creative and social significance, and how the modern industry operates. My reflections offer insight into professional mastering culture at points of skill acquisition, career access and development.

Hepworth-Sawyer and Hodgson (2018) declared their book, *Audio Mastering: The Artists*, as the first to offer "a comprehensive overview of the audio mastering process told from the point of view of the artists who engage in it" (i). They added, "in so doing, [the book] pulls the curtain back on a crucial, but seldom heard from, agency in record production at large." They also stated, "we have endeavoured as much as possible to 'get out of the way' in this book. We wanted to allow mastering engineers themselves to speak to us, and therethrough to you, about what it is they think they do when they set about to mastering a record and how they go about doing so" (2). In my introduction, I explained that Hepworth-Sawyer and Hodgson's book presents expansive and verbatim extracts from the 24 interviews that were conducted by the authors (see i). As such, the authors did not perform deep

analyses on their data – they did however provide conversational reflections as concluding discussion. In these discussions, Hepworth-Sawyer and Hodgson did not interpret, conceptualise, theorise, critique or frame their data interchangeably with existing scholarship. I said this not to suggest that the authors should have done so or that their work does not form a crucial contribution to the field. Rather, I wished to convey how my own methods for exploring the creative culture of mastering have been different. Again, I have chosen to engage deeper levels of academic analysis and I have drawn on ideas that relate to three key areas of scholarship throughout my interpretations of original interview data. I have compared and contrasted different opinions, reflections and revelations offered by different engineers. In doing so, I have shone a light on some understudied significances of contemporary mastering culture.

Hepworth-Sawyer and Hodgson posed their selection of engineers with identical sets of interview questions, also permitting "improvisation as the discussions evolved" (2). This format would, as they explained it, "ensure that each engineer addressed similar topics, so we could get a broad spectrum of opinions about some of the more pressing topics which modern mastering engineers presently face." My own approach to question design had been similar, yet, I designed registers of questions that were informed by information and ideas gathered through my ongoing engagements with wide ranges of extant scholarship (see chapters one to three). Some questions delivered in each of my own interviews had been shaped and tailored via research into whatever career histories were available for each engineer. Though having signified their historic contributions to an emerging academic field of 'music production studies' (1), Hepworth-Sawyer and Hodgson did not explain the extent to which (if at all) their questions had been influenced by one or more explicit and scholarly systems of thought.

Before closing this section and this chapter, I will mention that Birtchnell and Elliott (2018: 78) conducted original and semi-structured interviews with "professionally listed and globally recognized audio mastering engineers, including a handful who have been in the industry for more than 30 years and are considered exemplars in professional circles." Birtchnell and Elliott explained, "The empirical research also involved participant observation in nineteen studio spaces." Whilst these scholars

have too offered crucial contributions to the academic study of mastering, their findings were used specifically to analyse how artificial intelligence might impact on the creative economy of music production and audio mastering as a creative industry. Their analyses and interview extracts were incorporated into a paper titled *Automating the black art: Creative places for artificial intelligence in audio mastering*. Shelvock, Hepworth-Sawyer, Hodgson and myself have gathered and presented expansive findings as part of much larger bodies of work.

Through this chapter, I have explained and justified the multimethodology I adopted to carry out research. I also examined how others have researched the field. My own research activities have spawned new contributions to our understandings of mastering, and I will now draw interpretations from both interview and autoethnography to explore six core themes that are essential to understanding mastering as a creative culture. These themes are access, education, expertise, people, studios and equipment. They will be studied across two expansive chapters.

Chapter 5: Creative Mastering: Access, Education and Expertise

Via *Chapter 2*, I established how mastering can be examined as creative labour in the cultural industries. Mastering is a creative field through which people can 'self-actualise' and carry out stimulating work – if they can gain access to employment and maintain a stable career, that is (see Hesmondhalgh & Baker 2011: 33). Hesmondhalgh and Baker informed us that present-day demand for employment in creative fields of work would tend to outweigh opportunities for access. Furthermore, junior worker salaries are seldom generous. This means that low-paid or voluntary internships often form obligatory beginnings of pathways to professional success.

Through applying my methodology, I have interpreted that audio mastering is a 'people industry' as much as it is a creative practise. Career progression and acquiring paid work in the somewhat difficult to access field that is mastering is a function of an engineer's ability to demonstrate tangible expertise and experience, develop or draw on professional connections and cultivate trusting relationships within the wider music business. Thorley (2019: 312) said that, "despite the seemingly large reliance on technology, relationships are very much at the heart of the work of the remote mix engineer." I would say that today's mastering engineers are similarly still dependent on relationships and trust acquired over time. Before exploring how professionals work in the studio, I want to set out the process through which engineers gain creative experience, make connections and establish trust at three stages of a career. The first stage I consider is *access* - where prospective engineers cultivate their intention to actualise. The second stage I consider is *education* - where developing engineers begin to actualise. The third stage I consider is *expertise* – where engineers actualise and convey a level of knowledge about their practice that others recognise. Drawing from interview and autoethnography to explore these career stages will help us to understand the new creative culture of mastering. It will also expand our current perceptions of creative labour in the cultural industries.

Before researching the *Access* section of this chapter, I was aware that junior engineers might apply to assist at an established studio, acquire a mentor, or seek out free and freelance work with artists right away. In order to yield trust and membership understanding at this early stage of a career, aspiring practitioners typically demonstrated experience or skill in at least one of a variety of recognised creative and technical disciplines. Aspirants might also develop their fundamental creative and technical proficiencies through other eclectic means to secure work, training and mentorship, or professional affiliations and recognition within the industry. For engineers with a good foundation of experience, access to specialist mastering work and high-level training could be more easily granted through personal connections or a referral offered by someone already operating in the wider music business.

For the *Access* section of the chapter, I have analysed various narratives of career entry that emerged from my interviews. I am not suggesting that career access in today's industry is markedly different from previous decades. In actual fact, the pathways remain largely similar to those walked by some of the more senior engineers in their earlier years – particularly those who began learning their craft in the late 1990s or early 2000s. But while various aspects of career entry and access do remain largely similar, much has changed in terms of how mastering is valued and more widely understood as a creative contribution to production. Becoming a mastering engineer is far more competitive than it was, and this is matched by a proliferation of online courses, elite workshop series and masterclasses that claim to 'certify' practitioners. I explore some of these in the later stages of this chapter.

The emergence and fresh abundance of online courses, elite workshop series and paid masterclasses lead by experts is a relatively new development in mastering. This development speaks of how mastering is starting to achieve a greater degree of recognition as a creative endeavour. Enrolling on such a course not only educates a prospective engineer, but it also helps them to alleviate a degree of competition in their attempts to access paid work or an internship. At the same time, mastering workshops or courses delivered by industry professionals function to legitimise the practice as a creative endeavor - a practice that should be learned only through members of the established culture offering hands-on experience and

a closer degree of mentorship. The second section of this chapter, *Education*, reflects on my own experience of having learned and been taught mastering. I will explore how this relates to my previous Music Technology training, my attendance at the *Vlado Meller Mastering Workshop Series* in September 2016, and my continuing efforts since then to develop creatively in this field. Through all this, I also show how my own particular route into mastering has manifested in particular approaches to creative decision-making, technical operation and professionalism. By reflecting on my own experiences, I hope to demonstrate how creative and professional practices connect to formal education, assistantships and other types of learning via digital media. I will highlight the key points of skill acquisition, career access and development within mastering culture.

In the third and final section of this chapter, *Expertise*, I will delve further into how engineers who are highly active in the industry go about maintaining their status, not only as expert audio technicians, but also as those who have offered extensive creative contributions in the mastering phases of a recording. In order to develop cultural and social capital within the field, or indeed gain a competitive advantage, there are opportunities for mastering engineers to legitimise their status as an expert in many different ways: whether by association (a discography or working at an established studio facility), through industry awards and bodies, attendance at conferences, hosting podcasts or through a variety of other activities (see also Collins et al. 2019: 265).

Access

In his own podcast, Adam Gonsalves (2011: 0m20s) said, “There are as many ways to approach a career in mastering as there are mastering engineers.” In my 2015 interview with Greg Calbi, this engineer similarly expressed that there is no central school of mastering. *‘I think everybody would have gotten to their career in a different way and learned in different ways’*, he said. On reflection, these testaments resonate with my broad observations. Yet, Gonsalves had continued to offer three popular conditions of access or training that can be associated with those who gain

professional status. “Some become assistants and study for years alongside a master; some go to school and learn in a more formalised setting; others just hang a shingle outside and start mastering.” I have found that today’s prospective engineers will often be subject to blended conditions of learning. Knowledge gained in a more formal education setting can complement the process of learning through assistantship or starting out alone. This is not to say Adam Gonsalves would have disagreed back in 2011. Later on in the same podcast episode, Gonsalves (2011: 5m45s) suggested that technical and social environments offered via modern university education could present “fertile ground to plant the seeds for a career”. This tells of how aspiring engineers now benefit from some degree-level instruction in a relevant field.

Engineers who work in today’s mastering industry might have walked a combination of familiar pathways to professional status. Many will have developed palatable experience in a few areas or at least one specific area before accessing work and training. These areas include musicianship, academia (creative arts and sound engineering related), electrical engineering, live sound, music technology or other recorded music industry labour. Certainly, each pathway to professional status could be rendered unique via personal narrative. As with other forms of creative labour, career access might be facilitated through personal, professional or familial connections. Career access could also be remembered as a stroke of luck and such tropes would help uphold that mastering is a relatively unattainable, albeit creatively fulfilling career. This view of mastering might be further upheld through discussions of humble beginnings, starting out making tea and the like.

Back in 2015, I learned that Greg Calbi began his career through less creative beginnings and a personal connection. Calbi started work at *Record Plant*, New York City, where he drove their trucks in 1972. Calbi had later progressed to cut records for *Record Plant* and, in our interview, the engineer explained that his early creative and technical engineering skills were developed through close contact with *‘record producers and mixers’*. The engineer’s early entry to a job at *Record Plant* had been steered by a personal connection. *‘I got the job originally in the studio based on a friendship with a guy who I had gone to high school and college with and there was no interview and there was no resume being presented, there was*

literally an offer just to show up and drive a truck', he said, having previously told that despite a Bachelor's degree in 'Communications' and a Master's degree in 'Media Studies', there was no interface between his education and his entry into the industry. Though a university education might have offered Calbi little to no influence for accessing the music industry, Scott Hull of *Masterdisk* (USA) conveyed that being enrolled on a *State University of New York at Fredonia* course in the more closely related topic of 'Recording Arts and Music Performance' had lead him to intern for an already established Bob Ludwig at *Masterdisk*. Ludwig had been scouting for an assistant at a place where, in Hull's terms, *'there were candidates that were getting a decent education and [...] had some of the basics already underhand.'*

Adam Gonsalves and Robin Schmidt are two of a younger mastering generation who previously completed creative arts or audio engineering programmes at a university in the 2000s. After graduating, they eventually ventured into the field as proprietors of their own businesses. Whilst their university experiences were valuable, both engineers conveyed how mastering was not a sizeable element of the curricula they had been taught. Schmidt graduated from a BA (Hons) in Sound Technology at *Liverpool Institute for Performing Arts* (UK). I deduced that mastering was not really touched upon nor talked about during his time at *LIPA*. Yet, the engineer started mastering the work of other students who were enrolled at his institution, and that this was a pursuit of self-driven learning. Before mastering full-time, Schmidt gained work experience through live sound, acoustic installation, studio work, and sound to picture. These experiences might have given the engineer some exposure to trusting and prospective clients. In 2003, following these experiences, the engineer opened *24-96 Mastering* in Karlsruhe, Germany. It took approximately four years before *24-96 Mastering* became a full-time earner. On the other side of the pond, and having completed a Master's degree in Music Technology at *New York University (Steinhardt)*, Adam Gonsalves began developing his *Telegraph Mastering* in Portland, OR. He garnered further knowledge and established himself as an emerging expert through hosting *Square Cad: The Mastering Podcast*. Gonsalves described his now dormant show as a *'sort of a "fly on the wall" for people to listen to and uninterrupted conversation between two professionals talking about something.'* The engineer gained a mentor via the first

episode that aired in 2010. Mastering engineer Chris Athens of *Sterling Sound* would begin offering Gonsalves advice in the realms of professionalism and good business practice. In 2012, when Athens departed *Sterling Sound* to work freelance in Texas, Gonsalves had helped set up a new studio for his mentor. I have deduced that *Square Cad* impacted positively on the development and expansion of Gonsalves' network. Gonsalves said:

> *There was no earthly reason in 2010 for me, in the position that I was, with the clientele that I had […], to pick up the phone and talk to Chris Athens. There was no way for that to happen, other than if I was calling to interview him. […] I mean, if you look at the people that I interview […], if I just called and said, "hi, my name's Adam, I'm a mastering engineer from Portland, I'd like to just chat with you for an hour about mastering", you know, they would have hung up the phone. And so the show allowed me to make connections with those people and those are all connections that I've maintained to this day.*

Darcy Proper also graduated from *New York University (Steinhardt)*, having herself completed a four-year Music Technology scholarship. Like Schmidt, Proper supplemented her Bachelor's education by offering live sound assistance. This led to her engineering at *Soundworks Studios* (NYC). Proper's career was later propelled via the help of a university friend, who carried out *'reissue work'* in the Classical division at *Sony*. The division were looking for an ideal person to carry out *'quality control'*. Proper remembered that *'[QC] were just a list of four or five people who got called, you know, on evenings and weekends to come in and listen through the master tapes before they went to the plant.'* The engineer described this work as *'a big responsibility'*, and she clarified that master tapes would be copied four times for various plants around the world at that time. Each of these copies needed to be analysed for technical errors. Proper credited the job for having put her on the path to mastering. Over a seven-year period at *Sony* (NYC), Proper acted as 'Assistant Recording Engineer' and 'Remastering Engineer' for classical and Broadway reissues, before graduating to the position of 'Senior Mastering Engineer' in 1998 (see Proper 2021, online). Proper saw value in her experiences gained through recording and she expressed that recording knowledge continued to bear

influences over her mastering work in 2016. *'That attitude of getting it right from the start and then being very careful in between not to do any harm is important and that is something that I still bring into my mastering'*, she explained.

Maria Triana, younger than Proper, graduated with a combined degree in Performance and Music Production & Engineering from *Berklee College of Music* in the early 2000s. Triana had previously completed a music programme at university in Colombia (see *Battery Studios* 2014, online). Echoing the university experiences of Schmidt and Gonsalves, Triana explained that a rigorous course in mastering had been left out of the degree syllabus for her *Berklee* programme. Despite receiving some thorough schooling in recording, mixing and production, Maria Triana decided against a career in any of these areas. *'I wanted to go towards mastering'*, she affirmed, indicating that the speciality had by the early 2000s developed some allure for those wishing to actualise their creativity through audio engineering. In 2003, Triana began at *Sony*, working alongside Darcy Proper and a more senior Vlado Meller. After Triana had sent out résumés to *'everywhere in New York'*, it occurred that *Sony* had required an assistant, but that this was not related to mastering. *'I figured if I just get in and work myself up then it could work out'*, she remembered. Triana's early days as a more general assistant would see her volunteer to work late and observe the responsibilities of the current mastering assistants during their normal working hours. Her experiences resonated with Hesmondhalgh and Baker's (2011) research that implied low-paid or voluntary internships often form obligatory beginnings of pathways to professional status in creative forms of labour. Eventually, Triana's enthusiasm would lead her to assist Darcy Proper, and Triana is credited for having assisted Proper when mastering Donald Fagen's (2006) 'Morph The Cat'– a record that secured Proper her first win in the 'Best Surround Sound Album' category at the 49th Annual *GRAMMY* Awards in 2007 (see *Wikipedia* 2021c; 2021d).[1]

Alex Wharton at *Abbey Road Studios* explained that his own access to a career in mastering had been helped through a familial and personal connection. Pre-millennium, Wharton studied at London's *SAE Institute* (previously *School of Audio Engineering* and *SAE Technology College*). After graduating, Wharton tried to

[1] The work of a mastering assistant is unacclaimed at these ceremonies (see *NARAS* 2015, online; 2019, online).

secure a job as a 'runner' at numerous studios. He remembered *'bombarding' Abbey Road Studios*. His persistence in contacting the Studios suggested to me that the reputation of the *Abbey Road Studios* was as prestigious back then as it ever had been previously and as it still remains to this day. Wharton explained, *'One of the technical guys, who's still here, he was best mates with my sister's boyfriend of the time.'* Wharton, whose sister's boyfriend's best friend had made sure a CV was taken in, was asked to begin work. Eventually, after gaining experience in different areas of work at the Studios, Wharton began working as a mastering engineer.

David Mitson recalled his own time in London in the late 1970s, where he worked as a bass player. He moved from London to Los Angeles and began working in the mailroom at the former *CBS Records*, prior to the company being bought by *Sony*. It was here that another personal connection would help set Mitson's own career compass towards the mastering specialty. Mitson and an already established Joe Gastwirt, who had formerly apprenticed under Bob Ludwig, were the only two employees who rode a motorbike. *'[Gastwirt] and I would share a parking space for our two bikes and we just got talking, got to be friends and then when Sony bought CBS, they wanted to build a room, […] so he came into the mail room one day and said, "hey, do you want to be my assistant?" And that's all it was. Total dumb luck.'* Mitson would progress to become, *'I guess you'd call "the main mastering person" for Sony in Los Angeles for a long time.'* I suggest that Mitson's eventual progression into mastering, the turning point in his career, should not be remembered solely or chiefly as luck. Vacancies opening, companies restructuring and other music industry happenstance may indeed be connected with 'lucky' outcomes. Yet we must honour the foundations that might already be in place and that improve chances of being initiated into a creative role. Whilst Mitson might not have been aiming for a job in mastering specifically, he and his strong musical background had been within arms reach of the studio environment at *CBS*. Narratives of the role 'luck' may have played in someone's access to a career can make for good storytelling. These narratives would too suggest that their career path has been inspiring. To remember one's access to the mastering industry as luck might also reinforce the sense of mystery around mastering and uphold the prospect of mastering engineers as creative experts.

In 1984, the outcome of a coin flip was apparently responsible for the resulting career trajectory of Miles Showell. Speaking in March 2016, Showell recalled his access to working at the now defunct recording studio and cutting facility *Utopia Studios* in London (UK). Showell remembered a high demand for paid work in the mid-1980s industry, and that *Utopia* had advertised for a trainee disc cutter and tape copier. Of the many applicants, four were interviewed twice, and then two successful interviewees, including Showell, would ultimately represent the 'heads' and 'tails' sides of a sterling coin. Showell's side had landed upwards, and the engineer would thus go on to enjoy a longstanding mastering career involving many landmark projects. Showell would also help trigger the latest resurgence of a half-speed cutting process – a reclaimed expertise that the engineer is often attributed with and thus hired to perform. The half-speed process saw disc cutting engineers enact technical modifications to compensate for sonic limitations imposed by early cutter head designs. Still today, audiophiles enjoy some distinctive nuances that might be introduced or retained through this process. One key pitfall of half-speed cutting is its efficiency - cuts take twice as long to perform. Two days after I spoke with Showell, Adam Sherwin (2016: 19) of *The i* wrote that the "award winning engineer […] has applied the technique to *The Beatles* and *Queen* catalogues". Sherwin also stated that "further releases from the *Universal Music* catalogue will follow". Not only did Sherwin label Miles Showell as "one of the world's leading exponents of half-speed mastering", but he also stated that "acoustic experts" are declaring half-speed as "the path to perfect sonic reproduction".

Lewis Hopkin recalled playing guitar in his younger years that were enjoyed living in Devon. Also in his younger years, Hopkin began what would become a lifelong interest in music technology, soldering and consequentially more complex forms of electrical engineering. Hopkin had eventually contributed his musicianship and production skills to *'a phenomenal amount of music in the nineties.'* He said, *'Most of which you can't find on the internet because it was a vinyl only thing. […] You'll probably find it somewhere on Discogs[.com]. Most of it didn't have my name on it.'* Hopkin named himself as being *'one of the earliest first generation of what people call "ghostwriters"'* for large names in the dance music industry. *'They came in, smoked weed, did pills, and went, "we want it to sound like this!" And I made it sound like that, you know. They were like, "we've got this sample from this disco*

record" […] and then I'd build them their tune around it.' Hopkin explained that his work as a 'ghostwriter' occured at a time when in-the-box approaches to production were less prevalent. *'You needed to be a really fucking good engineer because you were operating 10 different pieces of [hardware] equipment with a lot of technical limitations and you needed to do something that bit special and it was a wonderful time'*, he remembered, before explaining that his work lost its shine when approaches to production became increasingly centered around the DAW and various digital software tools. Still reflecting on his work in the nineties, Hopkin said, *'I was able to be the enabler for a lot of these guys who were out playing to 20,000 people every weekend, but it wasn't politically the done thing to let anybody know that anybody was enabling them and I was totally cool with that.'* Hopkin described his step into mastering as a *'natural progression'*. I have deduced that Hopkin's earlier work as a ghostwriter and his later work as a mastering engineer are similar in a sense that his role might still be thought of as 'the enabler' – helping artists to actualise their own creative goals. Hopkin also recounted how he was driven to begin mastering professionally. *'I was listening to what other mastering engineers were doing'*, he said. *'And I was going, honestly, I was going, "I'm better than that", you know, there was a bit of a kind of, "I can do that and I can do that really well!"'* A short while earlier in our interview, Hopkin had said, *'I learned to cut records by watching other people cut my records'*.

Jon Astley and Simon Heyworth progressed into mastering from similar backgrounds of production. Heyworth established a reputation after co-producing Mike Oldfield's (1973) 'Tubular Bells' at Richard Branson's *The Manor Studio*. Heyworth's spell of working at Branson's studio happened after his earlier attempts to shadow and develop connections with numerous mixing engineers and other people based out of London recording studios. *'I just had a passion for music'*, he remembered. Heyworth, intent to actualise his creativity through music production, was eventually introduced to people working at Branson's *Student* magazine and *Caroline Records* – a subsidiary of *Virgin Records.* Having developed some creative audio engineering experience in London, Heyworth approached Branson with the prospect of putting together a studio at the manor house. Eventually, Heyworth moved away from *The Manor Studio* and towards *Chop 'Em Out*, a London-based company that offered *'audio post-production for CD'* and *'very high quality*

cassettes' that resulted from digital or tape masters. Heyworth started work as a *'remastering engineer'*.

Astley was a solo artist and he also worked as a producer before progressing into mastering. At earlier stages in his life, Astley established some important connections with key industry figures via family. His father, Edwin Astley, had scored TV shows and films in the 1960s. Edwin had taken a young Jon to the score recordings of TV series *Danger Man* and *Department S*. Edwin had also shown his son to an eight-track studio, an *EMS* VCS3 synthesizer and to a meeting with Robert Moog, inventor of the first commercial synthesizer. In early adulthood, Jon Astley worked at *Radio Luxembourg* for just two weeks. In our interview, Astley remembered leaving work for the day and going to see *'a sort of uncle'* at a pub in Barnes (London, UK). *'He introduced me to Keith Grant, who was the manager at Olympic Studios.'* Grant had requested Astley to begin at the London facility. *'After working [at Olympic Studios] for about a month, I realised there's a whole file cabinet full of letters from people trying to get a job at Olympic Studios, you know, and they were all on waiting lists for a vacancy'*, said the engineer, indicating that demand for paid work in the industry was as high back then as it is right now. At *Olympic Studios*, Astley began as a *'tea boy'*, then an analogue tape machine operator, and he eventually began an assistantship with producer Glynn Johns. *'[Glynn Johns] took me all over the world. We went and recorded stuff in America and I was like his right hand man for about three years'*, Astley remembered. Astley later stated, *'Glynn taught me a lot about handling people and how not to handle people'*, which to me highlighted that other career specialties within music production require people skills as well as creative dexterity.

By the mid-late 1980s, Astley would either be using his current mastering room and home in Twickenham, or else a nearby barge owned by Pete Townshend of *The Who* fame. In Twickenham, Astley worked on pre-production with US singer and songwriter Marilyn Martin. This work came after the release of 'Separate Lives', Martin's successful duet with Phil Collins (1985). I attempted to research Astley's career and the history of *Close to the Edge* before our interview. It wasn't until arriving in Twickenham and speaking with the engineer that I had learned his No. 2, The Embankment was the former residence of *The Who*'s Pete Townshend and the

rock star's "garage studio" *Eel Pie Sound* – words courtesy of Neill and Kent (2002: 254). Whilst publications celebrating *The Who* had not shied from alluding that Townshend operated a small studio here, it appeared that Astley had done a good job of doing so up until the point we spoke. Astley is the ex-brother-in-law of Townshend (see *Wikipedia* 2021e, online) and his *Close to the Edge* website did not register any such history that could be used to elevate the cultural and creative significance of the space in which the mastering engineer chose to operate.

Astley (1987; 1988) recorded and released two studio albums under his own name, and his first single featured in a televised advertisement for *Heinz* (see *Close To The Edge* 2021, online). In the decade after, *The Who* asked a now well regarded Astley to oversee the remixing and mastering of all their albums – processes carried out respectively by Andy MacPherson in Manchester (UK) and Bob Ludwig at *Gateway Mastering* in Portland, ME (USA). Astley shared dinners with Ludwig, observed him carry out mastering work and was thus encouraged to develop his own mastering skills.

*

An emergent theme, then, is that engineers develop relationships with those already operating in the music industry. Calbi's access to *Record Plant* was steered by a friendship. Once at *Record Plant*, Calbi learned creative engineering skills through observing experienced mix engineers at work. Gonsalves developed a close relationship with expert mastering engineer Chris Athens, who became a professional mentor. Numerous other connections would have been fostered through Gonsalves acting as host for a specialist podcast. Athens coached Gonsalves in regards to professionalism and good business practice. Learning about these aspects of Gonsalves' mentorship supported the idea of mastering as a 'people industry', not simply a creative practise. Proper's university friend helped her gain access to work at *Sony*, and Wharton's career at *Abbey Road Studios* had been steered via a personal and familial connection. When Mitson worked in the mailroom at *CBS Records*, he developed a connection with an expert mastering engineer. Like Calbi, Heyworth developed creative and technical skills through observing established studio personnel. For Heyworth, this led to a network of individuals linked with Richard Branson. Astley had also been connected with

established locations and practitioners via friends and family. Astley conveyed how an experienced mentor, Glynn Johns, had instilled that success in audio engineering professions would depend on sound professional conduct and good client relations.

Some engineers had completed formal educations in a creative arts or sound engineering field. Their educations took place before their careers in mastering began. Gaining education in these subjects might have enabled them to signal a foundation of technical expertise or creative competency before seeking out assistantships, mentorships or alternative industry pathways. With or without formal education, many engineers developed palatable experience in a few areas or at least one specific area before accessing mastering work. These areas include live sound, studio work and musicianship amongst other forms of industry labour. In some cases, earlier experiences might have been less creatively involved. Calbi drove a truck, Mitson worked in the mailroom and Triana contributed general assistance. Nonetheless, both Mitson and Triana would have already been able to signal their creative dexterity through respective backgrounds of musicianship. In earlier stages of their careers, Astley, Hopkin and Heyworth had engaged with broader forms of production and engineering. I attest that these experiences would have gained each of them a more far-reaching reputation. Refined knowledge of electronics, and good appreciations of the impact of signal flow on a recording emerged as other crucial signals of rudimental audio engineering competence. Hopkin developed skills in electrical engineering long prior to his entry into mastering. Gonsalves expanded his own knowledge of complex electronics through managing a mastering themed podcast.

Younger engineers such as Gonsalves, Schmidt and Triana conveyed early motivations to actualise through mastering specifically. To me, this demonstrated how changes began to take place in terms of how mastering was valued and more widely understood as a creative contribution to production. Two older engineers, Heyworth and Astley, had initially set sights on careers in more general forms of production. Their eventual successes in these broader fields had occurred prior to them venturing into mastering, when it started to become more widely recognised as a creative specialty. Before I conclude discussions of access, it would be unwise to ignore the significance of location and major cities in various histories of entering

into the recorded music industry. Nine of the 20 mastering practitioners I spoke with were based in or around London when each gained access to relevant work. These engineers were Astley, Heyworth, Litwin, Parnell, Pesche, Showell, Staff, Wharton and Young. Four of the engineers I spoke with were based in or around New York City, namely Calbi, Ludwig, Proper and Triana. Grundman and Mitson were based in Los Angeles. Despite Gonsalves having studied in New York City, and despite Schmidt having studied in Liverpool, another major UK city, these young engineers successfully launched their businesses in Portland, OR, and Karsruhe, Germany respectively. I have noticed that engineers are now in a better position to join the growing list of peers who have jumped ship, moved office or set up shop at a residential location of choice or perhaps a place of economic convenience. More remote ways of working have truly been supported by powerful computing hardware, digital forms of multitrack production, high-speed Internet and network infrastructure.[1] Aspirants may now access or develop careers in mastering without following what might once have been a requisite of moving to a major city with entrenched industrial presence. The careers of Adam Gonsalves and Robin Schmidt have served as a testament to this.

Education

After time spent thinking about and examining various pathways to professional status in mastering, I began to assess my own creative, technical and educational experiences that could prove useful if I attempted to access high-level training or a career in the field myself. With growing drive to better understand what it means to actualise one's own creativity, bring "things that are interesting, important and *human*" (Csikszentmihalyi 1996) into being through mastering, and also understand the current realities of accessing the industry from a research perspective, I began surveying various options that could help me to learn more, earn a mentorship, earn some paid work or even some unpaid work. By summer 2016, aged 26, I found myself reflecting on a background of musicianship, production, occasional work in

[1] See Bregitzer 2009: 186-209; Edstrom 2011; Hawkins 2002; Théberge 2004; Wyner 2013: 9-13

live sound and eleven years of sales at a high street musical instrument store. This background was not so different from some of the earlier backgrounds of the mastering engineers I had interviewed. I had also finished two relevant degrees – the first, a Bachelor's in Music Technology (*Coventry University*, UK) and the second a Master's in Music Industries (*Birmingham City University*, UK). By summer 2016 I had learned of Vlado Meller's mastering workshop held around twice a year at *Truphonic Recording* – a recording studio complex in Charleston, South Carolina. Back in 2016, I observed that Meller was one of the only highly esteemed engineers to offer a course of this ilk, and advertise for anyone to apply.

Meller's website biography now describes a variety of his career highlights (see *Vlado Meller Mastering* 2021, online). We learn that Meller's achievements and major artist credits have emerged out of him working for over 40 years in music. In the world of record production, artist credits and discographies are clear signals of creative engineering expertise. The engineer also holds two *GRAMMY* Awards – likewise recognised by many in the industry as coveted signals of creative or technical proficiency. Meller's career began in the US as a disc cutter for *CBS Records* in 1969. He worked at *CBS* (later *Sony Music*) for 38 years. Longstanding experience in the field is another legitimisation of expertise, and Meller moved to *Universal Mastering* before spending a brief time at *Masterdisk*. He then ventured out of New York City and into his own operation, *Vlado Meller Mastering*, based at *Truphonic Recording.* Greg Milner's (2010: 289-292) interview with Meller seemed to have taken place after 2004, at *Sony Music Studios* in Manhattan. This would have been before Meller's move to *Universal Mastering.* Milner's reflections on the interview help to flesh out what can be gleaned from Meller's own website biography. They also help us to see that Meller's path into the industry, whilst unique, bears similarities to other pathways explained by the engineers I already discussed at length. Milner wrote:

> Meller grew up in a Jewish family in Czechoslovakia. His father worked as a refinisher of pianos, and Meller learned the violin as a child. He had his first exposure to Western music while studying electrical engineering at the University of Prague. At nights he would tune in to Radio Luxembourg, picking up the faint sounds of the Beatles, Chubby Checker and Dave Clark,

> when the signal managed to elude the Communist Czech government's signal jamming. "I'd listen between the noise," he recalled. "I said to myself, 'Wow, there's life on the other side of the fence, and it sounds so good!'" He took weekend trips to Yugoslavia, where the Communists had a more lax attitude toward Western culture, to buy 45s, concealing his purchases when he recrossed the border for fear of being arrested.
>
> Meller managed to escape Czechoslovakia in 1968 and eventually wound up in the United States, unemployed and unsure of his future. He met somebody who worked for CBS Records, who mentioned that the label had a recording studio. Although Meller knew very little about recording, the studio hired him as an assistant in December 1969. Eighteen months later, he was promoted to staff mixer and eventually transitioned into mastering. Over the years, he worked on albums by everyone from Paul McCartney to Public Enemy. Meller stayed with the company through all its corporate permutations. (Sony acquired CBS in 1988.) With Meller's reputation, he could certainly thrive on his own, but he's always liked the job security he has at *Sony.* In an extremely volatile industry, Meller has managed to hold down the same job for almost forty years.

Meller's workshop classes would take place over an extended weekend, and it was clear that they had been designed as intensive training for successful applicants who had aligned with a certain criterion. Some attendees might be those already operating as engineers at early stages of their careers. Other attendees might have gained experiences akin to my own, but had not yet gained access to a mastering assistantship or mentorship. As such, they might be looking for an established industry figure to offer a springboard of advice or feedback in the realms of creative practise and professionalism. During 2016, I harboured some vague thoughts about applying to attend the course. Despite living in an age where so much instructional content had become available online, I understood that a lot could still be gained from hands on experience and direct communication with a recognised expert operating at the top level. Moreover, if I did wish to seek out an assistantship or a longstanding mentorship in the future, then attending Meller's course might, I felt, show willingness to learn and take seriously my creative development. What had

eventually pushed me to apply was a breakthrough moment in my own understanding. This breakthrough had been steered by Lewis Hopkin, and it happened when I interviewed and first met the engineer on 4th July of the same year.

After my interview with Hopkin had concluded, the engineer offered constructive feedback on one of my more recent attempts to mix and then master a pop recording at home. I had used in-the-box methods of signal processing. Hopkin and I focussed on the mastered audio as it played through a stereo pair of *PMC* loudspeakers at his chosen reference level (volume setting). We were sat in a space to which the engineer was deeply accustomed. I had been amazed at what Hopkin's professional monitoring setup and expertly treated room could reveal about my mixed and mastered audio. I heard strengths and also flaws in the work. These strengths and flaws were not so defined through the monitoring setup I had used to carry out the work at home, and nor had they been so defined in my headphones or the car stereo system I had used for checking. We agreed that the balance of frequencies and the overall soundstage in the audio had been quite good. Yet, too much compression or limiting had been applied, and not just in the mastering stage, but also in the mix. There and then, I was duly reminded that superior, full-range monitoring systems and acoustically treated spaces can reveal as much about dynamics as they can about tonal or frequency balance – these things and much more. Through further discussions with Hopkin, I began to understand how recordings can be symptomatic of its engineer having applied too much dynamic range processing to individual instrument channels, mix buses and the master channel. On further reflection, I felt that my own approaches to mixing and mastering might have been too strictly influenced by foundational guidance acquired through a formal education in Music Technology, and also through methods I had gradually adopted via advice or tutorials posted online.

As an undergraduate, I had been shown various software plugin tools, such as compressors, that could be used to process a variety of instrument channels or mix buses in digital recording sessions. In the third and final year, I had learned how similar processes and signal flows might be applied through mastering. This learning took place via a dedicated module over a period of one semester, and

students would be assessed on the results of their own mastering or restoration work. The assessment would also be submitted with a written justification, and learning how to creatively adopt each essential tool of the trade was imperative to progressing through the programme. Myself and other students might have sought further information online and from instructional texts during our three years at university. From these sources I had garnered some recommended settings that could be used with stock digital signal processing tools and for certain situations in both mixing and mastering. After my experience at *Stardelta Mastering*, what I felt had resulted from the sum total of my education and self-guided learning to date was a proclivity to over-process various channels of audio through the mixing and also mastering stages. I would admittedly, on occasion, reach for particular EQ or compression settings and without performing a proper phenomenological evaluation as to whether the applied settings are actually benefitting the recording as a whole. I always worked in the digital domain. I have since learned that mastering, even mixing, should really be considered as processes of intense listening and decoding sonic phenomena based on a rich history of listening. Mastering, sometimes mixing, is partly a means of deciding what creative processing should or should not be carried out in any given instance, and this is a premise I tackle more thoroughly in *Chapter 6*. I now suggest that if mastering is indeed a means of deciding what creative processing should or should not be carried out in any given instance, then a well thought-out and familiar monitoring setup would be vital to the engineer's critical work.

Birtchnell and Elliott (2018: 81) considered issues of access to recording studios. They said, "sharing proximity with exemplary peers affords a degree of attainment impossible to achieve through programs of study undertaken during formal qualifications." Back in 2016, I remember feeling that my own formal education had been valuable. It helped me better understand the science of sound, the art of record production, and also some specialised career trajectories associated with the music industry. University had given me skills on which to develop, and with which I could demonstrate some degree of creative and technical competence as a sound engineer. Thinking back to the mastering module I completed, I did start to wonder whether any student on the course, or similar courses where mastering is introduced as part of a broader degree programme, might actually be rewarded in

the marking progress, were the student to decide that no work should be carried out on a given a track. I had started to question how a student might be marked for their use of an equaliser, compressor or limiter, if the recording in question had already sounded finished by their own reckoning. Moreover, I questioned, at what stage is an engineer deemed qualified to make this call?

After Hopkin's feedback, I established that there was still a way to go in terms of my learning, my ability to critically listen and perform creative work through mastering. I needed hands-on experience of high-end and dedicated mastering tools used by mastering engineers on a day-to-day basis. I decided that spending an extended weekend with Vlado Meller could help in this way. It would also give me the chance to absorb some key information that might be imparted through the sorts of assistantship I had learned about and that usually happen over a longer period of time. Meller would be able to offer advice on professionalism, and he would offer deeper explanations of how mastering engineers and studios interface with record companies, duplication or pressing plants and clients. I did not feel that close work with an established expert and attending a specialist workshop would be the only way for me to learn what I needed to learn - my research had already uncovered many who had taught themselves mastering and ventured boldly into the business with high-speed Internet and network infrastructure. Yet, enrolling on Vlado Meller's September 2016 workshop would form an important part of my own pathway, and I had remembered something Gonsalves put across in our interview of spring 2015:

> *One of the really unfortunate things about the democratisation of music technology is that the traditional mentor/mentee relationship is dying, and I think that that's bad. That's not to dissuade people from, you know, taking a crack at things and trying stuff that's learning and doing, and by that I really mean learning by failing over and over again is a really important way to learn. But you can save yourself a lot of time and gain perspective that there's no other way to get by talking to someone who's just been doing this job more than you and longer than you and at a different level than you and that's really important. […] I'm a little sad that there's less of that than there used to be, because I think it's really valuable.*

*

Day One of Meller's workshop began over coffee in the control room at *Truphonic Recording*. By this time, I had interviewed 18 mastering practitioners. I had been joined at the workshop by a music teacher who aspired to progress in mastering, and I was also joined by two young and established engineers. The first of these engineers was from a major and reputable studio complex in Australia. The engineer had so far enjoyed a 10-year mastering career. The second engineer was from Germany and worked for a smaller independent operation that offered mastering services. Clearly, Meller had been about to deliver an intensive course for a small group with pre-established skills and those who could draw from a broad audio engineering lexicon to describe sound. From the moment Meller began talking, I understood why a sufficient education in audio engineering, or else some equivalent industrial experience had proven vital to being accepted onto the course. In our preliminary discussions of frequency, decibels, artificial acoustic treatments and specific pieces of mastering hardware, I had been reminded of Porcello (2004: 734-735). "Learning to be a sound engineer must be thought of in great part as a process in learning to speak like one", Porcello said.

The group entered Meller's studio. Unlike the studios I had been given access to on my Bachelor's programme, this was a setup designed specifically for mastering. Meller pointed immediately to his Mac Pro, connected to a flat-panel monitor that displayed a Pro Tools GUI. "Here's our tape machine!" he said. The group laughed on cue and with no demand for explanation. Collectively, we understood how source material for mastering would be presented to engineers on reel-to-reel tape in a bygone analogue age. Straight away, I remembered research I had conducted around ethnography, and how adopting "locally specific humour and language" (Hine 2008: 259, in the context of 'virtual ethnography') would be considered an imperative strategy for communication and negotiating membership within a culture. I also recognised once more that my prior experiences were crucial to understanding the content of the workshops.

The acoustically treated room housed Meller's own full-range *PMC* loudspeakers, a large mastering desk equipped with a monitor selector and various pieces of hardware for signal processing. The loudspeakers were akin to those I had heard at *Stardelta*, and I remember thinking that *PMC* were clearly well regarded in the

realms of audio post-production. Each of us had arrived at Meller's workshop with our own source audio to be worked on during the sessions. We had been instructed to prepare our stereo recordings at native sample rate and bit depth.[1] Each member of the group, myself included, had also brought with them some audio they had already mastered and would hence be familiar with. It was this mastered audio that would help us acclimate with Meller's room, and I had chosen to bring with me the same mastered audio I had evaluated with Hopkin at *Stardelta* just a few months prior. I also brought a few more of my own mastered recordings. I felt that I knew these recordings inside out, having performed, engineered, mixed and mastered them. As it became my turn to acclimate, however, I received a similar experience to the one that happened at *Stardelta.* Much more had been revealed to me through Meller's professional monitoring setup and acoustically treated space than it had at home. Meller's setup had also revealed some strengths and flaws that were not so defined through the monitoring setup I had used previously at home. Regardless, this activity had helped me to adjust to the new listening space, and I would be able to use these mastered exports as reference points when working on their unmastered counterparts or other source audio recordings over the course of a weekend.

Meller began to guide the group through mastering some of their own recordings. In doing so, he familiarised us with some high-end digital tools, software and hardware, used by the engineer on a day-to-day basis. Meller explained signal flow and the stages at which certain corrections or enhancements might be performed. These activities had begun to challenge some of the processes I had adopted while learning mastering at university. They had also begun to challenge some of the processes I had adopted through advice posted online and through advice written into published instructional material. By the middle of Day One, I had started to learn some aspects of critical listening and signal processing that would carry over into the creative processes I still adopt as a mastering engineer to this day.

Meller's studio setup incorporated two *Weiss* EQ1-MK2 digital hardware equalisers and two DS-1 MK2 devices made by the same company. These mastering-grade tools were an essential part of the signal processing chain and methods I began

[1] See *Appendix D* – 'Bit depth', 'Sample rate'.

learning at the workshop. The DS-1 MK2 will function as a compressor, limiter or de-esser. It can thus be used to perform wideband or band-specific dynamic range processing. Two years on, and as a result of working with these tools during my training, I decided to acquire my own EQ1-MK2 and enjoy the functionality and sonic nuances that this particular device would help to bestow on recordings I master. Using this tool in my own setup, I would apply some of Meller's teachings to my own creative process. This serves as a demonstration of how my own training and pathway to professional status has impacted on both the creative processes I now undertake and the tools I adopt while starting to operate and actualise through the field. In a broader sense, I suggest that the sonic make-up of today's mastered audio might well have echoes of an engineer's professional lineage. When I flew to New York City to speak with Maria Triana after finishing the workshop, I had noticed two units made by *Weiss Engineering Ltd.* at the desk she herself used at *Battery Studios* (NYC). I also noticed *Weiss* hardware at the desk of Darcy Proper back in March 2016. Proper and Triana once worked with Meller at *Sony* in New York City. Having spoken with Triana, I ascertained that creative methods and equipment might be shared between colleagues or correspondent between senior engineers and their assistants who later go on to succeed in the field.

A few of the signal processing tools used at Meller's workshop were software based. Whilst many of the operative principles remained the same, the tools themselves differed from those I had used at university and at home. The workshop sessions themselves were centred around *Avid*'s Pro Tools and a mastering-oriented DAW, namely Sequoia (owned by *MAGIX Software*). In the creative workflow we adopted at the workshop, certain corrections or adjustments might be enacted before engaging with the *Weiss* hardware, and others might be enacted after. When it came to mastering a project and achieving a particular sonic outcome, I gleaned that there were no rights or wrongs per se, but that there would be some cardinal guidelines to be aware of. Our critical listening skills were paramount to us knowing whether the decisions being made were detrimental or advantageous. Our knowledge of format standards and delivery requirements, explained to us by Meller, were also paramount to ensuring the resulting audio would be accepted by a client, disc duplication plant or the like. Whilst mastering our recordings, we were free to

explore our own creativity (imagination and originality), aided by Meller's expert judgment as to what clients might well be looking for in any given instance or for any given genre. My ability to perform creative decisions via deep critical listening was truly helped by the accuracy and superiority of the monitoring setup. Through Day One, I had also begun to understand that the process of selecting creative tools to work with on a daily basis would involve scrupulous evaluations. A well-equipped mastering room would surely reveal the inadequacies of substandard tools. In *Chapter 1*, I said that when engineers and technicians speak of achieving perceived 'accuracy' in terms of their listening environment, this refers to building setups incorporating monitoring systems and room acoustics that deliver ideal presentations of sound. Their studios would allow them to hear music and perform critical listening in the most neutral way possible – uncoloured by the physical properties of certain spaces. Engineers would also hear balanced reproductions of the "sound stage" (see Moylan 2007: 50-5).

I have learned that the acoustics and physical surfaces within a listening space impact on how engineers hear sound reproductions that travel from loudspeakers to their ears. Poor room acoustics and parallel walls can introduce resonances or attenuations in the lower bands of frequency (modes). They can also introduce higher frequency reflections. Engineers and acousticians can install fibreglass or foam bass traps, wooden panels, diffusers for scattering sound waves and other absorption techniques to alleviate modes or 'standing waves', flutter echo, comb filtering, and other acoustic phenomena that inhibits neutral presentations of sound before creative adjustments are performed. Achieving 'accuracy' extends to having loudspeakers of a particular benchmark or specification. In mastering, engineers like Meller will often use 'full-range' speakers, thus ensuring reproduction of all frequencies within the range of human hearing. They often seek out speakers with flatter frequency responses for greater accuracy. Yet it must be said that an engineer's choice of loudspeakers is a personal affair. Engineers can choose between active (powered) or passive (unpowered) speakers. They can also select speakers of a certain power and cabinet design, or that incorporate particular driver types. Loudspeakers must also be positioned optimally in the listening space so as to achieve an ideal 'sweet spot' for listening. In rooms with less artificial acoustic treatment, this can also help with room modes. As Jones (2020, online) explains:

> In small, untreated spaces, low-frequency resonances called “room modes” wreak havoc with bass, creating peaks and dips that manifest as a boomy low-frequency buildup, or conversely, an absence of low end. This means that you could be hearing exaggerated low frequencies at your listening position, or in extreme cases, no bass at all—even though your speakers are reproducing low end just fine.

Managing bass issues effectively will ensure engineers hear more truthful reproductions of lower frequencies and whether these lower frequencies are lacking, problematic or exaggerated. Some basic steps can be taken to achieve an ideal listening ‘sweet spot’ and presentation of bass via effective loudspeaker placement. Jones first describes how familiar reference material can be used to determine a most optimal listening position when up against room modes. Listeners should also strive for a good phantom center image and perception of the sound stage by ensuring symmetry in their overall setup, as well as by ensuring equal triangular separation between themselves, their left speaker and right speaker – both of which should be aimed towards the face and with each high frequency tweeter at roughly ear height. As Jones explains, “higher frequencies are more directional than low frequencies”. Speaker stands and isolation pads can also be used to isolate loudspeakers and minimise vibration. To avoid inaccurate bass response and other undesirable phenomena, loudspeakers should really be placed a few feet away from walls or corners. Furthermore, loudspeakers should ideally be aligned along one of the shorter walls in a space, with the listener facing this same shorter wall. In rectangular rooms, this means that sounds leaving loudspeaker woofers and tweeters will travel longer distances and dissipate more before reaching a rear wall. Jones advises that loudspeakers should also be positioned so as to avoid any reflections off of studio furniture and hardware such as consoles or desks. She says, “This will minimize [sic] the potential for comb filtering, a constructive and destructive interference pattern that can dramatically color [sic] your sound.”

By the end of Day One, I had gained thorough and technical understandings of the studio topology and signal flow at *Vlado Meller Mastering*. I would be able to replicate Meller’s setup elsewhere. I can now, in hindsight, confirm that the engineer’s setup actually differs somewhat, when compared to setups adopted by

many who likewise operate at the top level. In the *Equipment* section of *Chapter 6* I will offer a deeper dive into a flow of signal that I suggest occurs in many mastering rooms today. This will form part of a larger exploration of mastering tools and their creative significance. Although Meller engages a somewhat unique setup, the fundamental creative and technical skills needed to navigate his studio are no different from those needed to function successfully in other studios. The way in which Meller's approach to mastering might have differed from others I had noticed was actually described to me by Mandy Parnell. Back in April 2016, after I had mentioned the prospect of attending Meller's mastering workshops to the engineer, Parnell described her US contemporary as *'a really interesting mastering engineer'*. *'Because of how he works'*, she said. *'He's very different to a lot of us. He's very digital'*. And she later clarified, *'Outboard digital'*. *'He works very differently to, say, Ted Jensen, Greg Calbi, Bob Ludwig. […] Instead of having analogue gear, he's got digital hardware. […] I think I'd learn a lot from him, based on that'*, she concluded, and with clear respect for the work that Meller had conducted over the course of his career to date.

On Day Two the group worked with each others' unmastered projects. We were thus working with unfamiliar recordings. From the very start of my research journey back in 2014, I had understood that mastering engineers are valued for having a degree of emotional distance from the projects they work with; their unhabituated ears are deemed better disposed for corrective work (see Waddell 2013: 3). Meller's group were now encouraged to operate whilst being mindful of the time spent on each recording. Working with foreign material and working somewhat against the clock had brought us closer to the realities of how paid engineers would need to manage their creativity in the real world. Throughout this activity, Meller remained within reach to offer constructive feedback and his informed perspectives from having mastered thousands of recordings for many high-calibre artists. There were still no rights or wrongs per se, but Meller would remind us of any creative or technical guidelines that should perhaps be followed and why. Speaking just a few days later, Maria Triana verified that different creative approaches are taken in mastering. She said, *'There's no right or wrong, everybody's doing their own [thing]. But it's a matter of taste and it's whatever applies to what the artist is looking for.'* Triana indicated that 'shootouts' are often instigated, whereby mastering clients ask

selections of engineers to perform test masters on one recording from an EP or album primed for release. A client would ultimately hire just one engineer to finish their entire project, and the client would base their decision to hire on a phenomenological judgment of the work. I have observed that the 'shootout' is a well-established concept. Some engineers might willingly offer test masters whilst others not, and decisions to engage would depend highly on the projects or artists in question. Decisions to engage might also depend on the mastering engineer's own career progress, schedule and status within the industry.

Meller had recollected his own experiences with participating in shootouts, and he explained how these were navigated from a creative perspective. Towards the end of Day Two, having mastered each others' recordings and having learned more about shootouts, the group gathered to perform critical evaluations of all work that had been carried out over both days. For each of the unmastered recordings we had brought over from our respective studios, there were now four mastered versions – one version for each student on the course. These versions were lined up on separate channels within Pro Tools, allowing for Meller and ourselves to compare approaches we had each taken to master the source audio. I found this to be a highly effective way of learning, as it engendered a multitude of observations that were based on varying degrees of familiarity with the original recordings in question. Meller offered some indications of how prospective clients might go about selecting the mastering engineer who would ultimately finish their project in a shootout situation. Each mastered version of the various source recordings differed noticeably, and that this was in spite of us all being acclimated to the same room and equipment. At the same time, however, I remember that each version did sound 'finished' and thus consistent with my own phenomenological points of reference. My understandings were enlightened by Shelvock (2017: 14), who positioned mastering as "a highly individualized affair." He said, "provided with the same tools and equipment, it is unlikely that two engineers would master a record in exactly the same way."[1]

[1] When reading Shelvock's statements, I had remembered Bregitzer (2009: 183-4), who conveyed that mastering engineers do not follow "hard-and-fast rules". I had also remembered Waddell (2013: 3), who said, "there is no standardized method of mastering".

Throughout Day Two, students each had discussion time with Meller. Discussions touched upon issues related to professionalism and how connections might be developed within the industry. Students could explain their own creative and professional situation to date, and Meller would advise them in regards to career navigation. My own discussions with Meller had bettered my understandings of professional mastering culture. They enabled me to confidently assert that audio mastering is a 'people industry' as much as it is a creative practise. Aside from being creatively skilled, a successful engineer would be able to demonstrate tangible expertise and experience, develop or draw on professional connections and cultivate trusting relationships within the wider music business.

On Day Three, the group assisted Meller in mastering some of his own and high profile projects. This enabled me to observe how various creative and technical tasks might be shared between experienced mastering engineers and early career assistants. Experienced engineers might assume creative responsibilities for particularly high profile projects, whereas assistants hone their creative chops through close observation and working on other projects. My observations led to some valuable understandings of mastering studio culture and career progression. Observing Meller master projects in real-time had also demonstrated the speed at which this expert might fulfil his creative objectives, seemingly effortlessly albeit to good effect. To me, Meller had demonstrated tacit proficiency (see Horning 2004; Polanyi 1958; 1966).

Each student took turns to master these same and other high profile projects of various genres. To me, it seemed that comparatively fewer corrections or creative adjustments were needed to bring a lot of these projects up to perceived standards of completion. Perhaps the biggest changes occurred in terms of dynamic range – projects would need to meet what are commonly deemed as benchmark loudness levels. I have deduced that mastering engineers are less likely to be performing high levels of corrective work or surgical EQ adjustments on projects that have been worked on by well-established and creatively accomplished producers. More likely, the mastering engineer will act as a second set of ears, a creative interjection if needed, and a critical judge of how loud the track might need to be for the proposed delivery format. These realisations have not diminished my appreciation of

Meller as an experienced engineer who could clearly work faster than myself but to good ends. Even though a mastering engineer might perform very little creative work on the project at hand, they would still be responsible for detecting any inconsistencies or fleeting and undesirable phenomena that might have slipped through the producer's net.

Our experiences mastering various high profile recordings were concluded by another group feedback session. The session involved another discussion of how our masters might fair in shootouts, but also how they might fair when distributed to various streaming platforms. Meller then offered some detailed overviews of mastering-grade software tools that are used for crucial tasks such as sample rate conversion, preparing track metadata, creating DDPs and determining the timing of spaces between mastered songs to be released on digital or physical playback mediums. We discussed how labels, major or independent clients, and duplication or pressing facilities might go about requesting mastered audio or certain deliverables. I learned that mastering engineers should be au fait with the ins and outs of various manufacturing and distribution standards – those current and those set to emerge. With this knowledge, engineers can advise their clients and ascertain the needs of those less adept with digital music distribution. Engineers should also strive to perform the most accurate job possible, not just in the creative domain, but also through the technical work that follows. Track metadata should be 100 percent accurate, for example. Operating with attentiveness would promote an engineer's reputation for offering reliable and professional services.

Attending Meller's workshop contributed greatly to the speed of my creative development and also to my understandings of mastering culture at points of access, education and operating as an expert. My fieldwork has proven that courses such as those offered by Meller would be helpful to those developing creative or professional skills. Studying with Meller helped me to gain more extensive understandings of mastering than I had been given via university. I share this not to discredit the value of modular learning as part of a Bachelor's degree-level Music Technology education. I rather wish to validate that working closely with a practitioner who interfaces directly with the industry and performs specialist creative work on a daily basis had injected a worthwhile supplement to my own

foundational skills built previously in the classroom. Studying with Meller also enabled me to progress much faster and more efficiently than if I had continued seeking out and learning advanced information via the Internet or published media. Face to face workshops can offer fast access to expert information, along with tried and tested methods of working. Sustained contact with workshop leaders could prevent self-guided learners from getting lost in the realms of bad advice that might be perpetuated by via the Internet by amateurs or those less experienced in the space. I felt that the issues I myself had experienced with forum culture were condensed quite aptly by Gonsalves, who suggested that *'patently false information'* could sometimes be disseminated through forums geared towards audio engineering. *'Just because of tone of the Internet and deadpan [aspect of] just reading text, it comes off sort of as definitive and authoritative'*, he said. Describing some of his motivations behind initiating *Square Cad: The Mastering Podcast*, the engineer revealed:

> *There's a lots of forums that are related to audio engineering online and these forums can be tremendous resources, especially for someone who's starting out or an artist who has questions. […] There are, on these forums, a lot of professional engineers, you know, GRAMMMY winning legends, some of them. There are also a lot of people who are less helpful but want to sound authoritative and I was getting frustrated with that. I was getting frustrated with discussions that could have been good discussions but then some random guy who bought a […] plug-in bundle and thinks that he's an engineer is trying to start an argument with [established mastering engineer] Dave Collins.*

Many professional engineers seemed to have love-hate relationships with popular audio engineering forums. Mandy Parnell expressed that one particular forum had offered a fantastic platform for learning, but that, unfortunately, *'there's a lot of people that talk a lot of shit on there.'* Similarly, none of this has been shared to discredit the amateur or those who willing offer advice through various spaces online. Many forums had been valuable and continued to be valuable in my own process of developing past the point of attending Meller's workshop. The crux is that when early career engineers spend time learning from places or people with

tangible experience, then they become better disposed to sift out erroneous advice, or suggestions that might not align with their own creative approaches to mastering. Whilst podcasts such as *Square Cad* can provide aspiring engineers with credible information, they would lack the direct interaction or opportunities for Q&A that face-to-face workshops and sustained contact with workshop hosts provide. Students who completed Meller's course would have reasonable access to the engineer's advice going forward. I later communicated with Meller for feedback on creative methods I had begun to adopt, and also on equipment I had thought about using. Students were also able to take home the mastered versions of their own source audio recordings. There had been an opportunity to revisit or fine-tune each of these recordings on Day Three, and the final masters provided us with benchmark references against which we could go about mastering other recordings in the future.

My critical listening skills had improved over the course of just a weekend. I could better discern the sorts of strengths and flaws that Hopkin and his monitoring setup had helped me to hear in the self-mastered audio we evaluated at *Stardelta.* My listening skills had sharpened to a point of being able to now notice these flaws on the same smaller and lower cost monitoring setup I used previously at home. Looking back, I am amazed at how underdeveloped my critical listening might have been. Post-workshop, I better understood mastering as a process that involves sharp discernment of where or why a recording is lacking. Performing quick action on these sensory discernments is a tacit proficiency learned and refined unceasingly through experience. Whilst palpable and clearly communicated experience can constructively influence the chances of a mastering engineer being hired, I suggest that this influence is neither absolute nor explicitly correspondent with age. Otherwise, why might anyone hire engineers below the age of 60? It was through speaking with Calbi, aged 66 at the time of our 2015 interview, that I began to form my own understandings of why hiring younger though perhaps less experienced mastering engineers might appeal to certain artists. I gleaned that some artists might feel comfortable working with engineers who are closer to them in terms of age and whose output, age aside, might pertain to newer or more niche genres of music. Calbi himself said, *'I can only say if I was in my twenties I would probably rather work with somebody who is younger.'*

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My mastering education and professional development had progressed in various ways after the workshop. With improved creative skills, listening skills and ability to speak like a mastering engineer, my experiences with Meller helped bring about the mentor-mentee relationship formed subsequently between Hopkin and I. Engaging in this long-term alliance with Hopkin brought me to a more full appreciation of something Adam Gonsalves had said when he reflected on hiring an assistant, Amy Dragon, who is now a highly accomplished mastering engineer. Gonsalves said, *'One of the best ways to learn is to teach. When you're forced to explain something to someone, it makes you organise your thoughts.'* It would seem that, in mastering, and perhaps even for Vlado Meller, the learning never stops. As a mentee, not a paid assistant, my exchanges with Hopkin seemed akin to those that occurred previously between Gonsalves and Chris Athens. Gonsalves had said:

> *[Athens is] not a secret keeper and I had a lot of questions for him. […] When I say that, people are going to think technical questions, like, "how do you EQ this kind of record?" I'd never ask Chris something like that ever. […] It was more about, you know, the trajectory of your career, it was more, you know, the kinds of things that I could stumble through myself and learn as I beat my head through the wall, or this guy could give me his perspective and I could integrate that into the experiences that I was having.*

Like Gonsalves, I refrained from asking my mentor any direct 'technical questions' that related to creative methods of work. This was my choice, and I can see how one might argue that such refrainments consciously uphold the construction of mastering as a 'dark art'. In reality, however, I sensed it likely that mastering mentors would be keen for mentees to explore their own styles of working and applying creative processing - much in the way musical instrument teachers encourage students to discover their own modes of performance. In *Chapter 6* I will consider some uses of mastering equipment as musical feats in and of themselves.

The equipment testing sessions I attended in 2017 and 2018 at my mentor's studio bore some influence over some of the hardware and software tools I later purchased for mastering. Having gained my own sense of the nuances offered by

tools that Hopkin himself might use, I set about integrating a few of the same products, or similar, into my own workflow. These experiences proved again that creative methods and equipment might be shared between colleagues or correspondent between senior engineers and their assistants who later go on to succeed in the field.

Alongside a mentorship with Hopkin and alongside my academic endeavours, I was able to gain further and more eclectic experiences via a technical support position at *MUSIC Tribe* - a company whose portfolio comprises of *Behringer* and other audio equipment brands such as *Tannoy* and *TC Electronic,* who are more relevant to mastering. My experiences spanned from 2017 to 2020, and working at *MUSIC Tribe* involved being deeply familiar with the creative and technical aspects of equipment used by professionals in post-production and audio mastering specifically. These experiences, not to mention undertaking a doctoral study into the new culture of audio post-production, led me to present as part of the *Audio Engineering Society*'s inaugural mastering conference in 2018. After the conference, I contributed a chapter for a publication that was edited by some of the conference organisers (see Hinksman 2020). The publication featured numerous other mastering scholars and engineers.

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So far through *Chapter 5*, I have shown how junior engineers begin assisting at established studios, they acquire mentors, or they seek out free and freelance work with artists right away. I said that in order to yield trust and membership understanding at earlier stages of a career, aspiring practitioners have typically demonstrated experience or skill in at least one of a variety of recognised creative and technical disciplines. Aspirants might also develop their creative and technical proficiencies through other eclectic means to secure work, training and mentorship, or professional affiliations and recognition within the industry. The experiences I presented in this section have substantiated all this. I have upheld that audio mastering is as much a 'people industry' as it is a creative practice. My own creative development and ability to harness connections at an early career stage has been supported by diverse albeit relevant and palpable experience. This experience enabled me to signal a degree of engineering competence, gain mentorship and

work. My participation at Meller's workshop offered glimpses into how mastering can be learned. The workshop revealed much about modern approaches to creative decision-making, professionalism and how early careers are nurtured.

Aspirants and early-career engineers can develop or supplement their skills via published instructional materials, online media and relevant webspaces. Some of these aids served as useful supplements to my own developmental process, and I cited some key instructional publications in earlier chapters. Other courses and masterclasses have existed and continue to be advertised alongside the elite offering from Meller. Some happen face to face and others online. I have chosen to discuss and cite key examples of these courses and various other means of knowledge dissemination in the following and final section of this chapter. This is because podcasts, *YouTube* channels, courses, forums et cetera can be understood as mediums through which hosts or leading authorities articulate their knowledge and convey expertise.

Expertise

I have begun to employ terms such as 'expertise', 'signalling', 'social capital' and 'cultural capital'. Patel (2018: i) interrogated the politics of expertise in cultural work, and she examined the cultural producer's use of social media for promoting or 'signalling' expertise. Patel defined 'signalling' as "conveying information about one's credentials", and she argued that the concept of expertise had been "taken for granted" through scholarship centred on work in the cultural industries. Having myself understood mastering as a cultural industry, Patel inspired an examination of audio post-production through extant theory that she herself had drawn together in support of her arguments. Patel studied the likes of Becker (2008: 23; 351), Bourdieu (1993: 215; 1996) Turner (2001) and Wynne (1992), thus illuminating how expertise and reputation in the arts or sciences can be studied as social processes (see Patel 2018: 25-6; 46; 283; 342-5; 365; 380). Patel deduced, "expertise is best understood as a social relation" (344; see also 380), and she quoted Prince (2010: 6): "where a particular actor has authority over another actor through their

possession of a particular form of knowledge: the way a doctor has authority over the patient".

I have learned that 'experts' require audiences to perceive them as such. Raven (2008: 3) conveyed that the 'power' of an expert will relate to "the target's faith that the agent has some superior insight or knowledge about what behaviour is best under the circumstances". Patel (343; see also 379) made clear, having referenced and engaged with the work of Jones (2002) Andres and Round (2015), that demonstrating expertise would be crucial in climates such as those outlined by Banks and Hesmondhalgh (2009: 420). Patel quoted Banks and Hesmondhalgh for having themselves described an "oversupply of labour" in the wider job market of the creative industries.

Although a mastering engineer requires no license to operate, audiences who can provide them with work must perceive the engineer's expertise as 'legitimate'. Patel's (2018: 56-9) interest in Jones (2002) and Goffman (1956) also established that strategic presentations of the self, or effective methods of 'impression management', were key to being perceived as a legitimate expert and in possession of specialist knowledge throughout various contexts in decades past. Strategic presentation of the self and effective methods of impression management would remain key to the successful navigation of creative careers or brand reputations via modern social media (see Patel 2018: 154-6; 196-201; 282; 366; see also Hogan 2010; Rui & Stefanone 2012; Van Dijck 2013). In a chapter that addressed the shifting discourse on audio mastering, Nardi (2020: 219) posed that "reputation in the economy of knowledge is an asset that defines the workers' position in the market and their capacity to increase or maintain their social capital and get jobs." Nardi also said that "the digitisation of most aspects of labour […] means, among other things, that reputation", he cited Gandini (2016: 38), "is now increasingly tangible, visible and, to some extent, also measurable via the activity of individual users on social media platforms. This measurability extends its effects over the whole labour market." Through his analysis of questionnaire results returned by 33 "freelance engineers and studios", Nardi established "a marked recognition of the importance of reputation" in mastering (217; 220). The importance of reputation was also established through his "thematic content analysis of websites" (220).

Nardi aptly stated, “reputation is obtained mainly through association with artists and through experiences gained in the field” (221).

I have concluded that various ‘signals’ of expertise can be deployed to legitmise ones mastering competence and set about securing work in precarious labour environments. This understanding is further supported via Patel’s (2018) specific reference to Jones (2002: 211), who stated, “signals can be used repeatedly to ease communication among parties, creating codes within an industry and reputation among players”. Patel (2018: 57) explained that Jones used “the example of cultural industries workers in TV and film to demonstrate the importance of signalling expertise for their careers”. Patel (14) also spelled out Dreyfus and Dreyfus’ (1986) ‘expertise-in-context’ model as follows: *novice; advanced beginner; competence; proficiency; expertise*. Patel suitably explained that as one hones their skill, responses to problems become faster and more instinctive. I suggest that mastering clients may be thought of as novices or advanced beginners. Those seeking to access the mastering industry could be advanced beginners, but they may exert some competence. Those learning and developing in the field can transition their competence into proficiency, and those operating with established reputations would be experts.

It is useful to understand that lots of established freelancers and studios are vying for business and they can advertise mastering services exclusively or as part of comprehensive recording packages. This is not to say mastering services are at war with each other, but competition is implied via customs such as the ‘shootout’. This way of describing how the skills of various engineers are tested evokes the image of gunfighters in the Old West settling a debate. Waddell (2013: 161-2) regarded competition in mastering as “heavy and well entrenched”. He denoted *Masterdisk*, *Sterling Sound*, *Bernie Grundman Mastering* and Bob Ludwig’s *Gateway Mastering* as established competition, in addition to others running “highly respected” studios in the US (see also Birtchnell and Elliott 2018: 82). I concur with Waddell’s assertion that to be regarded in such a way is only possible if mastering remains the engineer’s or studio’s “sole concentration”. I have established some important elements that influence whether competing engineers are hired or embraced as experts. Key signals of expertise include discography, working at a reputable studio

and earning awards. Other signals include running courses, hosting specialised podcasts or *YouTube* channels, contributing to academic journals and conferences, posting regularly in forums, and authorship.

As engineers progress through their careers, they amass various mastering credits and earn valuable discographies by attribution. Audiences correlate the quality and quantity of a mastering discography with experience - credits are thus key forms of social and cultural capital that can help secure work. Bourdieu (1986) outlined three forms of capital. 'Economic capital' has much to do with money, whereas 'social capital' denotes resources or reputations attained through connections, and 'cultural capital' denotes non-monetary assets that can enable greater social mobility (see Patel 2018: 7; 27). O'Grady (2019) also saw Bourdieu's framework as one that could help further our understandings of mastering culture. O'Grady applied Bourdieu's ideas of symbolic capital in a way that could account for "why mastering practice is framed as a mystery and […] what role technology discourse plays in this". O'Grady acknowledged that "symbolic capital provides social agents with significant cultural currency". He said, "social agents can use prestige to legitimatize specific knowledge" (151-2). With legitimate and tangible knowledge or expertise, workers can defend their stylistic choices. Reflecting also on Hibbett (2005, online) and Foucault (1977), O'Grady conveyed an understanding of how "the field of mastering is constructed around knowledge and power" (152). By way of conclusion, O'Grady said, "as new technologies have challenged mastering, social constructions about the practice as a mysterious yet crucial part of production, work to maintain the social order of the field. […] Mastering as a mysterious yet crucial part of music production has become more politically useful and more crucial to its continuation than ever" (160).

The value of discographies and credits is indicated via the prevalence of album cover 'showreels' displayed across websites built to advertise mastering services. I have found that tangible histories of working with higher calibre or cherished projects might actually take precedence over the sonics of back catalogues when clients seek out a mastering engineer. This it not to suggest, however, that performing bad work on hit records would promote sustainable careers and reputations. Geoff Pesche at *Abbey Road Studios* said, *'A lot of people think, "well,*

if he's worked on hits, he's probably alright at it!" Even though there's hundreds of records that I've worked on that haven't been hits and that sound better than all the records on the wall in here.' Pesche had explained that prospective clients could assume, for instance, *'That Kylie Minogue record sold whatever, whatever, whatever. Well, maybe our record will sell that many copies because it's going through the same signal path. Who knows!?'* Robin Schmidt suggested that clients might contact *24-96 Mastering* on the basis of his own mastering credits. Schmidt depicted their train of thought: *'I'm a huge Ben Howard fan […] Who's mastered that? Okay, I'm going to write to that guy.'* To me, this explicated that clients may approach engineers and request that they try to replicate a sound they associate with previous mastering work. As an appropriate summary to all this, I recall Darcy Proper saying, *'The way to make yourself as a mastering engineer or the studio visible is largely through the work that you've done.'* She added, signifying also the importance of effective communication, *'and being not difficult to find in terms of contacting.'*

If credits lead to future work, then early-career engineers could be more inclined to participate in shootouts. The advantages of developing recognition and connections via eminent or extensive credits would be proven to them in the long-term. Even established engineers should weigh up the advantages of participating in a shootout, irrespective of the project or artist's esteem. This is because new stars or successes are always in the making. For me, a key lesson from interviewing David Mitson was to *'never half-ass a job. Because you never know when it's going to blow up.'* This ethos can apply in a shootout or otherwise. Back in the 1990s, Mitson agreed to master the soundtrack album of *The Blair Witch Project* (see Various 1999) and, subsequently, the project film became a highly successful debut for the small independent production company *Haxan Films*. The soundtrack became a key credit in Mitson's discography.

The notion of mastering credits as key signals and substantiations of creative skill had become clearer to me over the course of my research. After speaking with Lewis Hopkin, I deduced that this notion would have grown in strength as creative mastering gradually evolved out of disc cutting. Amidst some general discussions of a mastering engineer's role today, Hopkin stated:

> *I think traditionally, 'mastered by X at Y' as a credit used to mean, 'that guy took the tape and made the disc sound like the tape.' Now it means, 'that guy took 60% and turned it into 100%.' So I think that the role mastering engineers play should be perhaps a little bit more, not just well understood but appreciated.*

I have learned that engineers can, as a matter of course, request and evaluate credit listings on label copies of records they have mastered. Improper credit on physical sleeve notes is common and particularly in the context of single releases. Some would say that there are critical problems to be addressed in the industry if engineers are so reliant on their credits and discography. I also learned that Mandy Parnell had worked on landmark albums that did not include her name on the physical release. Yet, the engineer expressed that she herself cares not so much about credits, and that her motivations for performing creative work through mastering are to be more closely associated with her love for music.

Credits and their magnitude aside, engineers are clearly still devoted to performing creative work on music they enjoy, regardless of its resultant chart success and so forth. Engineers can also be motivated to work specifically on genres that reflect their own musical tastes, and doing so would help establish some variance between experts and their identities. Case in point, Mitson mastered 'Songs from the Pipe' by *The Surfers* – not to be confused with the defunct Haarlem pop group of the same name. *The Surfers*' (1998) release on *Epic Records* had been one of Mitson's favourite projects to work on and thus listen to. Famed US musician, songwriter and producer T Bone Burnett had worked with *The Surfers* to produce the record, but it subsequently failed to sell many copies or gain traction. The band had comprised of, as Mitson described, *'one or two professional surfers on the surfing tour'*. Mitson explained that one of the surfers wrote a series of songs on acoustic guitar, which the group decided to demo, take to Burnett, who then decided to build an album around them. Mitson described his love for the record and the sonics brought about through the wider production process:

> *It's just the most glorious, beautiful journey of an album. […] It's so beautifully done that you don't really even hear the individual songs go by. You're just washed with these glorious songs, clattering drums and bits of guitar all over the place. I mean, it's just gorgeous.*

As chance had it, the album went to print before Mitson had been ascribed as the engineer whose mastering job was approved. Another engineer was misattributed.

*

I have established how reverence and a creative aura surrounds historic studio brands.[1] There had been a moment in my interview with Calbi, when the engineer said, *'I think "Sterling Sound", in general, when people see that, it's kind of almost like a stamp of approval in some ways.'* For mastering engineers, association with reputable studio spaces can exude a sense of expertise. Case in point, Vlado Meller's website biography celebrated the engineer's history of operating out of *CBS Records* (later *Sony Music*), *Universal Mastering* and *Masterdisk*. Though association with known studios may draw in clients, sustained careers are surely contingent on offering consistently reliable services and creative work. As part of a wider discussion into how the British mastering industry had developed over the 20th and 21st centuries, Tim Young offered an insight that was telling of how *Abbey Road Studios*, just like his nearby workplace *Metropolis Studios*, is recognised as one of the most important studio brands today:

> *If you shut [Abbey Road] down now, it would be on the nine o'clock news tonight, because it is without a question of a doubt the most important studio brand in the world. […] You had the most popular ground breaking influential group in the world so closely allied to one particular studio that they call [their very last album] 'Abbey Road.'*

Where *Abbey Road Studios* is concerned, I have suspected that there are times when engineers who operate out of the facility would be hired partly off the back of the brand. The studio complex is steeped in rich musical histories, and the power of its name made clear through the existence of *Abbey Road Institute*. The institute

[1] See: Anderton, Dubber & James 2013: 64-5; Birtchnell & Elliott 2018: 82; Cogan & Clark 2003; Horning 2013: 78-84; 120; 137; Massey 2015; Waddell 2013: 161-2

awards Advanced Diplomas in 'Music Production and Sound Engineering' from its locations in London and the Netherlands. Musicians may choose to master at *Abbey Road* thus connecting themselves with a revered creative hotspot and with stories of famed artists past or present. It is custom for artists, new or established, to take their photos on the front steps of *Abbey Road* after using the Studios to record or master projects. The concept, for some perhaps, is that if *Abbey Road* was good enough for *The Beatles*, then it might just be good enough for them. Via social media, photos and whatever experiences artists choose to share can reach huge audiences.

Lucy Launder, current Head of Mastering at *Abbey Road*, expressed that the greater portion of the Studios' 'Online Mastering' clients back in 2016 was based in the USA. Moreover, US artists may have even flown to attend mastering sessions for just one track. Doing so would enable them to walk through the famous doors and soak in the history of the space. Though mastering footfall at *Abbey Road* could owe partly to the reputation and history of the complex, Launder had expressed that the Studios' engineers would more likely be hired in view of credits and past work. Launder said, *'If [an engineer] worked on an artist that's the "person of the moment" or the "band of the moment", you know, everyone else wants to sound like them, so they'll come in and ask to use them.'* I suggest that regular work could also feed directly into the mastering department via the Studios' owners *Universal Music Group*.

*

With substantial discographies and reputations, established engineers may then receive awards or nominations. One of the most talked about ceremonies is the annual *GRAMMY*s. Certainly, there are mixed beliefs as to what *GRAMMY* awards represent, how they are earned and how others perceive them. To date, Darcy Proper is a 11-time *GRAMMY* nominee. She won four times out of being nominated in the categories of 'Best Historical Album' or 'Best Surround Sound Album' (see *Wikipedia* 2021d, online). Having interviewed Proper in 2016, I understood that many would regard nominations as meaningful and valuable. This is because *NARAS* (*National Academy of Recording Arts and Sciences*, responsible for the awards) employ skilled committees of people deemed fit to peer review the quality

of engineering performed by those nominated in technical categories (see also Moses & Garber 2020). These understandings would inform Addis' (2013: 329; cited also in Patel 2018: 13) work, via which I concluded that becoming recognised as an expert can rely on peer judgment. As part of a broad discussion on *GRAMMY* awards, Proper explained:

> *A team of people have […] listened to the entries and they have deemed that these five out of, in surround, I think the last entry thing that I saw, let's say it was at least 100 entries, it might have been 200. Now, it's a whole lot less than the 900 that might be submitted for 'Record of the Year' or something like that, but it's still a lot of material that gets called through, and also for 'Best Engineered [Album], Classical' and 'Non-Classical', committees of people sit down, listen to this material and then select […] the five that should be decided upon.*

The consensus is that *GRAMMYs* do not translate directly into financial gain or enquiries from new clients. Rich discographies and consistently good work performs better in this sense. Nonetheless, *GRAMMY* recognition is respected, it can evoke a sense of peer approval and *GRAMMY* accomplishments are featured in biographies written to promote engineers and their mastering services. Nominations and awards might also be celebrated publicly by manufacturers of mastering-grade equipment. *EgglestonWorks* (2013, online) declared themselves "proud to announce that Mastering Engineer Darcy Proper of *Wisseloord Studios* has won a *GRAMMY* Award for 'Best Surround Album.'" The album in question had been a surround reissue of Patricia Barber's (2012/1998) 'Modern Cool', and *EgglestonWorks* added, "This is a great accomplishment for Darcy individually and for *Wisseloord*." Proper had used one of *EgglestonWorks*' 5-channel loudspeaker systems to perform her work.

Throughout my interview with Proper, the engineer conveyed humility in having been recognised many times via the *GRAMMYs*. Clearly, winning awards is not the driving force behind her creative involvements with music, and the same could be said for the likewise multiple award-winning Mandy Parnell. In my interview with Parnell, the engineer said, *'I suppose none of us do it for the glory, so it's a bit embarrassing when you have to sort of, like, you know, be given the glory. Yeah, it's*

not about that, I don't do it for that reason.' Speaking with Calbi had prompted me to consider some other perspectives on award recognition. I suggest that clients who operate in certain genres or musical scenes may not be so drawn to engineers with *GRAMMY* success. Calbi said, *'The funny thing about something like a GRAMMY is that a lot of people who are in the alternative field, they think GRAMMYs are bullshit. And actually, to get a GRAMMY, I think some artists find they win a GRAMMY and then all of a sudden they don't have the indie credibility anymore, you know, they're not underground anymore.'*

Whilst the *GRAMMYs* are one of the most talked about ceremonies, they are not the only opportunity for mastering engineers to win awards or recognition for their expertise. Parnell has won multiple times in the *Music Producers Guild*'s 'Mastering Engineer of the Year' category, and I interviewed her prior to a second win. Through Parnell, I had learned of how careful the *MPG*'s peer review assessment of each nomination would be. Parnell reflected on the peer review process from an informed perspective of having herself been included on an earlier assessment panel. *'And the same with GRAMMYs'*, she concluded. *'It is very thorough and they really go into it. […] It's very serious.'*

Whatever implications are associated with winning a *GRAMMY*, the opportunities for a mastering engineer's creativity to be celebrated at these events have been restricted. Via my introduction and *NARAS*' (2015, online) earlier '*GRAMMY* Award Eligible Credit Definitions' document, I explained that mastering personnel have had limited opportunity to receive statuette awards and thus wide appreciation as creative contributors to production. Restrictions have endured, and *NARAS*' (2019, online) updated document clarifies: "mastering engineers who worked on 33% or more of the playing time of the album are eligible to receive GRAMMY statuettes in the category of Album of the Year. Mastering engineers are also eligible to receive statuettes in the categories Best Historical Album, Best Immersive Audio Recording, Best Engineered Album Non-Classical and Best Engineered Album Classical". I argue that, at face value, statuette awards for mastering imply recipients make significant creative and technical contributions to a project. Some would say that *GRAMMY* certificates for mastering acknowledge participation but do not imply such significant involvements. This latter distinction would be unrealistic and

arguments could thus be made in favour of mastering engineers having more scope for receiving statuettes.

Whilst scope at the *GRAMMYs* remained limited, it was actually broader than in previous years. 2011 saw US singer-songwriter John Mayer and some of the engineering team behind Mayer's (2009) 'Battle Studies' win in the 'Best Engineered Album, Non-Classical' category (see *Wikipedia* 2021f, online). 2011 was the final year that a mastering engineer, Calbi in this instance, would not receive a statuette for their involvement with a winning record in this key category. Knowing that the category was introduced in 1958 demonstrates how certain industry customs and codes upheld narrower perspectives of a mastering engineer's work in decades past (see *NARAS* 2021, online). Calbi remembered how 'Battle Studies' had been *'such a difficult mastering [job].'* He added, *'It was such an achievement to get an approval on that.'* But with the same humility expressed by Parnell and Proper, Calbi said, *'The fact that [Battle Studies] won or didn't win a GRAMMY, it really didn't matter to me'.* Calbi's reflection on his careful work with John Mayer's album reinforced to me that engineers engage intensively and creatively with projects they are hired to master. I suggest that awarding bodies have focused less on these efforts and more on efforts performed via other engineering specialists.

Knowing the scope available to mastering engineers at the *GRAMMYs* has highlighted some opportunities for today's practitioner to niche down and channel their expertise into particular genres or release formats. There could be greater odds of them being nominated in a specialist category such as 'Best Surround Sound Album', now 'Best Immersive Audio Album', that was first established in 2005. I say this not to devaluate efforts put into mastering for award-winning immersive projects, nor to suggest that past winners were explicitly motivated by recognition through award. This would not be true. To date, some skilled engineers who have won in this category are Bob Ludwig, Darcy Proper and Tim Young. Young mastered *The Beatles*' (2006) 'Love' album in 5.1 surround, and *Metropolis Studios* host a biography for Young in which this work is noted as a career milestone (see *Metropolis London Music Ltd.* 2021, online).[1] Young's biography, like those appropriate to most other highly respected engineers, presents many

[1] See *Appendix D* – '5.1 surround'.

other indications of expertise. These include notable credits, a history of working at reputable studios, winning a 'Mastering Engineer of the Year' award and accumulating decades worth of experience. The biography, cited below, also describes Young as engineer who can bring his own sense of creativity - imagination, inventiveness and originality (see *Oxford English Dictionary* 2022b, online) to a given project. It concludes with reference to an impressive discography showreel displayed below the text.

> Tim Young's career as an Audio Mastering Engineer blossomed at the start of the 1980s.
>
> After delivering multi-platinum albums for The Clash, Sade, The Smiths, Elton John, The Pretenders and many others, Tim joined Metropolis Mastering with Ian Cooper and Tony Cousins in 1993.
>
> Tim had already had seventeen successful years at CBS Studios, which eventually became The Hit Factory. This once-in-a-lifetime opportunity enabled the three engineers to finally fulfil their dream working environment, featuring state of the art monitoring married to a transparent and musical signal path plus large, comfortable mastering rooms featuring natural daylight.
>
> In 2008, Tim became the first non-US mastering engineer to win a Grammy Award (for his 5.1 Surround Sound mastering on The Beatles' 'Love' album). In 2011, he also won the Music Producers Guild mastering engineer of the year award. Now with over twenty years of experience in mastering at Metropolis, Tim is in constant demand from all levels of recording artists. His reputation as a classic 'all rounder' who enjoys working on all styles of music, means he is adept at bringing his creativity to any genre.
>
> His more recent credits include Elbow, The Killers, Take That, Manic Street Preachers, and 5.1 mastering for Queen. For more details, see the list below.

*

Having explored some vital signals of mastering expertise and some key dynamics of operating in the space, I will now examine other mechanisms and means through

which the established can disseminate knowledge and convey expertise. I will focus in on some key sites of interest that have crossed my own path towards a greater academic understanding of mastering culture and creative actualisation. I have noted two distinct mechanisms for disseminating knowledge as publications and courses. Mastering engineers Katz (2002; 2007), Göknar (2020), Waddell (2013), Wyner (2013), Cousins and Hepworth-Sawyer (2013) have published instructional volumes dedicated to mastering. Back in 2016, *Sound on Sound* (2016, online) advertised that "Hepworth-Sawyer of *MOTTOsound* and ex-*Abbey Road* mastering engineer Paul Baily" would host *The Mastering Course* for two days in Skipton, UK. They would take on a small group of students who aspired to learn creative techniques and gain exposure to professional tools. *SoS* stated that the course would be "intended for those with experience in the home or semi-pro studio", and that it would "shed some light on the 'dark art' of mastering." It is important to pause and reflect on this statement in connection with O'Grady (2019: 160), who asserted that terms such as 'dark art' "[position] the practice as complex with a seemingly impregnable knowledge threshold." Hepworth-Sawyer and Baily have since continued their course offering on a face-to-face basis and through online methods of teaching (see *MOTTOsound* 2021, online).

Mastering Academy offers similar training and is led by mastering engineer Friedemann Tischmeyer, who has previously hosted international workshops with esteemed peers such as Michael Romanowski. I had the opportunity to see Tischmeyer present a technical paper on loudness measurement metrics, and this presentation took place at the *Audio Engineering Society*'s inaugural mastering conference. The *Mastering Academy* (2021, online) website states:

> After 19 years of Mastering Courses and already 8 years under the label MASTERING ACADEMY in many countries like USA, China, France, Belgium, and Germany we have now transitioned into the leading Online Academy offering best possible coaching for you. […]
>
> The new Online courses replaces the former 5-day Master Seminar which is discontinued. This does not only reduce travel expenses; it also allows you to re-capture lectures in order to reduce learning redundancy.

Ex-*Metropolis Studios* mastering engineer 'Streaky' (2021, online) has spent ten years hosting a *YouTube* channel. Via the channel, and alongside his day-to-day mastering work, the engineer shares mixing and mastering expertise, tips, tricks, and workflows. He also discusses professionalism, client relations and he reviews numerous digital and analogue tools. Streaky is one of a series of engineers who have fully embraced online methods of teaching. Via *Streaky Academy* (2021a, online), the engineer charges for two courses, namely 'I Will Teach You To Mix' and 'I Will Teach You To Master'. The mastering course consists of eight modules offering "a deep dive into Streaky's exact process" (*Streaky Academy* 2021b, online). Students enrolled on the course, charged at fixed fee for lifetime access, can join weekly meetings via Zoom.

US engineer and CEO of *Mercury Mastering* Blake La Grange set up *Mastering.com*. La Grange (2021, online) explains that he teaches "musicians, engineers, and producers how to master themselves so that they can finally achieve professional sonic quality, and make more money by offering their clients this necessary last step in the music production phase." *Mastering.com* (2021, online) advertises that "knowledge transfer", "one-on-one mentorship", "tools", "resources" and a "music producer community" are all on offer through a variety of course options. Another US engineer, Maor Appelbaum, authored 'Creative Mastering with Maor Appelbaum' - an online and modular video course distributed by *Pro Audio Master Classes* (2021, online).

One final teacher and mentor I will mention is Tony "Jack The Bear" Mantz - owner and founder of *Jack The Bear's Deluxe Mastering* in Australia. Mantz spent years hosting his own podcast. *Mastering Music, Mastering Life,* defunct as of May 2021, offered insight, interviews and motivation concerning all things mastering, music, life and operating successfully in the creative industries. Mantz continues to work as an engineer, and he mentors those seeking to band together as a group, create different working lives or make positive adjustments to their lives in general. Mantz also offers intensive mastering workshops for those with sufficient knowledge of audio (see *Jack The Bear* 2021, online). His *Mastering Music, Mastering Life* podcast was an excellent resource for my own creative and academic development.

I have already established that podcasts, like courses, can be understood as a medium through which hosts or leading authorities articulate their knowledge and convey expertise. This is not to suggest podcasts and workshop endeavors (or *YouTube* channels and forum postings et cetera) are never born out sheer love for the practice of mastering, or out of eagerness to pass on knowledge gained through years of dedication to the specialty. Two other important podcasts gained traction over the course of my research programme. *The Attack & Release Show* offers analysis on music industry matters from the perspective of its two mastering engineer hosts. Via the show, Sam Moses and Matthew Garber of *Moses Mastering* (Nashville, TN) and *For The Record Mastering* (Charleston, SC) aim to "demystify the music industry and mastering" (Moses & Garber 2021a, online). Moses and Garber discuss equipment and studio space, how these are used and why certain investments might be made. They share perspectives on operating successfully in the creative industries and how to balance life with work. This show, like *Mastering Music, Mastering Life* and like *Square Cad*, was another excellent resource for my own creative and academic development. So too was *The Six Figure Home Studio Podcast*, co-hosted by US mixing and mastering engineer Brian Hood and Chris Graham of *Chris Graham Mastering*. This show has covered professionalism, entrepreneurship and the organisational skills needed to sustain modern audio engineering careers. The show has avoided discussion around creative processes or equipment and has focused more on useful technologies for business. Hood and Graham have introduced listeners to networking concepts such as 'mastermind groups' (see Hill 1928; 1937). The success of this podcast substantiates that mixing and mastering, though creative, can be thought of as 'people industries'. In June 2021 the show rebranded as *6 Figure Creative Podcast* (2021, online) to reflect its expansion into discussions concerning wider creative industry careers.

Two final podcasts that have aided my development are *The Mastering Show*, hosted by Ian Shepherd, and *Working Class Audio*, hosted by US mixing, mastering and recording engineer Matt Boudreau. Via podcast, Shepherd offers "information, news & discussion on all topics related to audio mastering, including hints and tips on getting the most out of the mastering process, suggestions for mastering your own music and discussions of news and important topics from the mastering community" (*Mastering Media* 2021, online). Alongside his wider audio engineering

pursuits, lecturing, making *YouTube* videos, running masterclasses and consultancy, Shepherd blogs via his *Production Advice* (2021) website. There, the engineer shares expert perspectives and advice in the realms of mastering, mixing and recording. I have observed many other mastering engineers promote advice and perspectives via personal blogs. Boudreau's *Working Class Audio* (2021) podcast aims to "[navigate] the world of recording with a working class perspective". Through interviewing hundreds of established audio engineering experts, including mastering engineers, Boudreau has created a valuable resource for professionals and aspirants. His guests discuss personal development, business, entrepreneurship, professionalism and industry etiquette.

Industry conferences and expos, web forums such as *Gearspace* and social media platforms like *Facebook* provide established professionals with further means to disseminate knowledge. Mastering engineers can, via conferences or social media, participate in expert panel discussions. Engineers can otherwise be hosted individually for question and answer (Q&A) sessions, specialist talks or seminars. Members of prominent *Facebook* groups such as *Mastering Engineers Worldwide*, *Mastering Nerdz*, *Mastering Pros*, and *Ask A Mastering Engineer* might readily engage with discussion involving key contributors and practitioners such as Bob Katz, whose expertise is valued. Russ Hepworth-Sawyer was one of the key organisers of the *Audio Engineering Society*'s inaugural mastering conference. As with other large industry events, the conference gave opportunity for experts to engage in public Q&A, present technical papers or keynote speeches. The 2018 event schedule had involved mastering engineers Mike Cave, Hepworth-Sawyer himself, Mandy Parnell, Darcy Proper, Katie Tavini, Friedemann Tischmeyer and Mike Wells.[1] Around four months on from the conference, Tavini (2019) was published in *PSN Europe* (*Pro Sound News Europe*) - a leading pro audio industry magazine. Her article spoke of how large industry conferences provide early career engineers with crucial opportunities for learning and gaining exposure to expert concepts. Tavini wrote:

> The whole event was a huge learning curve for me, and I would urge anyone, if they get an opportunity to go to a conference on their particular subject,

[1] See *Appendix C*

> do it! Learning from complete experts is such a valuable experience and I feel like I learnt more during the conference than I have over the past two years. That's not even an exaggeration; you can do as much reading as you like, but to have completely up to date information from the people who are creating the technology, doing the research and making the records is an absolutely incredible way to learn.

Contributing magazine or trade journal articles and authoring book chapters are effective ways of disseminating expertise. Being featured in relevant industry or academic publications would certainly be helpful to younger engineers who are establishing themselves as experts. Through research set out in this chapter, I have noticed some clear orders of expertise within the mastering industry. Older and more experienced engineers are highly respected for their work, and their well-earned esteem can be supported via award, conferences or other customs I have explored. Well-established professionals can also share knowledge via technical committees or via consultancy work for companies such as *Apple*, who now run one of the most popular music streaming services.

*

Via this third and final section of *Chapter 5*, I have explored some key aspects and dynamics associated with operating as a creative expert in mastering. There are some crucial opportunities for signalling and legitimising expertise, developing social or cultural capital and sustaining work. Towards the end, I focused on some mastering and audio engineering-themed podcasts that have emerged as a means of disseminating expertise. The recent surge of this medium shows that focused, uncensored and uninterrupted discussion around niche topics is welcomed by those pursuing creative goals or particular lines of enquiry. The very nature of podcasts and app-based playback lends well to modern lifestyles that leave little time for sitting down to learn new concepts or engage with printed technical literature.

Chapter 5 has examined processes through which engineers gain creative experience, make connections and establish trust at three stages of a career. The first stage I considered was *access*, the second stage was *education* and the third

was *expertise*. Now that we can appreciate where engineers operating at the top have come from, and how their craft can be learned, I will draw from my extensive data to examine their creative worlds, the spaces and equipment they use and how the engineers' choices are rationalised.

Chapter 6: Creative Mastering: People, Studios and Equipment

The first section of this chapter, *People*, explores how mastering engineers identify with their creativity and apply their listening skills. The second section, *Studios*, hones in on rooms occupied by engineers and how these spaces can be further understood as creatively significant places. The third section, *Equipment*, looks at tools engineers use to perform their work, how these tools are selected, and how these choices are significant to our understandings of record production.

People

> meraki [may-rah-kee] (adjective)
>
> A word that modern Greeks often use to describe doing something with soul, creativity, or love - when you put "something of yourself" into what you're doing, whatever it may be.
>
> (Moore 2004)

Through earlier chapters, I established that academics are focusing more deeply on mastering as a creative practice. Certainly, a key idea that arose from my own series of interviews was that of mastering as a creative endeavour - a process by which engineers interpret and help actualise the artistic intentions of musicians, songwriters et cetera. Mitson offered a rich perspective on what had appeared as a key rationale and familiar philosophy for mastering to exist separately from other creative production phases:

> *[Mastering is] a listening discipline. A mixer is going to listen to where the hi-hat is placed in the stereo field, I listen to the overall thing and it's very hard*

to detach yourself from what you're used to. Also, if it's a mixing engineer who's done the mix or the tracking engineer tries to master it, they have certain prejudices on that record. They remember when the singer had a meltdown 'cause he couldn't hit the big note in the third chorus, or the guitar player and the bass player getting into a fight over treading on each other's toes or whatever and they bring all that with them. If there's something they're not quite happy, a little technical detail in the mix, if they're not quite happy but it doesn't really make any difference, that's all they're going to hear. Yeah, they bring it to me who's never heard it, I don't know who had tears and tantrums in the recording and I don't know that that hi-hat might be a 10th of a dB too loud or something, I just accept it for what it is, unless there's something glaringly wrong, so the fresh ears accepting it as a product with the mastering listening discipline, it's the best person for the job.

Indications of mastering being envisaged as a creative interjection emerged via engineers who drew upon metaphors or analogies that, I suggest, are useful for helping laypersons understand where mastering fits into production. *'I see albums as being as much a work of art as a painting'*, said Heyworth, amidst broader discussion. Later on in our interview, the engineer encouraged me to picture a craftsman making a table or chair in their workshop. *'"This is my latest artwork" and he says, "but it needs…", and you say, "it's not quite finished" and he says, "no, it needs a polish", well, that's what we do, you know, it needs a polish.'* Calbi compared what mastering does for music to what his grandfathers, both tailors, did for fashion. As a form of labour, the dynamics and the nature of the exchanges are similar. The tailors would, in Calbi's words, *'take something which has already been created and then fit it to the person's personal taste, then get paid directly by that person for the job that was either approved or returned for adjustments. I mean, it's amazing, it's exactly the same dynamic'.* Schmidt encouraged me to compare his own mastering work to the duties of art critics or book editors. This was after I had asked the engineer to consider the extent to which mastering could be thought of as artistic or scientific. *'An art critic is not looking at, say, a painting and saying, like, "oh well, these lines aren't drawn properly, that's not good." But to an extent, an art critic would have to interpret what he's seeing and kind of understand what the*

artist was trying to do.' Schmidt added, *'Again, let's say a book editor, you know, if someone's writing a book and there's an editor who […] reads the book and he's looking not just for technical mistakes, as in like, you know, like errors in typing or like errors in paragraphs or incomplete sentences. […] The editor might say to the author, okay, well, […] that guy gets introduced but he hasn't been mentioned before and maybe you should mention, you know, so they might get into the story.'* In one final example, Wharton described his own day-to-day work as *'a bit like grading in film.'* He said, *'The sun could be shining on one day when they shoot and then it could be raining the next and it's being able to connect the frames.'*[1] Wharton conveyed that mastering involves, *'making sure each track isn't moulded into one but that there is a connection'*, and the engineer described his own process of determining the length of silence set between each track on a release: *'If I do it on my own, then I'll literally just* ***feel*** *it, maybe count beats, but I just get the feeling.'*[2]

Lakoff and Johnson (1980/2003: 5) maintained that metaphor is "understanding and experiencing one kind of thing in terms of another". They said, "we act according to the way we conceive of things". In this sense, if someone envisages verbal disputes like wars – 'let's battle this out' – then this determines the relentless manner by which they engage in quarrels. "Human thought processes are largely metaphorical", said Lakoff and Johnson (6). To this, I would add that other cognitive processes or figures of speech such as analogy and simile could permeate inner dialogues and govern our engagements with the world. If we do indeed "act according to the way we conceive of things", then we should entertain the degree to which particular ways of working are contingent on various metaphoric and abstract conceptions. If, for example, Heyworth figures mastering as a way of adding polish to something that has been meticulously crafted, then this could reveal a lot about how the engineer experiences and accomplishes his day-to-day work. Via their use of metaphor and analogy, the collective of engineers I interviewed helped me form a greater sense of their culture as a musical people.

[1] Collins et al. (2019: 258) too described mastering as "Akin to color [sic] grading for film".

[2] I previously cited Savage (2014: 250, my emphasis), who defined timing the length of silence between each track as "the last *creative* judgment to be made in preparing your master"; "a part of the overall aesthetic" that determines listener engagement and a sense of musical development over the course of an album.

Whilst engineers might not perform outright artistry, they nonetheless figure themselves as creative contributors or aides who try to decode musical intentions and enhance emotions embedded within recordings (see Paton & McIntyre 2009). Mastering engineers also aim to conserve what they regard as integral aspects of an artist's output. All this would resonate with views expressed by mastering engineers who spoke in much earlier interviews conducted by Owsinski (2008: 157-252). I drew from these interviews in *Chapter 2*.

Further discussions had continued to render the culture of mastering as a musically capable and musically oriented people. I also gleaned that, for many engineers, mastering work could be suited to an individual's own sense of personality or self. Proper explained mastering as *'the métier that my personality lends itself to, you know, my way of thinking.'* Proper also remembered her past love of singing in choirs, playing woodwind in large ensembles and how these activities had offered her an outlet for creativity, whilst at the same time feeling that she *'never wanted to be in the spotlight and never wanted to be improvising solos and that kind of thing.'* Proper added, *'I could read really well, I could play the notes that were in front of me, I could really enjoy it, but I was not the one who could take that creativity, the creative aspect to the next level.'* Hopkin spoke of having had, prior to mastering, opportunities to be, *'the guy who stood up in front of all the people'.* Yet, Hopkin identified as *'an anxious person'. 'Some people are performers, right, and some people just aren't and I'm just not'*, he added. *'I still have to do so many drugs to get out there to actually go and do the thing, that by the time I was out there I was fucking useless because I'd done so many!'* Similarly, Heyworth had long considered himself a *'backroom boy'* in the music industry. *'Rather than somebody at the front of the glass, you know, a performer or whatever'*, he said. *'I don't want to be out front, […] I'm quite happy being a backroom boy, you know, one of the people who are not necessarily that well known. Although there is a certain amount of cachet to being a mastering engineer, it seems.'* Bernie Grundman did not state that he himself would ever avoid working with large crowds of musicians. Yet, he conveyed that mix engineers who operate in busy and conventional studios would, in general, be *'more into dealing with a lot of people'.* Grundman suggested that, compared with mastering engineers, mixers *'have to be a little more outgoing maybe'.*

While assimilating all this, I had been reminded of how Calbi described the documentary film '20 Feet From Stardom' (2013). This had been amidst a varied discussion. *'[The movie is] about these four very talented background singers who worked with The Stones and Joe Cocker'*, he said. Calbi depicted how each singer had been portrayed to be *'as talented as any artist who's had hit records.'* Calbi also conveyed that the film could help its audiences to understand *'the personality type of people who can be in front of the microphone, in front of a band, or who can be behind it and it doesn't necessarily have to do with talent.'* Thinking about this film, I reasoned that some mastering engineers might sense how they themselves would not come off well in situations such as public interview – they might struggle to describe their work confidently and in ways that are commensurate to their engineering talents. Whilst engineers could lack confidence in explaining what they do, this would not reflect on their ability to perform mastering. I deduced that the socially isolated nature of most mastering sessions could appeal to engineers who identify as musical, but who would much rather apply their creativity and contribute something "interesting, important and *human*" (Csikszentmihalyi 1996) away from the limelight.

There were moments in my interviews where engineers discussed the differences between sessions where artists attend and sessions where artists do not. Via these discussions, and via Hepworth-Sawyer and Hodgson (2018: 3), I have conceptualised mastering as an artistic practice that is sometimes performed to greater effect if practitioners remain undistracted. Unattended sessions could better facilitate working "in the zone" – a flow-like mindset that Banks (2014) discusses in relation to creativity (see also Csikszentmihalyi 1990).

Hopkin felt that, *'without question'*, his best work would be performed unattended. Although open and honest with clients about his preference, the engineer would not discourage them from attending if they preferred to work interactively. Proper said, *'Most mastering sessions don't include an assistant.' 'We work alone. So when the client needs some coffee or tea […] or a little bit of social interaction, rather than just staring at my back as I'm up at the console, then you have to play that role as well and it can slow things down and take you out of the zone.'* In spite of this, Proper indicated that attended sessions do have plus points. She would not try to dissuade

clients from attending, as attendance can allow for faster communication, collaboration, or better rapport. Scott Hull explained that while an attended session can prove very helpful, *'It doesn't always make for the best record'.* Having spoken with Hull, I developed a greater sense of how client attendance might impede creative processes and distract engineers from *'[getting] into the deepers and vibe of the whole thing.'* Hull said, *'When people are here, I'm much more in tune with what knobs I'm turning and what the numbers are. […] I'm much more conscious of the technique and I think that's what takes me out of my game a little bit.'* Despite this, and for the same reasons as Proper, Hull would by no means discourage people from booking attended mastering sessions. Clients would be met with a professional and welcoming state of affairs at *Masterdisk*. It's not that unattended sessions are better or worse than attended sessions, it's just that they are different. Hull explained, *'Sometimes it really is helpful, having the person there to say yes and no to some options.'*

Mitson described mastering as *'a Zen thing.'* He added, *'You sit back and you just "hear it". There it is!'* Earlier on in our interview, Mitson had said, *'When I'm in that spot, that's where I am and it's very emotional, it's a very emotional response to what I'm hearing.'* Having compared the mastering process with a Zen-like state, Mitson then explained, *'If I'm doing dog and pony shows with clients where I'm having to talk, sort of turn around and talk and you know, "you want more coffee?" and everything, "blah, blah, blah, oh, the gig the other night", you know? […] You never get the best, because you're distracted.'* Hull had actually described instances of *'complete communication roadblock'*, arising from his own attempts to explain creative and technical manoeuvres to clients in attendance. Hull recalled, *'I've had kind of, not meltdowns, but I've had points where I'm like, "I don't know, I don't know why I did this, but here, this is [how it sounds] without it", and they go, "oh, well, that's nice!"'* Hull said, *'I find frustration, I suppose, in not being able to explain it.'*

Creative practitioners speak often of how ideas appear fully formed or how artistic roadblocks seem to resolve themselves as a result of taking short breaks from a task. Unattended mastering sessions can enable engineers to freely withdraw from their work. Proper explained, *'If I'm frustrated by a track because it's, you know, it*

doesn't necessarily mean there's anything wrong with the track but if it's not coming easy or whatever, then I can just, you know, get up and walk away if I want to and, you know, come back at it again.' 'Also', she later added, *'if a track is particularly moving and I'm moved to tears, then [working unattended] is less embarrassing than if there's somebody sitting in the room with you.'* This moment of Proper's interview had propelled my own understanding of mastering as a process by which engineers connect and sympathise with emotions put across via recordings. At *AIR Studios,* Ray Staff made a statement that would support what Proper said with reference to taking breaks. His statement also suggested the amount of time professionals dedicate to mastering projects. Staff said, *'I think on an average album, if you can't have all the EQing done in about six to eight hours and be moderately happy with it, then something's not quite right and you should walk away and come back.'* This had been the engineer's response when I asked about how quickly an engineer might lose their sense of perspective and become too familiar with a recording thus impeding the critical nature of the mastering session.

Findings presented so far in this chapter help account for why mastering remains an understudied and mysterious phase of production. My research upholds that discussion related to mastering bears hallmarks of creative practice and artistic interjection. Clearly, however, there is a sense that great mastering work can arise through performing in isolation. I suggest that these understandings could together promote the archetype of the mastering engineer as a creative expert who prefers not to be disturbed from their work, open up their space or let light in on their methods. I have established that mastering is often termed a 'dark art'.[1] I will now examine further concepts that build a richer picture of the mastering engineer and their creativity. As I set out in *Chapter 3*, there are many ways by which engineers can enact sonic changes on a recording. If changes are carried out in isolation, then it is important to understand how mastering engineers perform and how they experience the world from behind the studio door.

*

[1] See Bregitzer 2009: 183-4; Collins et al. 2019: 261; Hepworth-Sawyer & Golding 2011: 241; Sterne & Razlogova 2021: 8

By the time I set about interviewing Hopkin, I had understood that mastering could attract particularly audiophilic engineers with inclinations towards work involving detailed or intensive listening. Those aspiring to master would be devoted to sonic excellence through production (see Milner 2010). I felt that Hopkin expressed something of a concern for others, perhaps of a younger and less experienced generation, being so meticulous or excessive with their approach as to lose their critical sense of perspective and thus put the project being mastered at risk. In spite of good intentions, an engineer's time could be lost through testing out numerous technical adjustments. On their own, each individual decision may actually contribute negligibly on the finished product, particularly if changes involve half-decibel adjustments. With this being said, as Hopkin so appropriately stated, *'Sometimes you do put half a dB of EQ on something and it fucking nails it!'* Having myself spent many hours experimenting with various software plugins and their settings, I could certainly relate. There had been occasions where I lost sight of what needed to be achieved through mixing or mastering a recording, and this was made worse through 'gearlust' – believing, against rational judgment, that introducing certain tools into my workflow would be helpful.

Reflecting on these ideas, I considered how numerous small adjustments might be spread out over large chains of hardware or software processing tools – some of these chains and tools being questionable in terms of how they maintain the perceived fidelity of signals. This approach in mastering would have the potential to bring about differences that are much more perceptible, but not necessarily constructive. It is important to understand that audio signals degrade through digital-to-analogue conversion, analogue signal processing, analogue-to-digital conversion and digital signal processing. Paradoxically however, this degradation can, under the right circumstances, be sonically gratifying and outweighed by signal colouration, effective gain staging or performing sound corrective adjustments. Under the wrong circumstances, degradation can only be made more apparent. I found that the 'tyranny of small decisions' phenomenon offered a useful way into conceptualising some conclusions I drew from all this.

Economist Alfred E. Kahn (1966/2007) explored the so-called 'tyranny of small decisions' and described how smaller choices that appear rational in their micro

contexts can cumulatively upset the wider structures to which each micro context corresponds. Lloyd (1833) offered an early illustration of the concept, and this was later popularised by Hardin (1968). Via Hardin we see that if herders who share land each add more livestock, then all would begin to profit through increased sales. However, the effects of overgrazing would eventually signal ruin. In audio engineering, the adjustment of one particular frequency band will correspond to a changed presentation and perception of phenomena within different bands (see Katz 2002: 99). Applying the tyranny of small decisions phenomenon to mastering, we might say that if an engineer boosts the lower bass frequencies of a recording to accentuate the kick drum, the boost could upset earlier adjustments made to other frequency areas. Those earlier adjustments might have helped hold the recording together as a whole. Similarly, by the same laws of science and more, colouration brought about through subsequent stages of gain could upset or offset any previous colour and adjustments.

Knowing all this, it became clearer how younger or less experienced engineers might find themselves lost when performing excessive adjustments across arrays of vaguely familiar tools. Much could be made of quite little by those who, like myself, were learning to master recordings. I purposefully integrated this understanding into my process of developing as an engineer. My conclusions also underscored the importance of understanding how creativity is exercised and managed by professionals who might themselves identify as an audiophile or inclined towards work involving detailed and intensive listening. To regulate meticulous and unnecessarily detailed decision making, it seemed that Hopkin may advise younger engineers as follows: *'You need to know when to switch it on and when to switch it off, you know, that's what I've learnt and if I've learnt anything, it's that.'* Through speaking with Hopkin, who I have observed work quickly in each session, it also became clear that developing engineers could do well to distinguish a project's critical details and focus on the wider context. *'You do have to care about details'*, he said. *'Some of the time I can understand which ones of those details are the big ones and which ones of those are the ones that possibly we can let slide.'*

From a critical standpoint, academics might interpret Hopkin's expressions of concern and advice as mechanisms through which the engineer positioned himself

as an expert voice. I reject this idea, and I stress that Hopkin made clear efforts to educate and inform, rather than suggest the quality of service he himself offers as an experienced engineer. Hopkin demonstrated sincere interest and investment in advocating that the integrity of musical expression and work should be upheld through mastering. There had really been some vital words spoken in the midst of our discussions. Hopkin said, *'When I do try [something] and it doesn't make any difference, or it doesn't improve it, I don't fucking do it.'* The premise was essentially, 'do nothing, where appropriate', and numerous other experts had conveyed this philosophy. They also conveyed technical understandings of how, as I myself deduced, much could be made of quite little in mastering. "High-quality mastering requires a sense of priority and seasoned judgment", explained Waddell (2013: 3). "Because every process affects the entire mix, mastering virtually always involves a balance between benefit and sacrifice." Katz (2002: 12; 99) defined mastering as "the art of compromise". He explained, "each tool makes only an incremental improvement, and the final result comes from the synergistic totality of the tools working together." Hepworth-Sawyer and Golding (2011: 15) said, "less is more"; "know when to do nothing at all".

Miles Showell conveyed that, *'in an ideal world'*, he himself would *'try to be as hands off as possible'* and do nothing but a transfer, depending of course on the project. *'By adding any EQ or compression I'm going to muck it up, so let's just not do that and let's just have a listen and make it a really good clean transfer'*, he said. Proper echoed these sentiments via her reflection on some important philosophies of recording and how her early experiences with recording informed her later mastering work. Proper vowed, *'If I don't have to throw a piece of gear into the chain, then I don't. If it's not serving a purpose, if it's not doing something positive, then it shouldn't be there because it could potentially do something negative just by being there. So you know, the philosophy is sort of get from point A, which is the recording, to point B, which is the listener, in as short a distance as possible. Don't put any shit between the listener and the artist that doesn't have to be there to get the message of the music across.'* Grundman expressed an awareness of the potential for engineers, such as himself, to lose a critical sense of perspective when performing deep and focused mastering work. *'You can really get pretty deep into it, I mean, too deep'*, he said. *'In fact, so deep that you've taken yourself and gotten*

used to a bad sound, I've done that and then I go back to the original, I go, "what happened", you know, "I've taken this thing in a direction that I don't even like!"'

All these perspectives have highlighted the importance of a mastering engineer's careful judgment, knowing when less is more and knowing when doing nothing benefits the music. For the most part, processes of recording and mixing popular music are known to involve less restrained approaches to developing the so-called "sound stage" from the ground up (see Moylan 2007: 50-55). Understanding how engineers approach these phases of production differently reinforces that mastering is a critical process of connecting with the creative intentions of artists, producers et cetera. Mastering engineers apply creative or corrective interjections where needed.

We may at this stage question how those uninvolved with a particular recording would be able to deduce if mastering has made things sound better or worse. In *Chapter 2* I quoted Emily Lazar (in Gonsalves 2012: 21m45s), who said, "There'll be a lot of conversations about what mastering engineers do to things and people talk about this online as if they have a clue about what it sounded like before and they don't." I suggest that if outsiders lack the in-depth knowledge or experience of mastering records, then their informed judgment of another's work would really depend on them having gained access to two things. First, the same source audio export provided to the mastering engineer. Second, the same mastered export returned to the client. My feeling is that, without access to original source audio, experienced mastering engineers might well possess the knowledge, experience, listening competence and other credentials necessary to evaluate approaches taken by peers. There are of course situations where engineers can be asked to master recordings that were attempted elsewhere or by the artists themselves. In these situations, engineers are likely given access to the earlier masters as well as the source audio. With access to both these things, mastering engineers are able to conduct informed evaluations of approaches taken by others. Engineers would need to understand, however, that previous attempts at mastering might have been influenced by various stakeholders in the production process.

Yet, it must be said that a high degree of mastering expertise may not always be necessary to shape respectable opinions of whether recordings have benefitted sonically through their experience with an engineer. There are various industry

practitioners, audiophiles and music fans who would likely be able to comment on a whole range of sonic qualities introduced via mastering and that are considered undesirable or unfitting in certain contexts. One undesirable might be the 'pumping' effect brought about through excessive dynamic range processing. Proper expressed the implications of using compression or limiting in excess and in the wrong contexts by way of analogy. Amidst general discussions regarding the issue of dynamic range in music, Proper said:

> *You have to think of the music itself as like a lion in a cage. […] So you go to the zoo and […] for the first couple of minutes, the lion's looking pretty impressive. He's strutting around and whatever, but it doesn't take too long before you realise that no matter what he does, there's this nice big thick plate of glass there and he's not going to get through it, and that is compressed audio. It sits in the speakers and […] it sits there and it might be loud, but it doesn't ever move. It hits that brickwall limiter at the end and everything sort of smashes up against that and as human beings we are capable of recognising that it's not changing anymore. You see it, it's there but, you know, before you know it, you're leaning up against the glass and he's roaring, tearing a steak apart behind you and you're just checking your SMSs, you know. Take that limiter away, take that piece of glass away, everything that lion does is suddenly fascinating, whether he's roaring, whether he's moving, whether he is lying there sleeping and you know, licking his ass, whatever he's doing, you're watching that lion. Why? Because you know any second things could change and any second something can reach out and grab you and we can perceive this in music as well. When that limiter is not there, you know, yes, you would have to turn the volume up more because we can only fit so much dynamic range in digital media or any kind of media, be it digital or analogue. But when you turn that volume up, your whole nervous system becomes aware of the fact that things are moving and changing, and the guitar comes out here and that scream in the vocal happens there and there's a snarl that happens or a little spooky whisper that is going alongside the vocal and, you know, suddenly something else happens and your whole nervous system gets*

excited by this and you don't have that when that plate of glass is there. You get bored. That's what I try to explain to clients also, you know.

*

My research has proven that there are different as well as shared approaches to mastering audio. Differences in approach would be down to taste, preferences engineers have in terms of working with studio space and tools, along with how engineers perform their phenomenological assessments of audio and signal processing equipment. When I think about how equipment can be analysed, I am often reminded of a moment in my interview with Mitson. In a jestful manner, he said, *'Engineers also have this thing that they like to prove that they can hear better than any other engineer.'* Mitson had not been speaking of a particular mastering engineer or about mastering engineers in general. Nor had Mitson's comment been made in reference to any topics I have covered so far. Mitson had been reflecting on some controversies that were purportedly spread about the wider professional audio space. Through casual discussions of the controversies with Mitson and a few others, I had been inspired to ponder more deeply about mastering engineers and how they themselves might dig deep to form perspectives on the tools they work with. Some of the controversies had reminded me of Perlman's (2004) study regarding "the contest for epistemic authority in audiophilia" (783). Via Perlman (2004) I have understood that some audiophiles are known to disregard science – they pursue instinctive and subjective approaches to analysing sound. To the contrary are those said to embrace more objective and mathematical methods of analysis, relying less on their own subjectivities. Hence, 'golden ears' and 'meter readers', with each group contesting for 'epistemic authority' (see also Clark 1991: 5; Collins et al. 2019: 261). Perlman indicated, aptly, that audiophiles might never wholly identify with just one of these categories.

I described to Mitson some claims that were allegedly made by audio engineers and audiophiles. The suggestion had been that sonic variances could be heard between bit-for-bit identical files played off of different magnetic disk drives. At the time I interviewed Mitson, the claims had been only recently brought to my attention via hearsay. I had not yet substantiated them, attributed them with any particular individuals or gauged any sense of their prevalence. I couldn't say how recent they

were. Therefore, Mitson's comments would have only been made on the assumption that the claims were genuine and ongoing. In 2021, I have pinpointed some fairly recent forum discussions around the concept of hard drives sounding different (see *Head-Fi* 2016, online; *Steve Hoffman Music Forums* 2016, online; see also Masters 1987 re compact disc players).

Mitson had moved the conversation onto another audio-related controversy that perpetuated over a number of years. *'There used to be the thing where you put a green felt tip stripe round the edge of a CD to discipline the laser to make a better playback.' 'It's utter nonsense'*, he attested. *'See, ones and zeros are supposed to be an absolute.'* It was at this point that Mitson said, *'Engineers also have this thing that they like to prove that they can hear better than any other engineer.'* Unbeknownst to Mitson, I had then been reminded of how those learning to master should be wary of false information disseminated via forums geared towards audio engineering.

Hopkin and I had also talked over the controversies related to magnetic disk drives, and this was around two weeks prior to my interview with Mitson. *'Digits, digits, digits!'*, he ranted, and Hopkin expressed that if checksum analysis ensures bit-count integrity between two files then perceived differences would be a trick of the mind – a placebo event.[1] Mitson's and Hopkin's rational perspectives shone an interesting light on the idea of mastering as work that could attract audiophiles. My discussions with these two practitioners underlined a necessity to explore how mastering engineers think about broader and debated aspects of digital audio. A mastering engineer's concern for quality would surely extend into these wider realms. My research supported that mastering will remain relevant going forward - practitioners would thus contend with a variety of digital audio developments in future years. In the interests of maintaining sonic excellence, I felt that an engineer's ability to challenge or debate various changes should be exercised where necessary.

Heyworth recalled his own perceptions of digital audio developments as they unfolded before the time of him moving away from London and towards Devon in 2002. Back then, Heyworth had clearly adopted analytical perspectives and

[1] See *Appendix D* – 'Checksum'.

willingness to engage in intensive phenomenological assessments of emerging technological standards. The engineer had been committed to quality. His interview took place just one day after Hopkin's, and two weeks before Mitson's. In spite of my plans to discuss whether sonic variances could be heard between bit-for-bit identical files played off of different magnetic disk drives, the subject had arisen quite naturally amidst his thick descriptions of work in much earlier times. Heyworth said:

> *I didn't like the internet, in terms of moving audio, I was very worried about that and what it did to the audio, because that was the other thing is that in terms of quality and retaining the integrity of the digital audio, it was very concerning to me that, and we spent a lot of time worrying about that in the early days of digital audio, about whether or not cloning of an audio file from one hard drive to another actually changed the sound. Well, I believed it did, absolutely, I mean, we listened to lots of stuff and you know, I was absolutely convinced that, in fact, I used to, even with the early DAWs, I used to still make my master onto a [Sony] PCM-1630 because I didn't like, I was worried about the [Pre-Master CD], you know, the data integrity of that didn't… You had to make sure the error correction was right and there was lots of complexity, whereas I just felt more comfortable and I reckoned the disc sounded better coming off a 1630. So there was still a lot of unknowns, if you like, about that and there were lots of discussions in [Audio Engineering Society] forums about […] the laser cutters as well at factories and all of that, so there was, at all sorts of different levels, there was discussion about why some discs sounded better than others, why one pressing plant would press an album and it sounded great and another one would press it and it didn't sound very good at all, you know, on CD and you're going, "oh my God, the world of digital audio is full of pitfalls", and we were very, very sensitive to keeping the integrity of the music right and not having it all messed up by all this stuff. So blimey, the amount of time we spent on it was amazing. I mean, I was scared to begin with here, you know, people used to send the audio on DVD as a WAV file and I used to play it off the WAV file on my computer. I didn't transfer it onto a hard drive and then play it, I used to play it live straight off the computer hard drive and it*

sounded better to me doing that than it did me transferring it to a hard drive internally and doing it that way.

Mitson, Hopkin and myself had the power of hindsight on our side when we discussed the prospect of hearing differences between files played off of different magnetic disk drives. Heyworth had been remembering a much earlier point in his career and the uptake of digital audio as it transpired before the turn of the century. His descriptions conveyed that changes in understanding had taken place, and his perceptions of digital audio would have altered drastically between the time before his move in 2002 and the time in 2016 when he spoke for interview. In 2016, Heyworth's perspectives would have been closer to those offered by Mitson and Hopkin. For well over twenty years, Heyworth has performed distinguished work in the realms of digital audio - 'Super Audio CD' (SACD) and 5.1 surround sound most notably. It is clear that before all this work there were various unknowns and there were others who shared his concerns. These engineers had been acting as gatekeepers of quality and as critical sets of ears between the studio and listener - it was their responsibility to be tentative of new formats or new means of transferring audio. Systematic methods of verifying bit-count integrity might not have been so available or established back then, and it would have been necessary to call any claims about digital architecture into question via intense methods of critical listening and subjective evaluations performed at the most hairsplitting level. I assert that modern engineers should now be adopting the same critical responsibilities and philosophies as they begin to welcome in new formats or means of transferring audio.

Today's mastering engineers will, like audiophiles, embrace objective and subjective approaches to evaluating sound, equipment et cetera. Certain approaches can be popularised or legitimised by known experts, trade associations and professional bodies. One's approach could be influenced by beliefs and preferences or by peer groups and professional affiliations. Knowing this highlights the importance of understanding how, according to Perlman (2004), consumer audiophiles can "resist the scientifically authorized claims of audio engineering by privileging their personal experiences, and they argue against scientific methodologies that seem to expose those experiences as illusory" (784). All this is of course dependent on context and

what exactly is being evaluated. Perlman identified how "distinguishing between different brands of amplifiers, speaker cables, interconnects, or other components" is an established area of controversy between "golden-earism" and "meter-readism" (795). This controversy can extend into the realms of mastering and music production (see *Stereophile* 2012, online; Streaky 2019, online; Winer 2018, online).

The language that audiophiles use to explain their perceptions reveals much about their epistemologies and emotional investments in high fidelity sound. Perlman quoted the now late journalist, audio critic and founder of *The Absolute Sound* magazine Harry Pearson (in Anonymous 1990) as follows:

> Digital is simply a human disaster […] When sound is cut off too quickly, some primitive mechanism is tripped in our minds […] Think of the forest, filled with life; it goes dead silent only in the presence of some horrible threat – a predator. That treasured CD 'silence' – its deadness between tones; its complete absence of any ambient sound, of the gentle, sustained decay of the violin […] affects our limbic system in a profound way. Each time that silence occurs, our whole system panics, looking for the predator. No wonder bad digital sound is so horribly exhausting to listen to. After I listen to one of those CDs, I usually have to go and take a nap.

I opened this section by exploring a series of abstract and metaphoric depictions of mastering as a creative or creatively informed process. I later cited Proper's extensive descriptions of the musical ramifications associated with compression or limiting done excessively and in the wrong contexts. We might say that languages used in these explanations are akin to languages used by audiophiles in their discussions of music and sound reproduction. We might also say that for engineers to signal a propensity towards audiophilia would uphold the prospect of mastering as a valuable and human process. This would be advantageous to professionals who see themselves as up against the rise of automated online services. At the root of an audiophile's quest for sonic excellence is a downright passion for music.

Having explored how engineers identify with their creativity and apply their listening skills, I will now focus on rooms and spaces used for mastering. Relatively speaking, mastering studios have remained absent from wider industry discourse and studies

of popular music production. I will explore how mastering studios can be better understood as creatively significant places.[1]

Studios

Irrespective of many reputable mastering engineers having moved office at various stages of their careers, an issue I will explore later in this section, the need for mastering engineers to be aurally attuned with the sonic characteristics of their listening space would prove to be an incontestably popular demand. Birtchnell and Elliott (2018: 82) said, "mastering engineers take time to learn how a space sounds and this process involves investments of both time and money since any spatial eccentricities must be altered through treatment, for instance insulation or rearrangement of equipment." In *Chapter 1*, I said that when engineers and technicians speak of achieving perceived 'accuracy' in terms of their listening environment, this refers to building setups incorporating monitoring systems and room acoustics that deliver ideal presentations of sound. In *Chapter 5*, I explained that the acoustics and physical surfaces within a listening space impact on how engineers hear sound reproductions that travel from loudspeakers to their ears. I also delved deeper into matters of 'accuracy' and some of the technicalities of studio acoustics and listening environments.

Many of the mastering engineers I interviewed confirmed how efforts are typically made to adjust the acoustic properties of studios in order to construct, in Pesche's terms, *'controlled environments for listening'*, as opposed to recording. Pesche prompted me to compare the swapping of mastering rooms with divorce, insofar as moving somewhere that sounds totally different, having worked in the same room all the time, would require the engineer to reattune. Gonsalves positioned mastering as *'the final critical chance at QC from somebody who does this all day in a room*

[1] As I stated in the introduction, my final opportunity to publish before submission was for an edited collection by Braddock et al. (2020). I drew upon my research to form a short chapter, *The Creative Mastering Studio*, much of which is now incorporated into the *Studios* section of my sixth PhD chapter (see Hinksman 2020).

specifically prepared for the task'. Schmidt twice upheld that operating consistently within the same acoustic environment is vital bedrock to the mastering process; *'you press play and you know exactly what you're listening to'*, he said. From our interview 2015, I gleaned that Schmidt had previously hired an acoustician to design his room in Karlsruhe. Also speaking in 2015, Calbi confirmed Fran Manzella as the reputable acoustician behind the majority of mastering rooms inside *Sterling Sound*'s former and sole location at 88 10th Ave New York, NY. *'He's a genius'*, stated Calbi. Following my interview with Calbi, *Sterling Sound* publicly announced their impending departure from 88 10th Ave and their appointing of Thomas Jouanjean's *Northward Acoustics* to design their new facilities in Edgewater, NJ and Nashville, TN. By 2015, Jouanjean had designed the main studio at Hopkin's *Stardelta Mastering.* By 2018, Jouanjean had also been commissioned to redesign the mastering suite at Gonsalves' *Telegraph Mastering*. Hopkin described Jouanjean, his choice acoustician, as *'a fantastically knowledgeable guy'*.

Spending time with a cross section of mastering engineers affirmed to me that the conventional goal of any specialist asked to design a listening space or control room would be to construct the 'flattest' and most clinical listening environment possible in accordance with presenting circumstances; even the most sophisticated approach to acoustic design and correction will deviate from a hypothetically or mathematically optimal benchmark when unique structural or spatial limitations are imposed. I also learned that internal fixtures and everyday furnishings could affect the acoustic temperament of spaces used for mastering. Hopkin explained, *'I knew [Jouanjean] had designed a pretty much perfect acoustic environment. We looked at plots on a screen and the response was as flat as it was going to be'* - for his particular room, a repurposed Victorian Baptist church in rural Devon, I add. Thus, whilst efforts can be made to achieve sonically and mathematically optimal benchmarks through artificial acoustic treatment, I suggest that each particular mastering room would likely offer nuance and subjectivity to the listening experience. With this being proposed, it is essential I draw attention again to how, as Shelvock (2017: 201) explained, "phenomenological evaluation of a record's timbral and dynamic configuration informs every audio mastering session". Standing by this notion, I affirm that we should now consider each creative and critical choice made by mastering engineers as a function of the listening experience afforded by their

unique but understudied environment. This idea is further informed by a history of music industry personnel making sense of recording studios as musical instruments in their own right.[1]

If spatially and sonically acclimated mastering engineers remain in high demand, then their studio spaces deserve much greater recognition and study as culturally or creatively significant places. These engineers offer creative interjections at the final stages of production, and some discussions had prompted me to consider how such offerings should only be made in mathematically regulated environments. I suggest that this notion would reinforce popular interpretations of mastering as an amalgam of art and science. This notion would also foster the necessity of hiring a specialist to master recordings at a professionally treated facility. This being said, I observed how not all of the leading engineers I spoke with would have been in a position where they could have announced having chosen to hire an internationally renowned specialist to ensure the acoustics of their studio are treated or prepared to a more clinical specification. Thus, while some engineers may choose to promote the mathematically devised room as a high requisite for creative work, others such as Astley and Heyworth may bind their creative proficiency to deep-rooted and personal familiarity with the unique acoustic properties of a more organic space. Before delving further into all this, I should clarify that I found no overall correlation between a) the caliber of projects or clients that had been assigned to each engineer and their studio; b) the level of investment put in to artificially treat the acoustics of their room. Thus, equally acclaimed projects and artists have been mastered in many of the treated and untreated rooms operated by the mastering engineers I interviewed.

In September 2015, I noted that the mastering room at Astley's home did not show regular indications of having undergone radical levels of artificial acoustic treatment. *'I know [this room] very, very well'*, said the engineer, who proceeded to explain that the room's ornamental wooden paneling *'tends to absorb quite a lot.'* He added, *'The windows are recessed, so you're getting no zing from the glass and my chimney is a bass trap.'* By my interpretation, despite Astley having expressed a

[1] See Birtchnell & Elliott 2018: 82; Eno & Bass 1979, online; Geels 2007: 1429; Horning 2013: 87; 90; Marrington 2017: 85; Moorefield 2010: xiii

clear awareness of undesirable acoustic phenomena and how such phenomena may be prevented, the engineer proceeded to convey an innate familiarity with and preference for the natural aural characteristics of his room. Astley confidently signified his favoured listening spot as an area just behind where I sat. *'I know what's happening [there]'*, he said. Astley then encouraged me to consider how, once engineers have got used to their particular room, it may seem counter-intuitive for them to go about making further artificial acoustic adjustments.

Heyworth remarked that his own home studio, situated in a granite-walled roundhouse, *'is not an easy room.'* Like Astley's room, the unique space did not appear to have received extensive outfittings by an acoustician. I did however observe that Heyworth had fixed some modular acoustic panels to the roundhouse walls. He said, *'[The room] sounds great though. I quite like the edginess of having to work hard and having to listen carefully to what's going on, and then be able to say, "this is fantastic", "this is a great listen".'* To this, Heyworth added, *'In doing that, what comes out the other end seems to work on all systems.'* The engineer had explained all this after justifying his philosophy behind working within the space, by my interpretation of the discussion. Heyworth had stated, *'You can have a room that is perfect acoustically, but not very interesting to work in and actually what you do doesn't necessarily sound great on all systems. It might sound a bit bland. It might be right, but somehow it's all about the spaces in between for me. How the brain reacts to the feel of the performance, especially with acoustic or electric music. Of course, electronic music might react differently.'* Having interviewed both of these engineers in their studios, I sensed that Astley and Heyworth bound their own creative proficiency to deep-rooted and personal familiarity with the unique acoustic properties of, by comparison, lesser treated spaces. My interviews with Astley and Heyworth also helped illuminate the concept of mastering engineers performing creative work in direct response to the acoustic characteristics of a single space with which, as the industry voice crucially implores, they should be deeply accustomed and expert.

From all that I have referenced so far, it is apt to emphasise familiarity as the common thread that connected much of the discussion around spaces used for mastering. Broadly speaking, the mastering engineers I interviewed had verified that

they operate only in acoustic environments to which they are accustomed. Be this as it may, in *Chapter 1* I cited two historic cases where industry reporters and pro audio manufacturers honed in on instances where mastering engineers had formerly compromised this ethos (see Inglis 2012, online; Miller 2003; *SADiE* n.d., online). In one of these cases, Tori Amos (1998) was reported to have asked Astley to master 'From the Choirgirl Hotel' off location at *Martian Engineering* in Cornwall. 17 years after the album's release, Astley entertained that mastering at a different location had been an unusual prospect. The engineer described occasionally and formerly having performed mastering off location with other artists, such as Jools Holland. *'I'd thought, "this is actually quite an interesting route to take"'*, he said, and added, *'But it doesn't really work that well for me.'* My interview with Astley encouraged me to consider how transporting equipment off location may benefit the client in so far as them being able hear the mastering process in an environment to which they are accustomed. In such instances, however, the mastering engineer would need to trust their client and the client's ears, as practitioners such as Astley may not be attuned to the sonics of the space. I felt that in an interview with *Prism Sound* (2015, online), Parnell conveyed how "bigger clients" are often conscious of a link between the expertise of mastering engineers and their sustained relationship with the acoustics of a room. Parnell indicated that such clients "won't move with you", and that "it takes a couple of years for you really to get into your [new] room and be in control of it." Though both engineers had worked off location at previous points in their respective careers, I felt that discussions with Astley and Parnell had upheld that creative mastering work is best performed and demanded to be performed in familiar settings. This had been in spite of pro audio industry media stoking the novelty of more networked or nomadic approaches to production and post-production in the present day. I suggest that this had also been in spite of popular discourse and textbooks commending all that is possible through fast Internet connection and digital technologies that facilitate low-cost opportunities for amateurs to engage in creative mastering processes (see Bregitzer 2009: 186-209; Hawkins 2002; Wyner 2013: 9-13). It is valid to consider that mastering engineers may defend the concept of working in a known space for the simple reason that it would be in their own best interests of managing such challenges imposed by industry discourse and industry media. I also suggest that if engineers defend the

importance of familiar mastering rooms in such a way, then this may heighten perceptions of their work as 'dark artistry' or a valuable and tradable form of creativity. The notion of mastering as a 'dark art' is a construction that I draw further attention to later in the section.

Whilst familiarity had surfaced as a common topic that connected much of the discussion around spaces used for mastering, I had also learned that the character or design of spaces used for mastering would vary across different facilities and engineers. No matter the circumstance, I suggest that any engineer may justify that the design of their space will enable them to carry out creative work effectively. Those operating out of mathematically devised rooms could justify their doing so through science or through describing the genius of a specialist acoustician. Engineers operating otherwise could justify their doing so through other means. Moving on to other issues, I will now demonstrate how raising the profile of mastering studios to the point of being more widely understood as culturally and creatively significant places is a feat made difficult through various customs. The research I have presented so far has already unearthed that established mastering engineers can operate in contestably more modest, residential and, or, less acoustically treated spaces. This is interesting, given that, as I noted in *Chapter 1*, Meintjes (2012) used the term "iconicity" to denote the visual appeal or condition of 20th century recording studios as fetishably iconic, and costly architectural acoustics would become a key part of forming their mystical image. Other aspects of my research informed my understandings of the extent to which it is also customary for established and famed musicians or artists to not attend their mastering sessions – an issue broached in the first section of this chapter. As a researcher, it took a visit to a highly reputable and regarded studio complex for me to fully understand the significance of this. A number of other visits also made clearer the fact that mythologised spaces are so constructed as a result of their closer and more direct connection to creative work performed by more prominent names or historic figures. To show how I arrived at this understanding, I will now offer a reflection on my experiences as a visiting researcher. Subsequently, I will explore further aspects of unattended sessions.

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The date is March 11th 2016 and I arrive for the first time in St. John's Wood, London. Prior to meeting with Showell, I browse a shop set adjacent to the Georgian townhouse face of the broad complex that is *Abbey Road Studios*. Music fans lay flowers near a zebra crossing in tribute to the late Sir George Martin – the so-called 'Fifth Beatle' whose passing occurred only three days prior. The fans also add to the vast amounts of faded graffiti on the whitewash walls that perimeter both properties. "George forever." Back in the shop, I observe the proud display of noteworthy instruments and recording equipment owned by or loaned to the Studios. Numerous placards uncover the fundamental histories of "the most famous *recording* [my emphasis] studios in the world" - a slogan *Abbey Road* project extensively via their displays and merchandise. Copies of Lawrence's (2012) 'Abbey Road: The Best Studio in the World' are stacked in abundance ready for purchase. I choose a hardcover from the top of the pile and a T-shirt.

Showell and I are buzzed through numerous locked doors that separate the public from a studio the engineer shares with Frank Arkwright – an experienced and established practitioner in his own right. We pass 'Studio 1' – a 4,876 sqft space where, I recall, the scores of three 'Lord of the Rings' and four 'Star Wars' films were recorded. We pass 'Studio 2' - half as big, albeit big enough to home a famed staircase and to record both *The Beatles* and *Pink Floyd*. It was as Showell welcomed me inside 'Room 30', the newest of several mastering suites, that I recognised how visiting 'the most famous *recording* studios in the world', my emphasis again, was a necessary step for me to take if I were to fully comprehend something Calbi had said 5 months prior. Mastering, Calbi said, *'it's really not the sexiest part of the recording process.'* Mastering, in its former years, Calbi explained, *'happened in a small room, a little bigger than a closet, where you didn't have the musicians and you didn't have a lot of the fun that goes on in the studio.'*

In a place where comparisons of space and design could be made, I also perceived the looks and dimensions of Showell's modern room to be comparatively humble when matched against those of iconic studios 1 and 2. Room 30 offered enough space to home Showell's equipment, mount artificial acoustic treatment on the walls and position hefty *PMC* loudspeakers in ways that would ensure equal triangular separation between engineer, left monitor and right monitor. The analogue

tape machine, cupboard and sofa positioned at the rear of this set up left scarce space for maneuver, or for musicians to be present, and I would later learn that the lathe Showell had been using for cutting records at half-speed was, at the time, stationed in 'Room 5' – the mastering suite operated by Pesche. On my second visit to the Studios, Pesche revealed that for many years prior to his own arrival in Room 5, the mastering engineer who occupied this also comparatively humble space was the late Chris Blair – *'Mr. Abbey Road Mastering. Worked here forever…'*

In hindsight, I would learn that Blair's occupation of Room 5 was a fact that is missing from the pages of a book I had spotted at the back of Pesche's room - the engineer's own copy of the same hardback I had previously bought from the shop. I later noted that Lawrence (2012: 192), author of the book, had cited Blair for having mastered *Radiohead*'s sophomore album 'The Bends' (1995), and then later 'OK Computer' (1997). On page 197, Blair was also named for having mastered *Manic Street Preachers*' (1996) 'Everything Must Go'. Blair's final occurrence in the book could be found on page 282, where I spotted him pictured and noted for having enjoyed a "35-year career at the Studios". Prior to Lawrence's book being published, the author had also spoken with one current mastering engineer at *Abbey Road Studios*, Sean Macgee, who offered brief explanations of disc cutting technologies on pages 59-60. Despite mastering having a small degree of presence in the book, Lawrence neglected to research or comment on the history of rooms and spaces that mastering engineers had occupied in order to carry out work that is clearly respected by their peers at *Abbey Road*. The outsider remains unaware of when such spaces were built, changed or assigned to different engineers. At best, readers learn that "the TG12310 transfer console […] was installed in six of the mastering suites in the 70s to optimize transfer of audio signals to vinyl" (page 261). On my third and final visit to the Studios, Lucy Launder offered fond memories of Chris Blair. *'He was a star*', she said. *'One of the top mastering engineers at the time.'*

I suggest that the comparative lack of profile Lawrence awarded to rooms used for mastering and disc cutting at *Abbey Road Studios* is demonstrative of the fact that these processes are often understood as 'bridges' (Katz 2002: 21) or 'gateways' (Nardi 2014) between production and manufacture. As I have conveyed previously,

it would have long been considered unfitting, to a certain degree, for manufacturing facilities concerned with procedural disc duplication or even vinyl pressing to be historicised in details commensurate with the sorts of mythical 'temples of sound' used for recording in the mid-twentieth century and onward. I also suggest that the comparative lack of profile Lawrence awarded to mastering speaks of how authors and wider discourse will tend to focus on places that are more closely bound to the classically fabled processes of penning, recording or 'producing' popular music. I suggest that authors and wider industry discourse will focus on these places due to their closer and more direct connection to creative work performed by more prominent names or historic figures such as *The Beatles* and Sir George Martin. Mastering, in its former years, as Calbi had expressed, happened in smaller spaces and without the typical studio camaraderie or presence of musicians. Despite this, and for reasons I have begun to establish so far, I maintain that authors who attempt to document the rich history of recorded music production should dispel this stigma and now offer increased focus on mastering as a creative interjection made at critical stages of the production process - one that it is subject to the room used for carrying out the work.

I would later experience a further and somewhat validating epiphany in respect to what Calbi had told me, and this occurred in the July that followed my final visit to *Abbey Road Studios* in June 2016. Heyworth sat me in the so-called 'sweet spot' of his mastering studio in rural Dartmoor – *'not an easy room'*, he'd said. The engineer permitted me to hear one of my all time favourite songs played out of the very *Dunlavy* speakers through which, and in the very room in which it had been mastered. I remember being captivated by the fact I was able to hear Imogen Heap sing 'Wait It Out' in this way. The song had appeared on Heap's (2009) 'Ellipse', which won 'Best Engineered Album, Non-Classical at the 52nd Annual *GRAMMY* Awards (see *Recording Academy* 2021, online). Admiring Heyworth's contribution to her recording, I asked the engineer to describe how Heap felt and how she reacted when hearing her finished album while sat in the very spot where I had been placed. She had not attended the session, I learned.

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From my interview with Gonsalves in 2015, I gleaned that approximately 30-40% of mastering clients had been interested in attending their mastering session at *Telegraph Mastering*. Similarly, from my later interview with Parnell in 2016, I gleaned this fraction to be around one third at her *Black Saloon Studios*. *'Not too often'*, revealed Astley, when I asked about how regularly he would conduct attended sessions. *'Because [the studio] is in my house and I don't want to do it day in, day out, but I do offer this maybe once or twice a week.'* Similarly, Gonsalves explained that he began limiting himself to performing two attended sessions per week and that he had been considering reducing this number. From my interview with Gonsalves, I also gleaned that it is often a specific type of client who will request to attend a mastering session. Gonsalves described prospective attendees as artists for whom he would often be conducting a *'first record'* mastering session – *'they've never seen [mastering] before'*. Astley associated the prospect of attending a mastering session at his *Close To The Edge* as more important for unsigned artists, and I suggest that this would correspond with what Gonsalves had previously said. Having interviewed Astley, I deduced that the preponderance of work carried out for signed artists would be done so unattended at *Close To The Edge*, and Hull offered further insight into the nature of attended sessions. My interview with Hull had prompted me to theorise how, after a few records, the trust relationship established between facility and client could in itself eliminate the necessity for attending sessions.

Gonsalves, one of the engineers whose interview had prompted me to draw a link between attended sessions and the unsigned artist, associated his proposed reduction of attended sessions with crossing a certain threshold of busyness. I qualify 'busyness' to denote success in attaining regular work from labels or similar, and also the need to keep up with scheduling. Upholding this, Schmidt had alluded to how attaining more regular streams of work from clients such as record labels could perhaps lessen the necessity of operating in an accessible part of a major city, or as part of an established studio complex. Schmidt identified a modern tendency for established engineers to depart larger inner-city mastering facilities, such as *Sterling Sound* in the USA, move out into the country and convert spaces such as garages into studios. *'You get the files online'*, he said, being the first engineer to hint at vast changes in digital technology and network infrastructure that have been

embraced by music industries of the 21st century. At a time prior to each interview, the Internet would inform me that both Schmidt and Gonsalves owned and operated *24-96 Mastering* and *Telegraph Mastering* respectively from rooms within family-sized homes on residential streets. They served regular and respected clientele – as did a more senior Hull, who chose to move *Masterdisk* from New York City and into the Peekskill suburb of the northern New York metropolitan area, where he spoke for interview in 2016. From Peekskill, Hull will cut vinyl records for the likes of *Dave Matthews Band* – an artist recognised to have amassed the largest number of concert ticket sales in the 2000s globally (see *Dave Matthews Band* 2013, online). *'You can set up your studio anywhere that has high-speed Internet'*, he stated, and I further deduced from our later discussions that the trend is for mastering engineers to now be working somewhat unattended. Whilst Parnell's *Black Saloon Studios* is conveniently situated just a five minute walk away from the accessible *Walthamstow Central* London tube station, it nonetheless operates from a residential and suburban street. From my interview with Parnell, I grasped that most of the Studios' clients enquire from overseas and also that demand for her expertise is largely based on previous work or on recommendation. Though Parnell understood that established engineers have moved out to the country and still get work, the engineer expressed satisfaction in living her London lifestyle.

Exploring how frequently artists will attend mastering sessions offered further insight into why mastering rooms are comparatively absent from wider discourses that have addressed or mythologised spaces where creativity (bringing new, imaginative innovative and culturally significant things into being) is performed as part of the whole production process. I have argued that discourses celebrating the penning, recording and 'production' of popular music have strong tendencies for privileging spaces occupied by established artists and, in a more conventional sense, 'producers'. I further suggest that if mastering engineers are now more physically isolated from these people, operating from contestably smaller, rural and, or, residential locations, then this will detract from understanding their rooms as sites where artistic endeavours are fulfilled and creative methods of working are performed. Furthermore, I contend that technological affordances, ever-developing infrastructures of the digital age and also rising costs of inner city real estate, will all

together promote the isolation of mastering studios from star figures who can assign their work to any of the engineers I have interviewed. Likewise, it will encourage the growing trend of engineers departing from established mastering facilities. When demand for specialist disc cutting and stereo mastering involved transferring audio from larger physical mediums of storage, such as magnetic tape, clients would have enjoyed the convenience of inner city locations or the greeting of a more commercial state of affairs at facilities such as *Sterling Sound* and *Masterdisk* in New York City, or *Abbey Road Studios* and *Metropolis Studios* in London. But with less or no reliance on freight, established engineers are now in a better position to work elsewhere. Birtchnell and Elliott (2018: 79) stated, "the high cost of property in urban cores of the twenty-first century means creative labourers are compelled to substitute some physical proximity for net locality to stay in their relevant 'scenes'." They said, "Once client bases exist, established experts are able to reside in more geographically isolated places, and this has been a spatial phenomenon across different creative industries with the advent of the Internet."

Having established all this, it is necessary for me to divert our attention back to the matter of familiarity. Regardless of circumstances and incentives that may inspire an engineer to depart from an established studio, or an established studio to depart from an inner city location, it could be acknowledged that the very act of doing so would contravene an industry voice that has implored for mastering engineers to operate only in acoustic environments with which they are deeply accustomed. I have already cited Parnell, who conveyed in an interview with *Prism Sound* (2015, online) that "bigger clients" are often conscious of a link between the expertise of mastering engineers and their sustained relationship with the acoustics of a room. Parnell also indicated that such clients "won't move with you", and that "it takes a couple of years for you really to get in to your [new] room and be in control of it." It would seem, however, that not all engineers might have agreed with my interpretations of what Parnell had said, if she had been referring to the prospect of engineers aurally and sonically adjusting to newer studio spaces. For example, though Pesche expressed that engineers would need to reattune after swapping mastering rooms, he had also qualified that it took about 10 days for him to adjust to the sound of Room 5. I learned that Pesche had helped to refurbish Room 5 after the passing of Chris Blair and his own departure from *Townhouse Studios*, then

owned by *Virgin Records*. Similarly, Hopkin moved *Stardelta* and began operating in its current premises, outfitted by Thomas Jouanjean, as of January 2015. Hopkin had experienced *'instant'* satisfaction with performing creative work in the newer space. *'There was no adjustment process'*, said the engineer. *'The room was spot on.'* Hopkin later explained that he mastered a number one record just one day after he moved to the new studio. Hopkin also conveyed that the mathematically devised room should afford engineers with the ability to carry out creative work effectively*. 'If mastering engineers do one thing'*, Hopkin argued, in a hypothetical sense, *'then they say, "we have listened to your music on the finest available monitoring and in the finest available environment. We've made adjustments based on what we heard there and we hope that they translate into the wider world quite well."'* It was just prior to this stage of our interview when Hopkin had explained, *'I knew [Jouanjean] had designed a pretty much perfect acoustic environment. We looked at plots on a screen and the response was as flat as it was going to be.'*

Pesche and Hopkin were two engineers whose interviews had encouraged me to broaden my grasp on the concept of profound familiarity with a space as vital bedrock for carrying out effective mastering work. Moreover, the insights of theirs I have shared had prompted me to take a step back and critically examine this prospect as a moot bargaining chip that could be fostered from within the industry and that could serve to promote or construct the creative proficiency of the engineer, unless circumstances are different and, or, other assets take precedence – operating in a space that is professed to be near-mathematically perfect, for instance. Immediately following our discussions of room acoustics, but in no regard to my own reflections I have just outlined, Hopkin had noted that *'quite a lot of dark science has been bandied around to build mystique.'* To this he added, *'There's no witchcraft in [the studio.] Just equalisers and compressors.'* And whilst the broader cross section of the 20 mastering practitioners I spoke with had also been keen to dismiss any clear-cut notions of mastering as a dark art, I do suggest that such images could be fostered through some of the more underlying ways that a mastering engineer may construct him or herself as a creative contributor to the process of recorded music production. In reflecting on my interviews with Pesche and Hopkin, I had taught myself to question whether assertions of having

developed profound familiarity with a particular studio space would be examples of one such mechanism.

After I had interviewed Pesche and Hopkin, my discussions with Mitson inspired me to question the necessity of operating in familiar, mathematically devised, or somewhat palatial spaces altogether. Mitson was one of the last engineers I interviewed. In July 2016, at the time of us speaking, Mitson was mastering on a freelance basis and under the name of *Mitsonian Institute* in the West Midlands, UK. Though Mitson explained that he owns and uses a pair of loudspeakers to which he is accustomed, he prompted me to be objective and entertain the concept of mastering through headphones - despite how such a concept would cut hard against the grain of how the wider majority of mastering engineers agree to work. By July 2016, I had learned that many mastering engineers would insist practitioners in their field could check on headphones, tell if something is wrong on headphones, but they would refrain from mastering entirely with headphones. After speaking with Mitson, I identified the most outspoken outlier and one of the very few proponents of actually using headphones outside the group I interviewed as mastering engineer Glenn Schick (2019, online). Schick had outlined his philosophy on headphones in a very public and thorough manner via his website, stating that, “Old Rules Don’t Apply……”

> We are not like other studios. No more archaic mastering rooms. Non-traditional monitoring. No needless additional damaging A/D conversions. The newest of technologies. We had been one of the premier analog mastering studios in the US for the past 25 years. The best rooms, speakers, and gear money could buy. But now, we've developed something better. The future is now.
>
> Glenn and his mobile audio mastering rig, with the most cutting edge technology, and proven success of multiple Billboard #1 hits, Grammy winning and nominated albums, and hundreds of gold and platinum RIAA awards, is here <u>now</u>. We are where you need us to be. At your studio, wherever the country, or online. And we've upped the game. New methods, new technology, new techniques. Our masters have never sounded better!

ProSoundWeb (2015, online) elaborated on Schick's approach in their article 'Mastering Engineer Glenn Schick Finds Solutions In *Antelope Audio.*':

> When mastering engineer Glenn Schick found himself missing out on projects in his Atlanta-based studio because he had to attend a high profile awards show in Los Angeles, he realized he needed a new workflow that would allow him to continue his mastering work on the go. "I was thinking to myself, 'Man, if I only had a portable setup it would be great to knock out a job in my hotel room'," he recalls.
>
> Schick has completely abandoned his old CD mastering rooms in Atlanta and masters all of his records on the go, including top hits such as Future's DS2, which recently charted #1 in the United States.

Before I had considered headphones with Mitson, *Sony*'s former engineer had begun alluding to *'dogs and ponies, "The Emperor's New Clothes", smoke and mirrors.'* With more time spent talking to Mitson, I perceived that dogs, ponies, smoke, mirrors, and 'The Emperor's New Clothes' may have altogether encapsulated the engineer's reasoning for having me question some essential mastering studio dogma. 'The Emperor's New Clothes' (Hans Christian Andersen, 1837) is often used as metaphor to illustrate the commitment people have to concepts that are socially accepted as logical or true, when it is against the social norm to question their validity (see *Farlex* Dictionary of Idioms 2015, online). *'I don't want to sound too strident'*, Mitson had said. *'There is definitely room for [established engineer] and [their setup]. If Taylor Swift comes in with an entourage, then they need all the facilities and somebody's got to cater to them.'* And the engineer stated that none of his clients attend mastering sessions at *Mitsonian Institute*. *'It's as simple as that'*, he settled.

And so, in the process of reflecting on Mitson's interview and my resulting interpretations, I had started to broaden my grasp on the entire concept of needing a large 'studio', in the classic sense of the word, to carry out effective mastering work. I had been reminded of Schmidt, who when discussing how trust is built between studio and client, had alluded to a philosophy that underpinned his own approach to interior design at *24-96 Mastering*. Through experience, Schmidt had

learned that working in a studio deficient of *'super polished'* façades could make gaining the trust of prospective clients quite difficult. *'I wanted [my mastering studio] to look in such a way that when people walk in* [or see it online, I add,] *they know someone's put thought into it'*, said the engineer. *'It's not to mesmerise or blind people; it's just about gaining that initial trust.'* For me, this would later raise questions concerning some of the more strategic and not so creative benefits of operating in established or generously furnished spaces. But whilst Mitson's words and Glenn Schick's operations had prompted me to maintain a more objective perspective on the notion of dedicated or plush studio space as a requisite for good mastering work, I still recognised that Schick's approaches to mastering would conflict with those adopted by the cross section of engineers I interviewed and beyond. Moreover, Schick's more recent approaches to work had arrived after him having used dedicated studio space to master a wide variety of records that were recorded by household names. Therefore, I also considered it valid to question the extent to which demand for any specific engineer's creative input is largely subject to their discography, notwithstanding the realities of their current studio setup. This question would inform my exploration of mastering expertise in the previous chapter. I will now conclude my exploring of studio spaces used for mastering by stating that the preponderance of engineers would strongly suggest headphones be used for 'checking' (at best!), and that loudspeakers allowing music to propagate through air should be used as a primary reference setup for listening. In simple terms, there is strength in numbers and time spent in the field has led me to assert that the convention of mastering with a studio monitoring setup is far too entrenched, at present, for headphones to be considered as a pervasive solution to concerns of 'bigger clients' who 'won't move with you', or having to reattune to a new studio.

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Over the course of this section I have drawn on aspects of my research that consider studio spaces used by mastering engineers. Although I have questioned the construction of profound familiarity with a space as vital bedrock for effective mastering work, and although I have also questioned the necessity of operating in a mathematically devised space, I do suggest that one particular idea stands to reason. I propose that we have been somewhat taken in by the grandiose nature of

studios such as *Abbey Road* or *AIR*, both of which have been understood as culturally and creatively significant through artist narratives and historic sessions of tracking or mixing. Through becoming more cognisant of the range of ways in which a mastering engineer can work with their room as they perform creative interjections to a mixdown recording, we can also begin to consider the creative and cultural significance of the mastering studio. Whether the engineer's room is treated or untreated, I have upheld that the acoustics of a particular studio will offer nuance and subjectivity to the listening experience and the creative mastering process. As I progressed through this section of *Chapter 6*, I began outlining various customs that could present as obstacles to our making sense of mastering studios in this way. One custom is that of established mastering engineers operating out of contestably more modest, residential and, or, less acoustically treated spaces. I suggest that from the perspectives of those working outside of the mastering and wider recorded music industries, the aesthetic of some setups may be thought of as banal or less relevant when compared against some of the long celebrated and grandiose studios that have permeated discourse, artist biography and myth concerning the tracking or mixing of popular music. In this section, I also explored the issue of established mastering studios remaining and becoming increasingly more isolated, physically and socially, from creative processes undertaken by key figures or prominent names in popular music. This is subject to developments in digital technology and network infrastructure.

Through my interpretations of research presented in the latter stages of this section, I entertained that there could be more strategic and not so creative benefits to operating in established or generously furnished spaces. I also questioned the extent to which demand for any specific engineer's creative input could be subject to their discography, notwithstanding the realities of their current studio setup. As said, this question informed my exploration of mastering expertise in the previous chapter. Having used this section of *Chapter 6* to focus on rooms and spaces used for mastering, I will now finish exploring the creative world of leading experts by focusing on their discussions of equipment.

Equipment

When I opened up a conversation with Proper about learning to master and the prospect of her running a workshop, the engineer signified that it would be important for students to understand some fundamentals of audio engineering, such as gain stages, before they would be taught the finer details. Proper stated, *'I think there's a lot more to learning about mastering than just sitting down and "mastering".'* She later added, *'Why waste your time getting into the real fine details of mastering if you could potentially be talking to somebody who doesn't really understand signal flow and gain stages and that kind of thing, because no matter what you teach them to do in terms of EQ […] and what to do with the compressor or whatever, if they don't have those basic concepts of audio right, then things are broken before they get started.'*

I have deduced that much of high-level mastering is about the creative and careful configuration of electronic signal flow and gain structure in the analogue domain. Although outliers have attested that good mastering can be performed purely within the digital domain, or digitally 'in-the-box' – hence the philosophy adopted by Glenn Schick, I note that 'hybrid' setups featuring analogue and digital tools remain prevalent. Key engineers discuss analogue signal processing and conversion tools enthusiastically, and they use these devices creatively. I have also found that engineers are less open to there being any de facto equalisation or template compression settings used in each and every mastering session. Engineers would more likely explain that their adjustments are project dependent, aside from there perhaps being a few cardinal rules of thumb.

The foremost aim of this section is not to compare or explain in detail various mastering techniques, but rather to establish how decisions made around studio equipment underscore the creative significance of engineers and specific processing tools in the context of record production. Before examining claims about analogue equipment specifically, we should first acknowledge how strong endorsements of certain tools could be interpreted as a way of engineers justifying prior investment into costly hardware. Endorsements of certain hardware tools

could also be interpreted as a way of signalling more individualised or creative approaches to mastering - the results of which might be less attainable via lower-cost software and automated services (see O'Grady 2019: 160). I have observed that particular analogue tools do in fact offer something unique to a project. Select combinations of less 'transparent' equipment may help engineers construct their own 'sonic signatures' (see Burgess 2014: 89; Shelvock 2017: 23; Sterne 2012b: 174; Zak 2001: 104), and thus, each practitioner's choice flow of signal warrants greater study.

Bob Katz (in Hepworth-Sawyer & Hodgson 2018: 55) expressed that stereo digital recordings now make up 99% of source material given to mastering engineers. I will begin by providing a necessary overview of a hybrid signal processing workflow that can be used for mastering this source material, but I will first justify not focusing on monitoring equipment and loudspeaker technologies. I reason that it would be more fitting to consider these technologies in the wider context of room acoustics and holistic studio topology, rather than in the context of signal flow and gain structure. Signal processing and conversion enacts permanent changes to recordings whereas, like room acoustics, equipment for monitoring and metering impacts only on the engineer's phenomenological assessments of sound. I feel that these distinctions had been validated through discussions of studio design with Hopkin. I gleaned from Hopkin that his acoustician planned the acoustic treatment of *Stardelta Mastering* with respect to particular loudspeakers chosen for use by the engineer. These plans would not have taken into account any sonic phenomena associated with equipment that Hopkin uses or periodically swaps out for signal processing and conversion. I maintain that Shelvock (2017: 75) held loudspeaker technology and room acoustics in a similar regard, when he stated that "new monitors and unfamiliar rooms can be particular troublesome for engineers […] as both affect frequency content." He said, "monitor topology can gravely impact the aesthetic decisions mastering engineers make" (see also Cousins & Hepworth-Sawyer 2013: 41).

*

Stereo recordings or 'premasters' that are fed through a hybrid signal chain are most often supplied to engineers in digital .WAV or .AIFF format (see Shelvock

2017: 19-20). Engineers bring these recordings into their DAW at native sample rate or else at resampled rates. Some initial processing can be executed digitally 'in-the-box', and engineers might lean towards corrective or restorative work at this stage. Mastering engineer Adam Ayan (in Hepworth-Sawyer & Hodgson 2018: 12, my emphasis) stated, "For every track, of course, the first thing I'm going to focus on is any corrective EQ, or any corrective measures, I have to take with the mix. In other words, if things jump out as being just plain wrong, those are the things I need to address first before I can delve into the craft or more *creative* part of what I'm doing." Scott Hull explained to me, via balanced discussions of digital and analogue signal processing, that there might be some advantages to using *'really high quality digital tools'* in instances of performing *'very small finite corrections in EQ'.* Reflecting on this interview, I gleaned that digital tools can offer engineers something different in terms of convenience, but the tools would need to be of a high quality in order to meet perceived benchmarks offered through analogue counterparts. Discussions with Hull also highlighted that engineers could be highly invested in analogue processing alternatives - I would need to keep this in mind when people attempt to qualify whether digital or analogue is better in certain contexts.

Neither Ayan nor Hull confirmed whether their own corrective methods are performed in the digital or analogue domain. There might be some flexibility in this regard. Gonsalves had indicated that great software tools do exist and that he himself might reach for a series of restoration features and algorithms via *iZotope*'s 'RX' software. *'There's no way to do that in the analogue domain'*, said the engineer. *'I mean, [RX] is like Photoshop for sound.'* Gonsalves did not specify whether his own use of restoration tools occurs before or after analogue processing. Based on my own knowledge of mastering, however, I assert that it would be productive to perform various aspects of restoration or correction at the initial stages of a session.

Though analogue is often used for more creative forms of processing, engineers do have agency to remain in-the-box entirely – or, they can perform some explicitly creative decisions before digital-to-analogue conversion. Shelvock (2017: 20) identified that in order to work with analogue, "engineers must use [digital-to-

analogue converters] to convert digital code into alternating current, suitable for analog processing." Shelvock also said that converters should "exhibit sufficient 'quality standards,' which engineers are responsible for knowing" (see also Cousins & Hepworth-Sawyer 2013: 55). Once in the analogue domain, engineers can 'gain stage' and introduce signal colouration by adjusting the input and output voltage parameters of analogue hardware to taste. Adjustments can also be made to parameters such as equalisation frequencies or compression speeds. I explained this creative use of analogue hardware via chapters two and three.

Once audio has passed through the analogue domain as voltage, it arrives at the analogue-to-digital converter (ADC). Signals that are reconverted or 'printed' back to digital will appear on a new channel in the DAW. In the later stages of this chapter I will explore how engineers can drive analogue audio into their ADC at high levels, thus 'clipping' signals to lessen their RMS average amplitude (dynamic range) before reconversion. Done well, some perceive this method of lessening RMS average amplitude more gratifying or 'transparent' than alternative methods of analogue and digital limiting. Shelvock (2017: 20) rightly established that, as I explore later, "not all [converters] are created equal." He explained, "ADCs routinely imbue signals with varying levels of colouration (that is, they regularly create a non-linear transfer of data), deriving from the amplitude of the incoming signal and the unique circuit topologies of each ADC unit.[1] The same thing occurs in the digital-to-analog converters (DACs), which engineers require to facilitate playback" (see also Pohlmann 2006: 1).

Further creative and in-the-box processing can be performed on the printed audio – 'limiting' most typically. A recording would then essentially be in its mastered state, sonically speaking. From here, the engineer can perform dithering, before 'bouncing' or exporting the mastered audio as a high-quality file. Whilst dither and similarly 'noise shaping' can engender subtle sonic changes, many would argue that these are negligible. Dithering is a less creative and more technical form of processing

[1] "In signal processing, a nonlinear filter provides an output signal that cannot be expressed as a linear function of the input signal. A linear function can be expressed by simply adding or multiplying its component vectors. For example: $f(x + y) = f(x) + f(y)$; $f(ax) = af(x)$. Thus, non-linear signal processes provide an increased level of signal colouration" (Shelvock 2017: 20).

applied as per reasons stated in *Chapter 3* (see also Waddell 2013: 94-95). Any necessary sample rate and bit depth conversions can be performed during export, or else after the session recording has been exported at native sample rate and bit depth. Bouncing, exporting, along with sample rate and bit depth conversions are performed in accordance with relevant distribution standards (see Shelvock 2017: 24; 31; see also Cousins & Hepworth-Sawyer 2013: 214; Pohlmann 2011: 187-235).

Professional setups are built around consoles that allow for engineers to monitor and meter at various points or stages in a hybrid processing chain. These consoles link to stereo pairs of loudspeakers – via amplifiers if the speakers are unpowered. My research has substantiated that, like the acoustics of the mastering room, "monitor topology can gravely impact the aesthetic decisions mastering engineers make" (Shelvock 2017: 75; see also Cousins & Hepworth-Sawyer 2013: 41). Practitioners thus consciously familiarise themselves with the nuances of their chosen speakers. Having presented a hybrid signal processing workflow that can be used for mastering, I will now continue exploring the creative significance of signal paths and tools used by various engineers.

*

I asked Heyworth for his perspective on why mastering is considered a 'dark art', and his response alluded to much of what I have begun explaining in this section. Leading practitioners perform their work with good understandings of signal flow, electrical impedance and how adjustments to these parameters can affect the sound of a recording. *'It's because everybody keeps it under their hat, what they actually do and it's all about signal paths, you know, it's all about impedance and how you put together these bits of equipment'*, explained Heyworth. One day later, Hopkin said, *'A signal path has a certain sound and sometimes all that's needed is that certain sound or a combination of what can be achieved from that certain sound and a bit of gain.'* Hopkin estimated that he himself would use analogue signal colouration rather than equalisation in approximately 90% of cases. *'EQ is more of a corrective thing'*, said the engineer. *'And I tend to delve harder into EQ if I'm trying to solve a problem, which hopefully you're never trying to do. Hopefully*

you're trying to just say, "oh yeah, this is good, let's take it to the next stage of good and then let's get it onto the medium that it's going to get released onto"'.

At *Super Audio Mastering,* I learned that a recent client had approached Heyworth, knowing that the engineer mastered specific records released in the late 1980s. The client asked Heyworth for their new recording to be mastered and imbued with a *'British sound'* – one they associated with a former era and scene. Heyworth fulfilled his client's request by searching for old session notes and reviewing the analogue signal paths used to master each cherished recording from the 1980s. A short while on in our interview, Heyworth substantiated that choices made when working within the analogue domain are shaped by a devotion to uphold and enhance the sense of artistry and emotion embedded in recordings:

> *We take stuff out of the digital world and we put it into the analogue world and then we put it back into the digital world and why do we do that? Why is this such a big deal? Well, in my view, it adds humanity to the music, it adds a depth of field, it adds something that the human brain can grab hold of much quicker than just listening to a pure digital recording. […] We have a client in Nova Scotia who comes here and he just swears by whatever we do, it just makes it sound great.*

'His terminology was "chocolately"', said Andy Miles, who had been mastering full time at Heyworth's studio back in 2016. To me, the client's figurative, audiophilic and onomatopoeic description of Heyworth's work upheld that, via certain tools, mastering offers creative and musical contributions to the sonics of a record. At this point in the interview, I had also been reminded of Rodgers (2012: 476), who cited Katz (2004: 114-36), McCartney (1995), Peebles (1996: 12) and demonstrated how mythical constructions are to be observed in the way producers or musicians themselves describe their use of equipment - "DJs 'battle'; a producer 'triggers' a sample with a 'controller', 'executes' a programming 'command,' types 'bang' to send a signal, and tries to prevent a 'crash'." Rodgers explained that the parlance

of electronic music production culture is characterised by these sorts of military, space age and atomic metaphors.[1]

Guitar, tube amplifier and synthesizer fans have long regarded the likes of the *Fender* 'Stratocaster', the *Vox* 'AC30' or seemingly any musical instrument made by *Moog* as objects of historic and creative significance. Fjellestad's '*Moog*' (2004) is a documentary made in tribute to the synthesizer. Similarly, Dunn's '808' (2015) celebrates the cultural impact and history of *Roland*'s 'TR-808' drum machine. Fan discourses bind the tonal characteristics of such instruments or devices with a sense of time, location and more. I have observed that mastering equipment is only starting to be more widely discussed and made sense of in these ways. My research has shown that broader understandings of mastering equipment are justified, when considering how iconic guitars, synthesizers, amplifiers and effects pedals can feature only for fleeting moments in a chorus, song or album. An engineer's unique mastering processing chain will imbue entire catalogues of recordings and thus affect our sensory experiences of these many moments in a similar way.

Heyworth had helped me understand that electronic circuitry, impedance and signal path can endow recordings with a sense of era or, as I interpreted, a sound specific to his studio and manner of working. Hopkin similarly described how mastering chains imbue recordings with a particular sound - a *'sonic signature'*. Outside of interview, Hopkin helped me to understand how engineers might consciously construct their sonic signatures, developing and tweaking them to taste. 'Sonic signature' was a term I had dealt with previously and in the earlier stages of my research. I had observed it used by other scholars, though not in the context of mastering specifically (see Burgess 2014: 89; Sterne 2012b: 174; Zak 2001: 104).

My interview with Proper helped me to fathom two things. First, that mastering demands an ability to decode feelings or emotions articulated via recordings. Second, that uses of mastering equipment can be understood as musical feats in and of themselves. I have found that Proper uses a mix of digital and analogue

[1] Again, I note that it was Rodgers' primary objective to frame such allegorical language as a gendered issue; these sorts of vernacular draw from linguistic registers that are also shared with cultures and fandoms considered to be predominantly populated by those identifying as men (see also Keightley 1996).

signal processing tools to perform her musical tasks. Amidst a quite varied discussion, the engineer had said, *'Some things, they just sort of, they fly out of the equipment. They say 'it flies out of your fingers', but it's not the same as with a musician. But it's that same kind of idea… You sort of play your mastering tools as a kind of instrument and what you're trying to get is the maximum emotional connection to the music and that thread that holds an album together that makes people connect to it and not detach from it until they've had the whole listening experience that the artist intended.'*

Marrington (2017: 85) reflected on previous comparisons he himself had made between software used for production and "traditional instruments which have been previously associated with songwriting practice." Marrington suggested that, for songwriting, the DAW could be understood as "an instrument in its own right, whose idiosyncrasies need to be mastered if it is to be used effectively in the heat of the moment" (see also Eno & Bass 1979, online).[1] Proper had helped me build such a picture around the hardware equipment she uses for mastering. Understanding work with tactile signal processors as musical feats in and of themselves reminded me of impressions I had formed via Meintjes (2012: 275), who recounted her own experiences as a recording studio ethnographer. Meintjes' narratives revealed how pieces of studio equipment can be observed as complex and mysterious gateways to a perceived abundance of creative possibility.

Discussions around equipment with Heyworth, Hopkin and Proper had helped me to grasp that mastering is a form of creative and technical expertise based on refined listening dexterity. Mastering engineers apply signal processing techniques and gain staging to help realise artistic visions. These concepts were further signified by Grundman, who in the following excerpt of our interview, had transitioned from brief discussions on disc cutting equipment to equipment used in mastering more generally:

> *The only thing that's going to really tell you the quality of something or how well it's dealing with a signal that you're putting through it is with your own ears. That's the only, only way and our final decision is done on listening to*

[1] Marrington's assertions were brought to my attention via Shelvock (2017: 9).

what a piece of equipment sounds like in and out of the circuit. […] You just want to know what it does to the signal if you just have it in the circuit… You don't even have to use it in the way that it's intended necessarily, just put it through it, put it through the electronics but do not do any of the manipulation that the piece of equipment might want to do, you know, like an equaliser, a compressor, anything like that. […] The final conclusion is that everything seems to take a little bit of a toll, you know, there's a certain sacrifice of quality, no matter what you do. If you're going to manipulate the signal or if you're going to do something to it with a plugin or with, say, a [Black Box Analog Design HG-2], that does equalisation in analogue or whatever, you're going to lose a little bit of quality. Now, that's not to say you don't use it, because you still are going to come out with a better product if the product needs this [Black Box Analog Design HG-2]. You can manipulate it in such a way that it's actually balanced better and it's going to be more effective for the listener, you know, the listener is going to be able to connect better with it, because it's all an emotional thing anyway. The experience of music, it's a human expression and as a human expression it has a lot to do with our emotions and getting emotional things across to the listener. Any number of people can write music about love and they all have their own little different point of view and a different way of expressing it and so […] for us, it's just a matter of trying to get on whatever wavelength that these people are on, you know, whatever people come in and bring in to us, we're trying to sensitise ourselves to it.

Reflecting on these moments of the interview, I remembered that audio signals degrade through digital-to-analogue conversion, analogue signal processing, analogue-to-digital conversion and digital signal processing. Paradoxically however, this degradation can, under the right circumstances, be sonically gratifying and outweighed by signal colouration, effective gain staging or performing sound corrective adjustments. Grundman presented some constructive advice amidst further discussions around creativity and mastering tools. He said:

It doesn't matter if it's mixing, mastering, whatever, you know, you have to learn a lot about music and emotional connection. […] You have to be able to interface with the artist and the producer, because your job is to […] help

them realise their dream. […] If they're having trouble feeling something, you've got to find a way to [help]. So you need the right tools. You have to have all these tools that can give you what you envision in your mind and what you would really want to hear. How you're going to get it? You have to learn how to get it, how to manipulate the sound and get it to do what you want it to do, so that it'll improve the experience of the music. And so that's one of the responsibilities of an engineer. You know, don't just think you can walk into any studio and it just works. You have to know that equipment.

Like Grundman, many engineers suggested the importance of developing familiarity with equipment they own and use to help realise artistic visions. Some could argue that knowing equipment is on a par with knowing a room. Yet, swapping out signal processing tools can happen far more often than studio moves. Thus, knowing the ins and outs of particular tools would be deemed highly useful, whereas knowing a room is generally considered vital. Schmidt said, *'knowing your gear is much, much, much more important than having the latest gear'*, and Mitson denoted the 35-year old *dBX* compressor as the most valued piece of equipment he himself might use for mastering. *'It does everything I ask it to and I know it better than I know myself*', he explained.

We should at this stage remind ourselves of a premise I set out at the start of this section. I said we should acknowledge how strong endorsements of certain tools could be interpreted as a way of engineers justifying prior investment into costly hardware. Endorsements of certain hardware tools could also be interpreted as a way of signalling more individualised or creative approaches to mastering - the results of which might be less attainable via lower-cost software and automated services. I now suggest that similar justifications and signals could be achieved via narratives of familiarity.

Pesche discussed another prevalent idea - that signal processing chains should ideally be minimal as well as familiar. I suggest that this philosophy would be founded on concepts described at the start of this chapter – one concept being that signals degrade via each stage of processing and conversion. Ray Staff helped me to understand some particular contexts where minimalist approaches to mastering and constructing signal paths would be effective. Staff discussed his

recent task of archiving David Bowie's analogue tape recordings. Staff, who had formerly cut these recordings to disc when in his twenties and operating out of the now defunct *Trident Studios,* had said, *'The only way for me to get the truest sound that you can get is to go from point A to B and not via anything in between, so I have a very minimalist approach because I don't want to change the character in any way.'* Via email in July 2021, Staff (2021) added, *'If the project needs it, I'll utilise any necessary processor to achieve a good result.'*

Pesche attested, *'The best mastering rooms in the world are the ones that are the most minimalist. If you look around this room, there's not a lot of kit, but what there is in here is stuff that we know backwards.'* I had noticed that Pesche's room housed roughly the same amount of outboard equipment as other mastering rooms did. Thus, I deduced most hybrid mastering setups would in fact be minimalist when compared to lavish and iconic setups operated by those who mix records or collect entire walls of hardware synthesizers. *'We're not the mixer'*, explained Pesche, who had also said, *'What you can't do at the mastering stage really is offer too much choice because you'd never get anything done.'* A short while on in our discussions of equipment, Pesche concluded, *'You've got to finish it. Mastering is finishing it. The mixer messes about.'*

Schmidt had attested that analogue equipment has *'a very, very real effect'*, and that each piece of analogue signal processing equipment can offer *'a very specific sound.'* Schmidt made these observations amidst balanced discussions on how cherished analogue equipment might compare against lower-cost equivalents. Reflecting on these and other moments of our conversation, I concluded that engineers hold on to the equipment that works effectively for them. Although engineers may use such equipment to consciously construct and develop sonic signatures, they clearly see value in operating clean and transparent signal paths. There is a logic behind this paradox. A clean analogue signal path presents the engineer with a good foundation for work. If colouration is needed, then select devices can be introduced into circuit. Engineers can also patch in more transparent tools that are used for functional or surgical adjustments. Grundman outlined a criterion for analogue signal processing devices that he might think about introducing into circuit for corrective work. He said, *'There are equalisers that we've*

tested out. […] Even though it might be able to do a few things that we can't do on our equaliser, […] we don't want it, because it just doesn't sound good. It has to have good electronics, it has to really sound almost like you can't even hear it in the circuit.'

Many engineers discussed their personal and creative approaches to using outboard equipment for audible colouration or 'saturation'. Engineers also gave figurative descriptions of how signal would be reconfigured through various analogue tools. All this informed my sense of mastering as a process that enhances emotion and timbre in recordings. I asked Maria Triana if she preferred to work in the analogue domain. She said, *'Since a lot of things already are coming from tape, I feel that going through analogue is great and then I get some colour.'* It was clear that Triana had been carrying out remastering and restoration work at the time of interview. Over at *Mastering Mansion* (ES), Nick Litwin described the 'HG-2', a unit mentioned earlier by Grundman and made by *Black Box Analog Design,* as a *'powerful'* device in terms of the colour it can imbue. *'You have quite a lot of combinations, real tubes, saturation'*, he said. Later on in our interview, Litwin used the words *'twists'* and *'tastes'* to denote nuances that different pieces of analogue equipment introduce. At *Abbey Road Studios*, Wharton described colouration as *'vibe'*.

Wharton reflected on how he himself uses the 'Mastering Compressor' made by *Shadow Hills Industries. 'A lot of the time I will use [the Mastering Compressor] just for colour, even if I've set the threshold so it's hardly touching it, just using it for the actual sound, the actual sonics of it.'* Wharton had essentially described creative gain staging – introducing colour via analogue components but without, in this instance, adjusting any compression parameters. There are three particular settings on the Mastering Compressor – *nickel*, *steel* and *iron*. These settings allow users to switch between output transformers that each imbues a different sound. Wharton's own perceptions were that, *'**Nickel** adds a bit of brightness, bit of top, **steel** has quite a tight boost of the lows and **iron** is quite, it's like harmonic distortion, kind of a nice old school vibe.'* Litwin, also experienced with the Mastering Compressor, perceived *steel* as *'the biggest transformer sound-wise'*. Litwin's creative process can involve engaging the *steel* setting with a small amount of gain – he too would

not actually use the device for compression. Litwin might similarly introduce colour and gain via the *Manley* 'Massive Passive' equaliser or the *Chandler* 'LTD-2' – *'same thing – just the gain, no compressing.'*

Jon Astley remastered *Toto*'s (1982) 'Toto IV'. The remastering session took place just two weeks prior to our interview in 2015, and the engineer remembered that the source audio for this project needed little to no corrective work. He said, *'I just put [the record] on and went, "This is perfect, what shall I do?" I just made it a little bit louder, pushed it into a little warm compressor, bit of analogue, didn't touch the EQ. Brilliant.'* Earlier in our interview, Astley explained that he uses lots of *'valve gear'* - analogue equipment with vacuum tubes. The engineer recalled switching out three different types of *'valve EQ'* while mastering *Led Zeppelin'*s (1997) 'BBC Sessions'. *'Jimmy Page and I both decided we really liked the sound of [the TL Audio equaliser]'*, he explained. This was a significant moment in our interview. At this early stage of my research, I grasped that an entire body of work had been driven through an analogue signal processor to imbue a coherent nuance. A mastering engineer and a celebrated musician had sensed that this nuance helped carry the emotion and sensation of live performances over to the recorded format. This creative decision and critical application of the *TL Audio* equaliser had not been documented.

*

It is important that we, just like mastering engineers, consider the conversion stages of a hybrid chain as deeply as the processing stages. Converters can, just like the equalisers and compressors mentioned previously, be used for subtle nuance and more. Shelvock (2017: 23) aptly stated, "Converters, like many other signal processors, take on what we might call an 'instrumental' quality for many engineers. Indeed, convertors are as crucial to mastering engineers as guitar brands can be to guitar players. Electric guitarists may opt for a Les Paul style instrument rather than *Fender* Stratocaster, for instance, because the two instruments produce quantifiably different sounds (Martin 2014: 1-3). The same is true of mastering engineers who treat converters, or sets of converters, as an integral part of their 'signature' sound." Astley had explained why *dCS* converters were used for his earlier remastering of *ABBA* - *'They just sounded so much better than anything else*

around at the time.' He added, *'I still love them, they're kind of still warm and not spiky and they still have this kind of quite nice… They're not pure by any means, they have their own sound to them.'*

AD and DA conversions can be performed by one device or by separate devices, and neither process is ever truly transparent. Even converters designed to be transparent imbue subtle colouration, and so engineers looking for something clean would need to embrace compromise. I have found that while engineers can demand utmost transparency from a converter, there are some who seek out devices that blatantly contravene this ideal. Shelvock (2017: 22) attested that "the mastering engineer's understanding of each DAC's peculiar biases is as sophisticated as their understanding of the other technologies they use, such as EQs, compressors, and so on." The same can be said for the engineer's understanding of their ADCs. Shelvock also explained, aptly, "a divide exists between those who use so-called 'clean' or 'transparent' converters, and those who use converters to alter signals in specific ways." I had formed a greater appreciation and respect for these ideas through equipment testing sessions that took place at *Stardelta Mastering*. The sessions happened in 2017 and 2018. In one instance, the engineers present had focused on conversion. Each of us explained the disparities perceived between different devices and how each device handled recordings of various genres.

Litwin had been one of the engineers who, at length, communicated that there are creative aspects to choosing or working with DACs and ADCs. He thus features to a considerable extent through forthcoming discussions. The engineer remembered testing for transparent converters and noticing that many added colouration to the signal.[1] *'I was looking for transparency, as transparent as I could get'*, he said. *'Then, I realised there were a few, at the time, a few convertors which were [adding] some kind of, I don't know, brightness, glowiness, shininess, silkness to the sound. I wouldn't say they were not transparent, but they were not as transparent as a Weiss or maybe a Mytek or maybe a Prism* [exact models unspecified]*. But they offered a kind of shininess that was just the exact effect you wanted for a certain kind of music, especially pop music.'* Litwin used the term 'pop' to denote chart

[1] Litwin's testing happened way prior to 2017 and not at *Stardelta Mastering*.

pop, electronic pop, rock music, electronic music et cetera. He had also remembered that *CraneSong*'s 'HEDD 192' offered *'this slight bump on the mid range'*. Litwin regarded this nuance as *'just perfect for rock and roll.'*

Litwin continued to remember and rationalise the development of conversion stages for the hybrid setup at *Mastering Mansion*. Litwin reiterated that changing DACs or ADCs had altered the sound of his workflow. Similarly, he remembered that changing cables would *'affect the signal in certain ways'* that he might perceive as either *'very nice'* or *'very wrong'*. Litwin considered cables and converters as akin to equalisers in terms of the affect they have on signal. I was reminded of Perlman (2004: 795), who identified how "distinguishing between different brands of amplifiers, speaker cables, interconnects, or other components" is an established area of controversy between "golden-earism" and "meter-readism". Litwin said, *'I'm an audiophile, I come from the hi-fi business, so I do have a few cables that I, once in a while, change. I don't [change] them very often, to tell you the truth.'*

Litwin had ultimately chosen a *Mytek Digital* '8x192 Series' converter for *'when I wanted something more transparent'*. He also purchased a *CraneSong* 'HEDD 192' for *'when I wanted something a little bit more, let's say commercial… Let's say rock and rollish, or popish.'* Litwin's reputation and income increased over time, and this then led him to test 'LavryGold' converters made by *Lavry Engineering*. He remembered that these retailed at circa €15,000, and to me this hinted at the level of quality clients pay for in mastering. For Litwin, the LavryGold converters offered a far more coloured sound. Later on in our discussions, Litwin said, *'I wouldn't use [the LavryGold converters] for jazz, I wouldn't use them for classical, I wouldn't use them for, I don't know, very open natural sounding music, because they have this kind of glow, this kind of shininess. But it's so fucking great for commercial music, again, in a different way than the CraneSong ['HEDD 192']. It's not the mid range, it's the high range in this case, it's the treble and it's this kind of shininess that is also coming with some kind of bigness.'* In 2018, when we spoke, the LavryGold converters would be used for around eighty percent of projects received by *Mastering Mansion*. Thus, I deduced that greater portions of Litwin's work had involved genres such as chart pop. All of this work would be imbued with the nuances of LavryGold converters. Litwin also said that his LavryGold ADC offers *'a*

unique way of working with headroom and […] a unique way of working with clipping.'

It is not uncommon to hear of engineers driving analogue audio into their ADC at high levels, therefore clipping signals to lessen their RMS average amplitude. They would then perform final adjustments, such as limiting, in the DAW. Some might balk at using clipping to lessen the dynamic range across recordings, though for reasons already explained, others will prefer this method instead of limiting. The perceived clipping tolerance of an ADC is subject to how much level can be fed into the device before distortion becomes blatantly audible and unproductive. Hard clipping digitally induces less of a rounded saturation effect. It is less forgiving and engenders distortions that are not harmonically related to the input signal. As Shelvock (2017: 157) explained, "In audio engineering, non-harmonically related distortion refers to the production of overtones that are not integer multiples of the input source" (see also Robjohns 2013a, online).[1] Distortion introduced via clipping in analogue is generally and on the contrary less obvious or distracting. When audio leaving the ADC is recorded and represented in the DAW, all sonic phenomena that survived clipping will remain either at or under 0dBFS (digital clipping point).[2] A DAW channel fader or a software limiter's output ceiling can be set to lower a recording's maximum amplitude level so as to comply with particular delivery standards or recommendations.

I have concluded that mastering-grade converters might be chosen partly on the basis of how they perform in terms of clipping and thus whether they can achieve greater programme loudness with respect to the loudness war. I have also determined a few factors that influence whether louder masters are produced via clipping or via limiting – the two biggest factors being a) the nature of the source audio and b) the engineer's own preferences. Of course, engineers can apply combinations of ADC clipping and digital limiting if doing so offers perceptually smoother RMS average amplitude reductions. Engineers might choose to avoid digital limiting because of colouration associated with particular software tools.

[1] See *Appendix D* – 'Harmonic distortion'.

[2] See *Appendix D* – 'dBFS'.

Amidst some balanced discussions of various forms of signal processing, Staff explained:

> *Quite often [people] think, "oh, because it's digital, it's neutral" […] but it's not the case. [Plugins] do seem to have some sort of colouration which is maybe down to, in some instances, obviously, down to [deliberate] modeling. Sometimes it's just going to be down to the way the […] algorithm actually functions and gives you the end result.*

Recordings can be made perceptually louder by alternative forms of distortion (e.g. tube saturation) introduced at earlier stages in the analogue loop (see Shelvock 2017: 146; White 2010, online). Hopkin explained that he himself gain stages analogue equipment to achieve loudness. *'I don't use digital limiting […] and nearly everybody else that I know uses digital limiting'*, he said, adding, *'I do it a way which creates a lot of distortion. […] I'm creating the kinds of levels that you're hearing from people that are using digital limiters just by gain staging loads of analogue.'* It was my feeling that *'nearly everybody else that I know'* denoted a variety of professionals Hopkin discusses engineering with personally – producers, mix engineers, musicians and perhaps some involved with mastering. This is because Hopkin also expressed that he, along with other mastering engineers, may prefer to clip an ADC than apply limiting. Hopkin said:

> *We're well over [0dB], we're flying very far over [0dB], every day of the week and so are, I hasten to add, the other guys that you're speaking to. It's just they cover it up by using a bit of limiter, so you know, I'm giving the game away here and I'm totally happy to but that's how this works. […] Digital limiters don't sound very good when you compare them to doing it the other way, but there's only so far you can take it with the other way before you start to have to use a digital limiter, apparently. And the reason that they are doing that is because they don't want people saying 'I'm hearing distortion' when there isn't any and we know there isn't anyway, or we know that there isn't enough to cause a problem, but the playback medium, iTunes, that particular piece of software and usually the audio output on their Apple device as well doesn't cope with what we do as mastering engineers very well at all. So people rely very heavily on digital limiting, which doesn't sound*

> *as good as doing it the other way. So what I've done, I haven't reinvented any wheels or anything, I've just changed the way that some of my gear works, so that I can do it all and use little to no digital limiting whatsoever.*

Laypersons may be confused at the thought of musically invested engineers enacting distortion or performing signal clipping and digital limiting as part of their creative processes. As Shelvock (2017: 146) explained, however, "many masters benefit from the application of *subtle* distortion" (my emphasis, see also White 2010, online). I would extend that *subtle* applications of clipping or limiting can similarly enhance the musicality of a record. Yet my research has shown that, per the loudness war, clients demand less subtle uses of this processing and despite engineers recommending otherwise. Litwin said:

> *Clients ask you to kill the mixes. Sometimes the productions are pretty okay or even very well made and they come and tell you, "I want them to sound as loud as 'Californication', Red Hot Chili Peppers,* [(1999)]*", and you just look at them, listen to the music and say, "Are you sure of what you're asking me?" It's like, "You composed this, you arranged this, you have these dynamics, you have this sound staging, left, right, high, deepness and then you're asking me to put everything up front with distortion? Are you sure?" […] In the end, it's like, "Okay, if that's what you want, well, I'll do it, I hope I will do it better than the guy next door, because I have the skills, because I have the gear prepared to do that." And I crank the Lavry up and I crank my Shadow Hills up and I crank my EQs up and add up distortion every single way. […] And then they still want a dB of limiting on top, but come on, in the end, what can I do? They are the clients, they are paying.*

Via this moment of Litwin's interview, I had been reminded that "there are often many stakeholders involved in the mastering process" (Savage 2014: 254). Clients provide engineers with feedback, they can impose certain demands and they must ultimately approve an engineer's work. This means that musicians or label representatives maintain some creative agency in the formation of mastered audio. In the end, however, only the engineer will be credited for mastering.

Mitson suggested a unique and unconventional method exists for raising the programme loudness of recordings. His method would negate the use of software limiters that can induce unwanted colouration, and I can say with a high degree of certainly that Mitson's method would not engender anharmonic distortion as can be heard via hard digital clipping. The engineer found an *'anomaly'* in the Pro Tools DAW (version unspecified). Mitson explained that lowering RMS average amplitude via this anomaly would still ensure masters conform to 'Red Book' specification – no signal would exceed a maximum digital level (see Pohlmann 2011: 187-235; Wikipedia 2021h, online).[1] Mitson did not explain how to find and therefore work with the anomaly, but he did explain that US mastering engineer and friend Dave Collins discovered a similar quirk in a much earlier DAW developed by *Sonic Solutions. 'Given certain circumstances and signal flow, you can recreate the same anomaly in Pro Tools* [version unspecified] *and you don't need any kind of limiter, because I hate them'*, said Mitson. *'It does "limit", but you don't need a limiter, so it means one less thing that your signal has to go through.'* I had tried to ask Mitson if the so-called anomaly sounded more like limiting, analogue distortion or clipping. *'I can just make it so loud that it's unlistenable and never get an over'*, he said. Mitson also claimed to be unaware of whether others have found the anomaly. He clarified that his method involves executing *'one very specific thing'* in Pro Tools (version unspecified). *'I'm not saying that other people haven't discovered it, you know, because when [the anomaly] came out in Sonic Solutions it went round fairly quickly'*, said Mitson. *'But you have to do one extra thing in Pro Tools and it has to be very specific, but it works every time.'*

From a critical standpoint, we might say that Mitson withholding explanations of how to find and work with the 'anomaly' would enrich a view that mastering engineers "enjoy a 'dark art' status"; "the guarded secret of mastering is kept behind closed doors in a cloak of mystery" (Hepworth-Sawyer and Golding 2011: 241). The most striking significance for me, however, was that Mitson found a peculiarity in Pro Tools that changed his approach to crafting the dynamics of records. Looking back on our interview, I remembered Marrington (2017: 85) having previously compared production software with "traditional instruments which have

[1] See *Appendix D* – 'Red Book'.

been previously associated with songwriting practice." I cited Marrington at an earlier stage in this chapter when I examined Proper's creative work with mastering tools. Marrington suggested that, for songwriting, the DAW could be understood as "an instrument in its own right, whose *idiosyncrasies* need to be mastered if it is to be used effectively in the heat of the moment" (my emphasis).

I wish to focus more deeply for a moment on the idea that mastering-grade converters can be chosen, tested and compared for their perceived clipping tolerances. Speaking with Litwin, I gleaned that his LavryGold ADC enables a high degree of clipping. For the great majority of listeners, this clipping would be imperceptible via everyday playback systems.[1] I have said that the perceived clipping tolerance of an ADC is subject to how much level can be fed into the device before distortion becomes blatantly audible and unproductive. I now add that an engineer's discernments would be contingent on source material. *'I have to be careful'*, Litwin attested. *'I'm a mastering engineer, so I have to listen to everything that's happening.'* Litwin felt that his LavryGold (exact model unspecified) might tolerate *'one or two more dBs'* of clipping than a 'HEDD 192' – a converter that the engineer regarded as *'already very good at clipping.'* According to Litwin, the same LavryGold could tolerate *'maybe three or four more dBs'* than his *Mytek*, *'two or more dBs than a Prism'* (model unspecified) and *'3 more dBs than a Weiss'* (model unspecified). *'So [the LavryGold] is very commercial'*, he concluded, suggesting that the dynamic ranges of modern popular music releases are typically low.

All this said, I stress that clipping tolerance would unlikely be the leading factor in an engineer's decision to invest in a particular converter. Other aspects of how a converter handles audio would assume greater precedence. We can expect that manufacturers design their converters with a greater regard for transparency than for clipping tolerance – if this is even a factor. Converters are, for the most part, designed to facilitate the most faithful reproductions of signal possible. I insist that evaluations of clipping tolerance should be regarded more as incidental findings and less as crucial estimations of device design. Beyond a certain price point, most

[1] See Riesman (1950/1990: 8-9) and Wall (2003; 219-24) for descriptions of passive and active listening in the context of popular music.

converters are deemed fit for mastering work, yet each will present nuances and engineers make selections based on their taste for these nuances.

Over the course of a few years, Litwin had developed a setup that would, in each mastering session, allow him to choose between two or three different converters, based on what they offer sonically. All DA and AD conversion would essentially be transparent, but a chosen converter could at the same time offer particular *'flavours'* or *'twists'*. Before Litwin described all this, he had presented a philosophy that told of how creative mastering involves the introduction of certain tools, like converters, that imbue subtle nuances on a recording. *'We are working with left and right'*, he said. *'I mean, we are working with all the instruments at the same time. Sometimes what's needed is just a little bit of salt and pepper. It's just a tiny bit of salt or a tiny bit of pepper, it's just that!'*

Litwin explained that his choice of converter would be based on a judgment of the music and mixes received from clients. *'Some mixes are very good'*, he attested. *'And you may just need the sound stage that the Lavry gives you, or just the presence, the upfrontness that the CraneSong HEDD gives you, or just the wooden taste that the Mytek gives you.'* Litwin continued to employ this figurative language when translating subjective and phenomenological ideas of how converters manage sound. He equated his *Mytek* with a wooden broom in that, by his perception, the converter offers a *'transparent'* but also *'very natural'* sound. *'Whereas when I listen to the Prisms, it's a more metallic sound, you know, it is still transparent, but it has some kind of brightness to it'*, he said. Litwin also remembered that a *Prism* converter (model unspecified) had sounded *'a little bit more forwards'*, when compared against his *Mytek – 'a little bit more backwards'* and *'opaque'*.

Whilst Litwin decided against using *Prism Sound* converters, Hopkin had enjoyed using the company's 'ADA-8XR'. Based on experiences offered by Bob Katz (in Hepworth-Sawyer & Hodgson 2018: 54-5), we might say Hopkin felt, after carrying out his own testing, that the ADA-8XR represented something of a benchmark in terms of conversion transparency and neutrality. Katz said, "There are mastering engineers who use coloured converters on purpose. That's not my philosophy. I would rather let whatever analog processing that I choose to use provide the colour." Katz then later stated, "I believe in having accurate converters. […] I have at

this time settled on the Prism converters because they're the closest to transparent" (see also Shelvock 2017: 23). Katz explained how he might test for perceived transparency:

> You take your source on your DAW and you monitor it directly through your monitor converter, and then you insert in the middle of that chain a D/A going into an A/D. The winner is the insert that sounds as invisible as possible, where you can't tell whether it's in or out. There is no transparent converter, but the Prism comes closest for me.

Like Hopkin, Astley also progressed to using an ADA-8XR as a staple converter in his chain. While there are some engineers who might use the ADA-8XR for clipping, Astley expressed that the converter should not be used in such a way. *'It works far, far better if it's not [driven hard]*, he said*. 'If you're […] converting to analogue to go through valve gear and […] you're working from a digital source, just don't drive the converter hard to analogue and vice versa back to digital.'* From this, I gleaned that Astley might lean towards alternative methods of creating louder masters where necessary. Mandy Parnell has also used the ADA-8XR, and the engineer spoke highly of Graham Boswell - owner and designer at *Prism Sound*, she explained. I learned that Parnell carries out extensive listening tests before introducing or swapping out equipment at *Black Saloon Studios*. *'[Graham Boswell] knows I check his gear against everything else'*, she said. Tim Young maintained that each mastering room at *Metropolis Studios* was also equipped with *Prism Sound* converters (models unspecified).

It is clear that *Prism Sound* are highly regarded for their conversion technology, and I have concluded that the creative output of all mastering engineers who had used the ADA-8XR would be imbued with the same nuance. Litwin had not chosen *Prism Sound* for his signal path at *Mastering Mansion*, and so the conversion stages of his chain would imbue something different. This alone validates that greater understandings of mastering equipment, or how engineers use and test this equipment, are needed if we are to more fully appreciate the art of record production. Although our engineers are credited for mastering catalogues of iconic works, their longstanding use of particular converters and how these devices help shape the aesthetics of records has escaped sufficient recognition.

Hopkin remembered testing a range of converters back when developing the hybrid setup at *Stardelta.* In one testing session, an ADA-8XR had been compared against *Prism Sound*'s 'Orpheus' converter, *Lynx Studio Technology*'s 'Aurora 16', a first-rate unit made by *Apogee Electronics* and another converter made by *Lavry Engineering.* Hopkin had set up an elaborate system that allowed him to route digital audio to all converters simultaneously and via one external clock source.[1] *'They were all clocked externally, so everything was spot on'*, he explained. Each of the DA outputs had been assigned to individual buttons at random on Hopkin's mastering console. This allowed him to perform fast and objective comparisons at unity gain – equal output level that can be ratified using 'test tones'. Hopkin also tested how each device might handle AD conversion. He remembered, *'There were three of us in the room […] and we listened and we listened, and we didn't talk and we didn't say anything, and we punched buttons and we listened and we punched buttons and we listened and we did that for three or four hours. The three people in the room who I all rate as having pretty good ears, we all went, "what is that thing that's on button four?" And it was the ADA-8XR.'*

Why the ADA-8XR, I wondered. *'I can't tell you what it was'*, said Hopkin. *'But everyone in the room went "yeah, that's it!" So some of [the converters] were really different and we were like "ooh, yeah, that's kind of funky", […] or "that's kind of like, I can't tell the difference between one and two.. I actually can't tell the fucking difference!"'* Hopkin reflected that it was essentially *'the sound stage'* that sold him the converter. Hopkin acknowledged that a good share of engineers would likely be using and advocating the unit made by *Lavry Engineering* (model unspecified). This converter had not offered results that aligned with Hopkin's own critical determination of what needed to be achieved via the conversion stages at *Stardelta. 'But then, I kind of noticed that nobody really uses [Lavry] in the UK'*, remarked the engineer. *'And quite a lot of people use those in The States.'* A short while later and with this in mind, Hopkin questioned, *'Is there a US and UK type sound?'* He suggested, *'Yes, definitely.'*

This moment carried a lot of weight. I concluded that if engineers feel mastering differs from location to location, country to country, then we should encourage

[1] See *Appendix D* – 'Word clock'.

much greater study into their creative processes and choices of equipment. This would foster more complete understandings of the art and aesthetics of record production. One day later, Heyworth recounted his own perceived differences between earlier American and British approaches to developing monitoring setups or listening spaces for mastering and disc cutting. Heyworth remembered some much earlier visits to the US, where he observed *'more laid back, hi-fi [approaches] to listening.'* Heyworth had preferred the sound of early American studios, when compared to English rooms that were sometimes *'harsh sounding'*. The engineer explained, *'[Early American studios] were kind of home grown really, they were more hi-fi, if I remember it rightly, you know, they were more individualistic. Whereas over here, it was all lino floors and it was all very kind of, it was just different, it was more clinical because you were cutting vinyl. I mean, it wasn't as necessarily a creative process, although it was, but it was just a process. You had to get the stuff onto lacquer, so it was regarded as a process that needed to be done.'* I asked Heyworth to clarify whether he himself considers disc cutting a creative process. His response was *'Very much so, yeah, I do*', and ensuing discussion suggested to me that disc cutting chains, like those used for mastering, are developed with a sense of creativity and understanding for how they imbue nuance.

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At the beginning of this section, I acknowledged how strong endorsements of certain tools could be interpreted as a way of engineers justifying prior investment into costly hardware. Endorsements of certain hardware tools could also be interpreted as a way of signalling more individualised or creative approaches to mastering - the results of which might be less attainable via lower-cost software and automated services. Hull himself suggested that engineers could be highly invested in analogue - I would need to keep this in mind when people attempt to qualify whether digital or analogue is better in certain contexts. Yet evidently, there is much to be said for how or why particular analogue tools are used for creative mastering. Via balanced discussions of digital and analogue, Hull said, *'If [digital tools] sounded better I would […] sell all of my analogue stuff and just use digital, but I'm not getting the results that I think my clients expect with a strictly digital process.'* I have gleaned that Hull's sustained use of analogue is based on critical and conscientious

evaluation - he is motivated to develop and maintain the best possible signal flow for clients.

Schmidt also uses analogue equipment, but he would be happy to introduce digital equivalents that are available and up to standard. A digital software plugin had been Schmidt's choice equaliser at the time of interview - the engineer enjoyed its flexibility and precision. Yet, as Schmidt acknowledged, a digital EQ might not offer the *'"sheeny", you can say "warm", or you can say, like, the specific "somethings"'* that could be associated with analogue EQs in his studio. Where needed, Schmidt uses analogue to enact sonic and technical adjustments not possible via digital plugins. Like Hull, it would seem that Schmidt bases his choices on critical and conscientious evaluation - Schmidt too is motivated to develop and maintain the best possible signal flow for clients. Though an advocate for analogue, Schmidt explained that he would remain skeptical and objective if told that certain analogue tools will assuredly make all recordings sound 'better' - as if, perhaps, by magic. Some further discussion led me to ponder that others operating in the wider audio engineering space might buy into hype, narratives and myth generated around particular reputable or vintage analogue. Nevertheless, in the process of buying into hype and using certain tools, people might actually perform better work through something of a placebo effect. Schmidt explained this idea and also framed audio engineering as a musical undertaking as follows:

> *[It's] the same thing as if a guitarist is playing a 1959 vintage 'Les Paul' that's worth £200,000 or something and they'll say, 'oh, this has got such a sweet tone and I can play on this guitar like on no other.' They're right. I mean, if it makes them feel special and if it's really nice and playable and has a great tone, then that's how it is. It doesn't mean there's any 'magic' about it. You might be able to build that same guitar out of new parts, and if you were to switch out the guitars in a dark room and the guy wouldn't know it, maybe he'd be fooled.*

This analogy had later reminded me of Perlman's (2004) ideas around audiophilia. Via Perlman (2004) I understood that some audiophiles are known to disregard science – they pursue instinctive and subjective approaches to analysing sound. To

the contrary are those said to embrace more objective and mathematical methods of analysis, relying less on their own subjectivities.

Speaking with Hopkin encouraged me to take on deeper understandings of how younger engineers especially might respond to hype, narratives and myth generated around particular reputable or vintage analogue. *'There's a massive mystique involved in the sound of records. Classic records particularly'*, he said. Hopkin explained that engineers may be *'clambering to try and replicate a sound or get a bit of the "mojo" from something that was used on that record.'* Tentatively, Hopkin estimated there to be *'off the top of my head, let's call it five'* different ways to design amplifier circuits – those seen under the hoods of various pieces of mastering equipment. One design might use vacuum tubes, another transistors and another a combination. The engineer also conveyed that there are a few essential ways of designing input stages found in analogue equipment, and that, in essence, *'If you go and look at all these commonly applied designs, you'll see that they're pretty much repeated ad nauseum.'* Echoing Schmidt somewhat, Hopkin said that in a *'blind test'*, engineers would be hard pressed to tell the difference between vintage equipment and newer designs that could be attempting to replicate something older. Hopkin concluded, *'I think with gear [acquisition], it's like this kind of chasing some kind of dragon. To me, it stinks of not being happy with what you do, honestly, that's how I kind of feel. If I think something can be improved electronically, different story. But going out and spending your life on eBay, or wherever it is that you look for all this gear? I'm afraid I'm not one of those people.'*

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I began this expansive chapter by exploring how mastering engineers identify with their creativity and apply their listening skills. In the second section, *Studios*, I honed in on rooms occupied by engineers and how these spaces can be further understood as creatively significant places. Through this final section I have examined tools engineers use to perform their work and how these tools are selected in their creative processes. Clearly, there are preferences when it comes to equipment, and mastered audio is a function of these preferences. I have shown how entire bodies of work can be driven through unique signal processing chains to imbue a coherent nuance or 'sonic signature'. My research thus supports that

greater understandings of mastering culture and how engineers use equipment to fulfill artistic visions are needed if we are to more fully appreciate the art of record production. Although engineers are credited for mastering catalogues of iconic and socially significant works, their creative use of particular devices and how these devices help shape the aesthetics of records has escaped sufficient levels of recognition.

I focused much of my examination on the analogue stages of a 'hybrid' setup that I regard as prevalent in today's industry. I deduced that much of high-level mastering is about the creative and careful configuration of electronic signal flow and gain structure in the analogue domain. Yet, mastering has been outlined in different ways via simple or digitally focused technical guides that exist online and in print. These guides would often be targeted at amateurs who began embracing DAWs in the early 21st century. Languages used to describe changes brought about via signal path engender visions of mastering as a musical contribution, and this aligns with Shelvock (2017: 26), who expressed that engineers perform signal processing with "an *ear* towards some straightforwardly music goal, even while they remain ever cognizant of a host of technical concerns."

Conclusions

Right from the beginning of this research, it was common to hear references to mastering as a 'dark art'. Outside the world of professional engineers, there was little understanding of what mastering involved and why it was so important. There were few useful biographies of key figures, and even fewer studies of it as a creative practice. The aim of this research has been to alter our understanding of this field, to reveal something about the way mastering works and the people who do it. Throughout this thesis, I have explored a number of themes that emerged out of interviews with 20 of the world's leading practitioners. In doing so, I have identified mastering as a new creative culture of audio post-production. Each engineer I interviewed has dedicated well over 10,000 hours to their craft, and they exist as just a selection of many accomplished creatives who apply their skills to bring artist visions to life through mastering. I have also explored the field through autoethnography, and this has involved close work with some key professionals. Much of my writing has been imbued with autoethnographic reflection. As a collective, the engineers involved in this research and the projects they worked on have earned extensive arrays of prestigious *BRIT*, *GRAMMY*, *Mercury Prize*, *Music Producers Guild*, *MOBO* and *TEC* awards, or at least a nomination. Their work might well have been heard during yours or a friend's first dance, last night's final mile on the treadmill or a painful breakup. Like the more widely studied 'music producer' or 'mix engineer', a mastering engineer will offer his or her own artistic interjection to the production process. In my introduction, I presented three research questions that would remain central to my study. They were as follows:

- How has professional audio mastering evolved as a creative practice?

- How does studying today's professional audio mastering culture aid a better understanding and theorising of creative labour in the cultural industries?

- In what ways is the culture of professional audio mastering significant to social understandings of popular recorded music production?

To address these questions, I broke my findings down into six core themes, and these were spread out over two expansive chapters. In Chapter 5, *Creative Mastering: Access, Education and Expertise*, I homed in on the culture of accessing, learning and operating as a creative expert in mastering. In Chapter 6, *Creative Mastering: People, Studios and Equipment*, I examined how engineers identify with their creativity, apply their listening skills and perform artistry in close harmony with rooms and tools at hand. My research has shown that the majority of these themes impact on the sound of records and how records are sculpted at the final stages of production. Thus, mastering engineers and their studios merit far greater recognition from academics and music fans alike.

The mastering engineer's involvement with music has certainly evolved out of a more technical and procedural mode of industry labour, and I have explored how engineers approach their work creatively. Mastering bears explicit hallmarks of creative labour, and my findings have presented new ways of looking at how workers navigate the cultural industries. Establishing deeper understandings of mastering culture has engendered deeper understandings of popular music production as a whole, and I will conclude my thesis by offering a rundown of key understandings brought forward via each section of findings.

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Via the *Access* section, I examined routes into the mastering industry and skill development. Mastering is not an easy field to access and this speaks of how perceptions of the practice have changed. Mastering is clearly a 'people industry', not simply a creative practise - career progression and acquiring paid work depends partly on how well engineers demonstrate expertise and experience, draw on professional connections and cultivate trusting relationships within the wider music business. Engineers might now complete formal educations, providing them with foundations of skills before seeking out assistantships, mentorships or alternative industry pathways. With or without formal educations, many established engineers developed palatable experience in a few areas or at least one specific area before accessing mastering work. These areas included live sound, studio work and musicianship to name a few. I have found that career access can be

remembered in ways that make for good storytelling, and certain tropes can uphold that mastering is a relatively unattainable, albeit creatively fulfilling career.

In the *Education* section, I presented autoethnographic reflections on my degree-level Music Technology training, attending the *Vlado Meller Mastering Workshop Series*, and continuing to develop professionally in mastering from then onwards. Self-reflection on my own mastering training offered insight into advanced skill acquisition, career access and development. My reflections indicated that particular routes into working as a mastering engineer can manifest in different approaches to creative decision-making, technical operation and professionalism. My reflections shone a light on how creative and professional practices might now be influenced by teachings offered through formal curricula, assistantship or other cultures of learning afforded through contemporary digital landscapes. I have posited that the emergence and fresh abundance of online courses, elite workshop series and paid masterclasses led by experts is a relatively new development in mastering. This development too speaks of how mastering is starting to achieve a greater degree of recognition as a creative endeavour. There is evidently much to be said for working closely with an established expert, and I have suggested that enrolling on such a course not only educates a prospective engineer, but it also helps them to alleviate a degree of competition in their attempts to access paid work or an internship.

In the third and final section of *Chapter 5*, I delved further into how engineers are recognised as expert audio technicians and as those who have offered extensive creative contributions in mastering. I examined cultural and social capital and how this can help with navigating a mastering career in the creative industries. I established some important elements that influence whether practitioners are hired. Key signals of expertise include discography, working at a reputable studio and earning awards. Other signals include running courses, hosting specialised podcasts or *YouTube* channels, contributing to academic journals and conferences, posting regularly in forums, and authorship.

In the first section of *Chapter 6*, I explored how mastering engineers who are thriving in today's industry identify with their creativity and apply their listening skills. This established today's culture of mastering as one that is musical, and mastering itself a critical process of connecting with the creative intentions of artists,

producers et cetera. Indications of mastering being envisaged as a creative interjection emerged via engineers who drew upon metaphors or analogies that, I suggested, are useful for helping laypersons understand where mastering fits into production. I also gleaned that, for many engineers, mastering work could be suited to an individual's own sense of personality or self. Their creative work is often performed in a highly focused state, and I have understood that mastering can attract audiophiles with inclinations towards work involving detailed listening. Today's mastering engineers will, like audiophiles, embrace objective and subjective approaches to evaluating sound, equipment et cetera. In pursuit of sonic excellence, mastering engineers apply careful judgment and their knowledge of signal flow. They see importance in knowing when 'less is more'. Broad understandings of popular music production would be enlightened through better appreciations of how these engineers apply creative or corrective interjections to help realise artistic visions. It is also important we continue to understand how engineers think about sound, the tools they work with and how these things impact on their work with recordings.

Findings presented via *Studios* and *Equipment* validate the cultural and creative significances of mastering rooms and tools to popular music production. My findings have answered to reverence that has focused more on spaces where recording or mixing popular music has taken place. My findings also show that broader understandings of mastering equipment are justified, as individualised processing chains imbue entire catalogues of recordings with 'sonic signatures' that then permeate our sonic landscapes. Via *Studios*, I upheld that the acoustics of a space would offer nuance and subjectivity to the listening experience and the creative mastering process. Evidence suggests that familiarity with an acoustic space and monitoring setup still remains a high requisite for success through mastering. Thus, entire catalogues of recordings will continue to share in a common geographical relevance through mastering.

Via *Equipment*, I established that there are preferences when it comes to the tools used in a hybrid signal path, and that an engineer's output is a function of these preferences. A better understanding of how engineers select and use tools as instruments to fulfill artistic visions would, as I have found, result in richer

appreciations of the art of record production. I have expressed that although engineers are credited for mastering catalogues of iconic and socially significant works, their creative use of particular devices and how these devices help shape the aesthetics of records has escaped sufficient recognition. I have also said that languages used to describe how sound is morphed via signal path engender visions of mastering as a musical contribution. Exploring the use and significance of mastering equipment allowed me to touch on some issues around agency, particularly where loudness is concerned. I established how engineers might adopt different approaches to creating louder recordings as part of their creative processes.

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Stereo mastering for digital audio is by far the most popular work requested of an engineer today. As such, it has remained central to my study into their culture. Disc cutting and vinyl mastering, along with mastering for immersive audio, the comeback of audio cassette and a variety of other niche formats are all practices that demand further technical and creative expertise. I certainly suggest that another thesis could be written to hone in on the histories and creativity involved with either disc cutting, mastering for immersive audio or any other specialised format. Deeper inquiry into these practices fell outside of the scope for this research. In the coming years, another academic might choose to focus wholly on just one of subjects I have explored, research it in great detail and use my work as springboard for their own investigations into mastering. An academic might also probe deeper into the history and emergence of what I have termed ‘creative mastering’, which has its roots in early methods of disc cutting. This would be a huge feat in and of itself, as there are still many dots to connect, memoirs to be recorded and biographies to be formed for this era. There are many skilled disc cutting practitioners who have reached an older age, and some of this elder generation were at a working age when the process did actually begin to morph into something more creative.

My research began in September 2014, with interviews and fieldwork taking place between 2015 and 2018. After three years of assimilating my findings, I have now presented the creative culture of mastering as one could experience it over the

course of seven years. My hope is that this research will introduce a wider pool of scholars to the industry, its structure and how its members operate, while also navigating various challenges in the realms of audio post-production, recorded music production and beyond. Here in 2021, I can say that the art of record production and the art of mastering are continuously advancing – as are a range of technologies said to support or threaten these practices. Scholarship happening around the art of record production and the art of mastering specifically is also growing. Anyone reading these words past October will be further downstream, and some things might have changed, whilst other things remain the same. Without delving too deep into the weeds, I have chosen to go beyond the scope of this research and offer brief contemplations of the future. If you would like to read on, I have offered these contemplations in full via *Appendix B: The Future of Mastered Audio in Society*. I will end this conclusion by highlighting some salient points and themes that emerge through *Appendix B*.

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There are some particular issues, technological innovations and industry politics that could affect creative agency and professional autonomy in mastering for digital formats going forward. We can begin to make sense of these issues, innovations and politics by first examining earlier discussions of standardisation in popular music composition and cultural production more generally (see Adorno 1938; 1941).

When it comes to loudness and creative agency, one particular issue facing mastering engineers today is the fact that streaming services are pushing to create safer and more standardised listening experiences for their customers. As with other streaming services, *Spotify*'s algorithmic normalisation is currently built around 'LUFS' (see *European Broadcasting Union* 2020). This is a newer metering scale that has been adopted for evaluating the average perceived loudness across digital recordings.

Despite some clear benefits associated with modern normalisation schemes and loudness recommendations, some might say that mastering music within a systematic and technical confine constrains the engineer's freedom to enact particular creative decisions. Loudness guidelines, followed stubbornly, could begin

to standardise the dynamic aspects of all modern recorded music – that which gets hosted on digital streaming platforms at the very least. This is a problem if, from a creative perspective, there are recordings that sound great when conceivably crushed to death and there are other recordings that benefit from maintaining some wider dynamics. Most crucially, there are engineers who feel that recordings have their own perceived 'sweet spot' in terms of level - that this sweet spot is to be determined intuitively through mastering and to remain consistent across all digital versions, regardless of where the recordings are distributed.

There are advocates and skeptics of the LUFS system and its use in the mastering process. We might question whom the LUFS system benefits the most. My discussions highlight that streaming services hold a degree of sway over how modern productions are mastered and delivered to clients. The variety of stakeholders involved when it comes to loudness standardisation makes these debates complicated.

I conclude that, going forward, mastering engineers could be a powerful voice for challenging or determining how the dynamic properties of recorded music are regulated for standardised playback on digital platforms. Discussions around loudness normalisation also underscore the importance of engineers maintaining cutting-edge expertise whilst digital technologies and innovators help give rise to various other standards. Newly proposed practices for mastering and standards for content delivery will demand the same expertise from the engineer.

The mastering conference I attended in 2018 reinforced my understanding of the mastering engineer as an agent for technological development in the realms of modern formats and standards for digital music consumption. The conference showed that innovators and research and development teams converse directly with engineers to promote products or solicit feedback through such events. The relationship between innovator and engineer came across as one based on mutual respect and understanding for where their respective areas of expertise either cross or vary. While software engineers, audio design experts and music technologists might be familiar with the mastering process, there is yet a need for them to consult those whose business it is to engage directly with artists every day and whose business it is to work creatively with various tools of the trade. All this offers another

way in to understanding how mastering engineers and their expertise will remain relevant in the years ahead.

Numerous and varied standards for digital audio will be proposed or grow out of infancy over the coming years. I argue that their level of adoption will likely depend on various social and cultural factors. I reflect on how some emerging standards were discussed at the mastering conference - the 'MQA' (Master Quality Authenticated) audio codec and 'HD Vinyl' specifically.

Those involved or interested in mastering would have recently witnessed some other new formats and innovations gain a footing. Right now, with much focus being placed on immersive audio, the likes of '*Dolby* Atmos' and *Apple*'s 'Spatial Audio' features remain central to a lot of discussion. Currently, there is no requirement for engineers to operate out of 'certified' studios when working with Atmos for music. Whilst this does suggest that mix and mastering engineers can work with Atmos from wherever in the world, the cost of doing so is far from cheap. An Atmos loudspeaker and rendering setup forms a large investment. Moreover, the time it takes to create deliverables would result in clients needing to pay a premium.

The future of these formats can be viewed with confidence and also skepticism. We might ask, 'does the consumer care about immersive audio?' and I make the point that older generations of mastering engineers will have experienced the emergence of immersive formats purported to overtake stereo in the past, only to find that few of them caught on in a big way. I conclude that the development and implementation of immersive audio is, like MQA and HD Vinyl, something that mastering engineers will be paying close attention to and intervening with going forward.

Algorithmic and rule-based services such as *LANDR, eMastered* and *CloudBounce* are gaining popularity for offering low-cost and automated stereo mastering via the Internet. These services require comparatively little knowledge of the creative or technical basics traditionally needed to master a recording. I have noted that the development and growth of big data, automated services, artificial intelligence (AI) and machine learning can be discussed in ways that position future digital

technologies as a threat to particular forms of engineering work and what Birtchnell and Elliott (2018: 79) might describe as "'no-collar' jobs in creative industries".

Birtchnell and Whelan (2020: 245) concluded that the rise of automated mastering for digital audio has certainly evoked a discursive shift amongst mastering engineers. Engineers make a point to emphasise the creative aspects of their work, use analogue equipment and implore peers to promote the artistry of mastering.

My own research has reinforced that professional mastering engineers still remain in high demand. Their expertise is recognised in ways that ensure them healthy flows of work in spite of somewhat standardised and sonically questionable offerings from *LANDR*, *eMastered* or *CloudBounce*. I argue that when mastering is understood as creative work, a musical feat in and of itself involving humans who navigate their culture in the ways identified through this thesis, then the suggestion of processes being fully automated or standardised in the future holds much less weight.

Academics have rationalised that services such as *LANDR* will not eliminate the need for mastering engineers. Yet, these services may offer cost-effective and quick solutions for some. I myself propose that we might marvel at the challenges overcome and growths being made on the way to simplifying or making accessible the process of mastering through automation and algorithm. Yet, a continuation of these engineering achievements may well do little to gratify audiences who yearn to see artistic accomplishment through the production of music they enjoy.

Big data, automation, artificial intelligence and machine learning might actually be of service to the mastering engineer, if certain technologies are developed and harnessed in positive ways going forward. Future innovation in these areas might, for instance, help and encourage mastering engineers to reinvent what they do, or carry out their everyday responsibilities in better ways. It might lessen their need to engage in the less creative of tasks, thus allowing them to dedicate more fully to their artistry and take on greater volumes of clients who would be satisfied by faster turnarounds.

I attest that anyone with an interest in the craft will not be deterred from learning to master and self-actualising as a creative expert through hands-on work.

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Ella Fitzgerald (1959) *But Not For Me / You Make Me Feel So Young.* [single] Verve
Frank Sinatra (1956) *Songs For Swingin' Lovers!* [album] Capitol
Hans Zimmer (2017) *Dunkirk (Original Motion Picture Soundtrack).* [album] Sony Classical
Imogen Heap (2009) *Ellipse.* [album] Epic, RCA, Megaphonic

John Mayer (2009) *Battle Studies.* [album] Columbia
Jon Astley (1987) *Everyone Loves the Pilot (Except the Crew)* [album] Atlantic
Jon Astley (1988) *The Compleat Angler* [album] Atlantic
Led Zeppelin (1997) *BBC Sessions*. [album] Atlantic
Manic Street Preachers (1996) *Everything Must Go.* [album] Epic
Marconi Union (2012) *Weightless (Ambient Transmissions Vol. 2)*. [album] Just Music
Mark Ronson ft. Bruno Mars (2014) *UpTown Funk!* [single] Columbia, RCA, Sony
Mike Oldfield (1973) *Tubular Bells.* [album] Virgin
Patricia Barber (2012/1998) *Modern Cool*. [album] Premonition
Phil Collins and Marilyn Martin (1985) *Separate Lives*. [single] Atlantic, Virgin, WEA
Radiohead (1995) *The Bends*. [album] Parlophone
Radiohead (1997) *OK Computer.* [album] Capitol, Parlophone
Red Hot Chili Peppers (1999) *Californication*. [album] Warner Bros.
Songaminute Man (2016) *You Make Me Feel So Young.* [single] Decca
The Beatles (2006) *Love*. [album] Apple, Capitol, Parlophone
The Mars Volta (2003) *De-Loused in the Comatorium*. [album] GSL, Universal
The Surfers (1998) *Songs from the Pipe.* [album] Epic
Tori Amos (1998) *The Choirgirl Hotel*. [album] Atlantic
Toto (1982) *IV*. [album] Columbia
Various (1999) *The Blair Witch Project: Josh's Blair Witch Mix.* [album] Chapter III

Appendices

Appendix A: List of Practitioners Interviewed

Practitioner	Location (when interviewed)	Role (when interviewed)	Interview	Date(s)
Robin Schmidt	*24-96 Mastering*, DE	Proprietor Mastering Engineer	*Skype*	2015-04-27 *2h30m35s*
Adam Gonsalves	*Telegraph Mastering*, USA	Proprietor Mastering Engineer	*Skype*	2015-05-29 *1h07m38s*
Jon Astley	*Close to the Edge*, UK	Proprietor Mastering Engineer	On location	2015-09-22 *1h41m39s*
Greg Calbi	*Sterling Sound*, USA	Partner Senior Mastering Engineer	*Skype*	2015-09-28 *0h40m44s* 2015-11-03 *0h49m03s*
Scott Hull	*Masterdisk*, USA *Scott Hull Mastering*, USA	Proprietor Mastering Engineer	*Skype*	2016-02-16 *2h12m13s*
Miles Showell	*Abbey Road Studios*, UK	Mastering Engineer (Freelance)	On location	2016-03-11 *1h26m40s*
Darcy Proper	*Wisseloord Studios*, NL	Mastering Engineer	On location	2016-03-29 *3h12m43s*
Mandy Parnell	*Black Saloon Studios*, UK	Proprietor Mastering Engineer	*Soho Hotel*, London	2016-04-20 *1h06m20s*
Geoff Pesche	*Abbey Road Studios*	Mastering Engineer	On location	2016-04-20 *0h32m10s*
Bob Ludwig	*Gateway Mastering Studios*, USA	Proprietor Chief Mastering Engineer	*Skype*	2016-05-31 *0h35m29s*
Lucy Launder	*Abbey Road Studios*	Head of Mastering	On location	2016-06-14 *0h40m39s*
Bernie Grundman	*Bernie Grundman Mastering*, USA	Proprietor Mastering Engineer	*Skype*	2016-06-16 *1h03m07s*
Alex Wharton	*Abbey Road Studios*	Mastering Engineer	On location	2016-06-20 *0h40m47s*
Tim Young	*Metropolis Mastering*, UK	Mastering Engineer	On location	2016-06-20 *1h25m49s*
Ray Staff	*AIR Studios*, UK	Mastering Engineer	On location	2016-06-21 *1h41m13s*
Lewis Hopkin	*Stardelta Mastering*, UK	Proprietor Mastering Engineer	On location	2016-07-04 *2h24m30s*
Simon Heyworth	*Super Audio Mastering*, UK	Proprietor Mastering Engineer	On location	2016-07-05 *2h20m08s*
David Mitson	*Mitsonian Institute*, UK	Proprietor Mastering Engineer	On location	2016-07-20 *1h37m02s*
Maria Triana	*Battery Studios*, USA	Mastering Engineer	On location	2016-09-28 *1h10m44s*
Nick Litwin	*Mastering Mansion*, ES	Proprietor Head Mastering Engineer	*Skype*	2018-06-17 *2h15m00s*

Appendix B: The Future of Mastered Audio in Society

I have presented you with a thorough picture of mastering culture via discussions of access, education, expertise, creative work in the studio and more. Though matters related to the future of mastered audio in society were beyond the scope of my core research, I have chosen to offer continued discussion of particular issues, technological innovations and industry politics that could affect creative mastering for digital formats going forward. But to fathom the future, I suggest that we should start by looking at the past.

Around the time of the Second World War, Adorno (1938; 1941) outlined various approaches that he said achieved 'standardisation' in the composition of earlier popular music and in cultural production more generally. Some might say that these historic approaches were not so different to certain practices and principles adopted later on through modern day mastering. This is because engineers have often strived for recordings to sound 'finished' and consistent with somewhat common and phenomenological points of reference. But although engineers can still aim to produce a mastered product that sounds 'finished', each individual engineer might also regard their creative interjection as one that is audibly unique and subject to particular methods of working. Hepworth-Sawyer and Hodgson (2018: 3) have instilled that mastering is, with my emphasis, "a stubbornly unique artistic practice, undertaken by critical artists who often prefer to work alone, which resists *standardization*". Adorno (1941: 444) did actually suggest a "dual desideratum" to exist within the collective listener's consciousness. According to Adorno, composers of successful popular songs must answer to this desire by consciously deviating from conventional standards and formula, without straying too far from a few socially negotiated norms. In short, someone writing a 'hit' should pay attention to the structure of other hits, but set about making theirs different in some way (see 1938: 305). Adorno (1941: 443) also argued that popular music standards "were originally developed by a competitive process".

In *Chapter 2*, I explained how the emergence of digital format standards facilitated the competitive process of making recordings sound perceptually 'louder'. Through

Katz (2002: 86-132; 185-196), Milner (2010: 237-292) and Vickers (2010), I observed that the term 'loudness war' emerged to describe how recorded music industry personnel began exploiting the affordances of digital audio to ensure new music releases competed, in terms of perceived loudness or level, when played alongside earlier releases or other releases contesting for chart space and attention in passive listening environments. Competitive leveling involved the aggressive narrowing of a recording's programme loudness or 'dynamic range'; the RMS average difference in amplitude between loud and quiet signals that represent musical passages played out over time. I drew connections between the so-called 'loudness war' phenomenon and issues of creative agency and professional autonomy in production. Later on, through my own findings, I demonstrated how competitive leveling could indeed transpire in mastering and sometimes against the will of the engineer. I have explained that excessive dynamic range processing is claimed to sacrifice 'fidelity' - a deeply problematic term, as identified by Devine (2012; 2013).

Through *Chapter 3*, I cited previous scholarship that focused on complex and longstanding dialogues between society and concepts of 'fidelity', 'loudness' or 'noise' within the context of high fidelity sound reproduction. I set out that Sound Studies scholars, such as Bijsterveld (2001; 2008), have examined issues of loudness and noise and what these acoustic phenomena reveal about society. All this helped me to justify the significance of studying audio post-production culture, particularly as discourses surrounding the issue of loudness in mastering indicated that the supposedly positive and creative contributions of mastering engineers were being held in question. Efforts originated to start raising public awareness of the purported 'issue' that was excessive loudness brought about through mastering. These efforts continue to be shown through formal industry conventions, organisations, the ongoing development of technical 'standards' and formal white papers to encourage changes in professional practice. I have observed that mastering engineers themselves are also known for contributing to or problematising the anti-loudness campaign, and I still suggest that such efforts could be understood as just one way of mastering engineers signaling their expertise and emotional investment in music as a form of creative expression.

When it comes to loudness and creative agency, one particular issue facing mastering engineers today relates to the fact that streaming services are pushing to create safer and more standardised listening experiences for their customers. From the perspective of the streaming service, all digital content should be level matched thus avoiding stark changes in loudness, or perceived loudness, when skipping and shuffling songs. Streaming services themselves apply methods of playback normalisation in order to achieve this. Through a knowledge base article titled 'Loudness normalization', *Spotify* (2021, online) have stated:

> Audio gets delivered to us at different volume levels.
>
> We use loudness normalization to balance soft and loud songs, creating a more balanced uniform experience.

As with other streaming services, *Spotify*'s algorithmic normalisation is currently built around 'LUFS' (see *European Broadcasting Union* 2020). This is a newer metering scale that has been adopted for evaluating the average *perceived* loudness across digital recordings. LUFS stands for 'loudness units relative to full scale' and most modern digital audio workstations feature the ability to measure LUFS amongst other loudness phenomena in audio. A mix engineer might place a dedicated LUFS metering plugin on their main stereo output channel and then play their project from start to finish. During this process, the plugin will typically display three numerical values in flux. These values would indicate the perceived loudness of momentary regions of audio, short-term regions of audio and finally the 'integrated loudness' of an entire song or project. Technically speaking, there is a lot more to understand about LUFS, but a fundamental grasp will be all that is needed to digest some points I am making.

A digital recording might be made that would resultantly measure at around -20dB LUFS overall. Perceptually speaking, this would be a quieter recording and it would likely have a broad dynamic range with some larger peaks or transients happening well below digital clipping point. Another digital recording might be made that measures around -9dB LUFS. Think of a rock band. Perceptually speaking, the rock band's recording would be louder, it would have less dynamic range and its peaks would frequently fall just below digital clipping point. If both recordings were

delivered to *Spotify* then, via normalisation, the streaming app could apply positive gain to the first recording and negative gain to the other recording. Essentially, the first recording might be turned up, the other turned down, and both would be algorithmically level matched. As a result of this, the rock recording would no longer sound as loud, and it would not stand out in the way that was originally intended when played back-to-back against other more dynamic releases. We can arrive at these assumptions through *Spotify*'s (2021, online) own explanation of their current loudness adjustment process:

> We adjust tracks to -14 dB LUFS, according to the ITU 1770 (International Telecommunication Union) standard.
>
> - We normalize an entire album at the same time, so gain compensation doesn't change between tracks. This means the softer tracks are as soft as you intend them to be.
>
> - We adjust individual tracks when shuffling an album or listening to tracks from multiple albums (e.g. listening to a playlist).
>
> Positive or negative gain compensation gets applied to a track while it's playing.
>
> - Negative gain is applied to louder masters so the loudness level is -14 dB LUFS. This lowers the volume in comparison to the master - no additional distortion occurs.
>
> - Positive gain is applied to softer masters so the loudness level is -14 dB LUFS. We consider the headroom of the track, and leave 1 dB headroom for lossy encodings to preserve audio quality.
>
> Example: If a track loudness level is -20 dB LUFS, and its True Peak maximum is -5 dB FS, we only lift the track up to -16 dB LUFS.
>
> Premium listeners can also choose volume normalization levels in the app settings to compensate for a noisy or quiet environment
>
> - Loud: -11dB LUFS

> Note: We set this level regardless of maximum True Peak. We apply a limiter to prevent distortion and clipping in soft dynamic tracks. The limiter's set to engage at -1 dB (sample values), with a 5 ms attack time and a 100 ms decay time.
>
> - Normal: -14dB LUFS
>
> - Quiet: -23dB LUFS

In the same article, *Spotify* present 'mastering tips', aimed at helping artists or engineers avoid submitting recordings that would ultimately incur algorithmic level adjustments as per the above. The company state:

> Loudness normalization means we don't always play your track at the level it's mastered.
>
> - Target the loudness level of your master at -14dB integrated LUFS and keep it below -1dB TP (True Peak) max. This is best for lossy formats (Ogg/Vorbis and AAC) and makes sure no extra distortion's introduced in the transcoding process.
>
> - If your master's louder than -14dB integrated LUFS, make sure it stays below -2dB TP (True Peak) to avoid extra distortion. This is because louder tracks are more susceptible to extra distortion in the transcoding process.

In 2018, Ian Shepherd introduced a free service named *Loudness Penalty*. Shepherd is a mastering engineer and known advocate for preserving wider dynamic ranges in recorded music. *Loudness Penalty* exists via a website and it was developed in collaboration with *MeterPlugs*. Still today, *Loudness Penalty* allows users to drag then drop their exported audio onto the site, and in doing so, see whether or not their song would be turned down by a streaming service. This is a useful tool for anyone who masters audio and anyone keen to avoid level adjustments, or 'loudness penalties', as a result of whichever normalisation scheme is adopted by a service. All streaming services seem to administer their own methods of normalisation, and these have been known to change from time to time.

Loudness Penalty also exists in plugin form, meaning that loudness penalties can be monitored without engineers leaving their digital audio workstation (see *MeterPlugs* 2021).

From the engineer's perspective, normalisation schemes and loudness recommendations might be thought of as a double-edged sword. In a positive sense, the ongoing integration and adoption of these things could see less professed loudness war catastrophes and thus less blame directed at whoever mastered the recording (see Devine 2013: 165). There could also be less pressure on the mastering engineer to conform to wishes that contradict their own judgment of what constitutes high fidelity music - if a client wants it 'loud' then they need only be told that *Spotify* does not. Of course, there is also money to be made. Many engineers charge extra to deliver digital masters that are optimised for streaming - their normal delivery will likely be 'Red Book' standard audio. Masters optimised for streaming might well just be delivered in the required sample rate or bit depth, but they could also be rendered so as to conform to a target loudness level and lower 'true peak' where necessary.

Despite some clear benefits associated with modern normalisation schemes and loudness recommendations, some might say that mastering music within a systematic and technical confine constrains the engineer's freedom to enact particular creative decisions. Loudness guidelines, followed stubbornly, could begin to standardise the dynamic aspects of all modern recorded music – that which gets hosted on digital streaming platforms at the very least. This is a problem if, from a creative perspective, there are recordings that sound great when conceivably crushed to death and there are other recordings that benefit from maintaining some wider dynamics. Most crucially, there are engineers who feel that recordings have their own perceived 'sweet spot' in terms of level - that this sweet spot is to be determined intuitively through mastering and to remain consistent across all digital versions, regardless of where the recordings are distributed. Mastering engineer Jay Hodgson (2020: 231) stated, "I like a lot of obnoxiously loud records. I also like a lot of records that are so dynamic they could easily cause a car crash if listened to without prior experience."

In April 2018, mastering engineers Sam Moses and Matthew Garber of *The Attack & Release Show* released a podcast episode titled, 'LUFS and Normalization' (see Moses & Garber 2018a). This formed a wise critique of the LUFS system and how it had been rolled out across streaming platforms relative to the time of discussion. The episode would encourage listeners to question numerous scientific methodologies, and general conclusions drawn up about how humans perceive sound, that ultimately lead to the design of LUFS – something originally intended for television and radio broadcast, thus not for its current application. Through the episode, listeners also learn that although LUFS might represent a step taken positively towards tackling loudness discrepancy, improvements could still be made to its design and integration. On the one hand, manufacturers and developers of certain metering plugins have benefitted from wider adoptions of the LUFS system in its current form - it would be in their best interests to continue advertising its alleged benefits. On the other hand, engineers might uphold that changes are required to better serve the music. Towards the end of the episode, Moses stated, "There's not enough people in the industry right now fighting for what we're talking about, and what we're talking about is so important. […] We're trying to get people's music to sound the best it can across all platforms. Like, that's what you are I are basically arguing for." With this, his co-host Garber said, "If something doesn't change, it's literally because […] we've gone too far with it like this. That's the only reason it won't change" (01h16m05s). The stances taken by Moses and Garber had reminded me of a moment in my interview with Simon Heyworth. As I set out in *Chapter 6*, Heyworth had remembered a much earlier point in his career where he adopted analytical perspectives and willingness to engage in intensive phenomenological assessments of emerging technological standards. The engineer had been committed to quality. Moses and Garber, like Heyworth, conveyed a dedication to promoting sonic excellence through recorded music production.

Moses and Garber acknowledged, as I would later do so myself, that various streaming services seem to administer their own unique methods of loudness normalisation. The methods adopted by each service have also been known to change from time to time – hence a master 'optimised' for release on a platform in 2021 may no longer be optimal on that same platform in 2022. As is the case, like other mastering engineers, Moses and Garber might approach digital mastering

with an awareness of the LUFS system and various models of loudness normalisation, but with a foremost goal of performing whatever processing is required to bring recordings up to a perceived state of completion. I suggest that a 'loudness penalty', or being turned down on a streaming service, might not be so noticeable as implied. Moreover, certainly in the case of *Spotify* at present, listeners can have the option to disable normalisation.

In spite of all this, the engineer's objective to press on and just a master great sounding recording regardless could be hampered if clients are still made anxious by the LUFS system or knowledge base articles such the one authored by *Spotify*. Although clients might wish for their music to adhere to a streaming service's recommendation, they may not actually understand the technical underpinnings or sonic implications of the recommendation itself. Garber said, "I'm giving people a lesser-than product because of this system and because they are so uneducated on it, and they don't care because they're concerned that their music won't play back loud enough, back-to-back with a song on Spotify" (43m00s). In October 2018, Moses and Garber released a 'LUFS & Normalization FOLLOW-UP' episode (see Moses & Garber 2018b). There, Garber addressed his audience of engineers and advocated, "Set it and forget it. Get it to where you believe it is breathing the best. […] Wherever that music feels most alive, is where you should set it and forget it. And that's literally my two cents on it" (15m48s). Slightly later on in the episode, he posed, "The moment that someone besides the artist tells you how to listen to the artist's music is when I start to have a problem" (19m55s). Later on again, and amidst some balanced discussion around the topics in question, co-host Moses stated, "We serve the artist and not the distributor. […] I don't want people to be scared to make their music more compressed or, you know, how they want it because their music may or may not be turned down by a certain amount at this current stage, when *Spotify*'s changed their playback, like, four times in the last two years" (45m00s).

There are clearly some skilled professionals who would question methods of loudness metering and standardisation supported by digital streaming platforms, distributors and software plugin manufacturers (see also Macciochi 2021, online). On the other hand are those who more readily embrace certain methods. The

variety of stakeholders involved when it comes to loudness standardisation make these debates complicated. Going forward, mastering engineers could be a powerful voice for challenging or determining how the dynamic properties of recorded music are regulated for standardised playback on digital platforms. Studying the mastering engineer and their influence on these sorts of changes would advance understandings of users as agents for technological development.

Discussions around loudness normalisation have underscored the importance of engineers maintaining cutting-edge expertise whilst digital technologies and innovators help give rise to various other standards. Newly proposed practices for mastering and standards for content delivery will demand the same expertise going forward – as Sterne and Razlogova (2021: 2) stated, “Mastering engineers mediate between art and formats”. They said, “Every media text bears the mark of its anticipated modes of circulation and audio is no different.” The mastering conference I attended in 2018 reinforced my understanding of the mastering engineer as an agent for technological development in the realms of modern formats and standards for digital music consumption. The conference showed that innovators and research and development teams converse directly with engineers to promote products or solicit feedback through such events. The relationship between innovator and engineer came across as one based on mutual respect and understanding for where their respective areas of expertise either cross or vary. While software engineers, audio design experts and music technologists might be familiar with the mastering process, there is yet a need for them to consult those whose business it is to engage directly with artists every day and whose business it is to work creatively with various tools of the trade. All this offers another way in to understanding how mastering engineers and their expertise will remain relevant in the years ahead.

*

Extrapolating from the past, it is safe to say that numerous and varied standards for digital audio will be proposed or grow out of infancy over the coming years. Their level of adoption will likely depend on various social and cultural factors - such was the case with 5.1 surround sound and ‘Super Audio CD’ (SACD). Of the many proposed or recently developed formats, two of the bigger names had been

discussed at the conference. Bob Stuart presented a technical paper on his 'MQA' (Master Quality Authenticated) audio codec. The conference schedule read, "MQA technology is licensed by labels, music services, and hardware manufacturers worldwide and so, at some point, you may be asked to deliver or work on an MQA project."[1] After Stuart's presentation to a mixed audience, including some well-known mastering engineers, an ensuing discussion would reinforce how I have already described the relationship between the culture I researched and innovation teams who work with digital audio.

In order for us to understand MQA, we should first remember how the likes of *Spotify* or *Apple Music* began offering musical content via lossy compression streams. *TIDAL* and a few other services consequentially offered streamed content at CD quality, hence better fidelity. *TIDAL* and others also began offering streamed content at even higher resolutions and '*TIDAL* Masters' would eventually use MQA to offer up a library of 'master quality' audio. Although major record labels have adopted the format, I have found that MQA itself is not so easily explained to laypersons. Roberts (2021a, online) offered a succinct outline of the format for readers of *What Hi-Hi*. The following excerpt demonstrates how MQA is described to high fidelity audio enthusiasts:

> [MQA is] a method of digitally capturing and storing original master recordings as files that are small and convenient enough to download or stream, without the sonic sacrifices traditionally associated with compressed files.
>
> MQA claims its tracks use a similar bandwidth to that required for CD-quality streams. So if you're able to stream Tidal's hi-fi tier with relative ease then the new Tidal Masters tier using MQA shouldn't be a problem.
>
> Rather than being a new file type to sit alongside FLAC, WAV et al, MQA files can instead be packaged inside any lossless container such as FLAC, WAV or Apple Lossless. You will need compatible hardware, such as a

[1] See *Appendix C*

> music streamer or portable music player, or software such as the Tidal desktop app, to decode the MQA files.
>
> And this is no pie-in-the-sky promise; the hardware is available. And, now we're some years into its existence, there's plenty of it.
>
> If you don't have […] hardware, then you can still play Tidal's "millions" of Masters tracks through the Tidal desktop, Android and iOS apps, which can decode and play them through your, say, phone or Macbook.
>
> These apps can complete the first 'unfold' of MQA file decoding, outputting streams to a maximum of 24-bit/96kHz. However, the only way to entirely unpackage an MQA file for playback, and therefore give you a more accurate representation of the file, is by pairing the app with a MQA-compatible product […] that takes the decoding process away from the software (the Tidal app).

More can be understood about MQA via the same article (see also *MQA Ltd.* 2020, online) - a detailed examination or comprehensive appreciation of the format is not needed here. It is however relevant to know that this is a format engineers will be watching closely in the coming years.

Back at the mastering conference, Guenter Loibl of *Rebeat Innovation GmbH* presented a technical paper on ‘HD Vinyl’ – a concept in development then and still in development today. The conference schedule described *Rebeat*’s innovation as “a next general vinyl technology that offers a universal improvement to the industry’s most classic format.” Addressing the same mixed audience, Loibl tackled some challenging and skeptical questions in regard to the technology as it appeared through earlier stages of development. Questions were most certainly raised by some who appeared familiar with or involved in traditional forms of disc cutting. Detailed forays into the art and culture of disc cutting fell outside the scope of my research. Nonetheless, we can acknowledge that there is a value in mastering engineers keeping abreast of developments around new concepts related to vinyl manufacture. The success and popularisation of HD Vinyl would supposedly result in higher quality records for the consumer and eliminate the mastering engineer’s

need for a specialist lathe designed to cut lacquer. The most sought out of these lathes are long out of production, thus costly and not to mention scarce or scarcely working.

When mastering for HD Vinyl, some of the parameters a mastering engineer works with on a lathe would be available to them via a unique software package. The proposed software would allow engineers to convert high-resolution audio into 3D topographies and listen to how the record might sound. Through creating 3D topographies, engineers would eliminate various production steps, including lacquer cutting on a lathe, all of which remain necessary at this time. The reason why various production steps would be eliminated is because topographies can be used to produce physical, laser-cut stampers directly. As has traditionally been the case, 'stampers' are used to press large batches of vinyl records at the manufacturing site. Currently, this happens after the initial lacquer cutting process, then the creation of a 'father' copy and a 'mother' copy - the latter of which is recast and electro-plated to produce the stamper, or 'son'. Alongside numerous other suggested benefits, HD Vinyl would essentially be more efficient and eco-friendly. Crucially, the processes involved would still require experienced mastering engineers with broad knowledge of vinyl (see *Rebeat Innovation GmbH* 2021, online).

In April 2021, Scott Hull hosted an interview with *Rebeat* software designer Andreas Wagner via the *Masterdisk* channel on *YouTube*. Hull and Wagner (2021, online) shared some varied discussion around the development of HD Vinyl and the associated 'Perfect Groove' software. Hull expressed his ongoing support for the format, making it clear that the pair had previously conversed and pooled expertise. For me, the interview substantiated that mastering engineers are to be considered as agents for technological development in audio. The interview exists as a fine example of how innovators or research and development teams might converse directly with engineers in the field. I have already explained that while software engineers, audio design experts and music technologists might be familiar with the mastering process, there is yet a need to consult those whose business it is to engage directly with artists everyday and work creatively with various tools of the trade. Midway through the interview, Hull said:

> It looks like I'm a lacquer cutting engineer, and I'm really getting behind endorsing a product that's gonna potentially replace the work that I do. But it's really kinda far from that. It would be more like a brand like *Kodak* or *Smith Corona* or something, you know, that sees a new technology coming and says, you know, 'What can we do with that that's even more interesting than what we're doing now?' Certainly the lacquer [cutting] lathe will exist. That process is well heeled and a lot of material is gonna go through it. And we're also anticipating, from what I've been told from *Rebeat*, that the cost of [HD Vinyl records] will be substantially higher than conventional records. Or could be, at least initially. But we feel that it's worth it, [*Rebeat*] feel that it's worth it because of the advantages in sound quality, and it's gonna be one of those things that, yeah, you won't know until you hear it… Until the reviewers put their words behind it and such. But I don't really think the lacquer cutting process is going away. I really see this as a technological sidebar that kinda moves the whole process along. If HD Vinyl establishes a new standard then either the […] other ways of making records are gonna have to catch up or eventually give up trying. But I like to be on the fast train and see where it's going.
>
> (25m14s)

Those involved or interested in mastering would have recently witnessed some other new formats and innovations gain a footing. Right now, with much focus being placed on immersive audio, the likes of '*Dolby* Atmos' and *Apple*'s 'Spatial Audio' features remain central to a lot of discussion. Mastering engineers Darcy Proper and Thor Legvold (2020: 20) delivered a chapter where they explored "the realities of working in immersive audio and [shared] the experience and advice of pioneers in this developing field". The engineers said, "Immersive audio allows creative people to break free from the constraints of the 'stereo straightjacket' that has existed since the 1950s, allowing much greater artistic freedom" (22). Their chapter serves as a helpful way into understanding how to master for immersive formats.

I have noted that Atmos, developed by *Dolby Laboratories, Inc.*, began to gain traction back in 2012, with the object-based audio format first being introduced and

installed into cinemas.[1] Similar in some ways to the 'Auro-3D' format developed by *Auro Technologies*, Atmos began to set a new standard in what had been referred to as surround sound. Atmos took 5.1 a step further by incorporating 'height' channels to create more precise and three-dimensional listening experiences. The likes of specific Atmos-enabled receivers, ceiling speakers or dedicated Atmos-enabled speaker systems featuring up-firing drivers would be required to enjoy or work with the technology in listening spaces. Many of today's portable playback devices are Atmos-enabled to support a more precise three-dimensional listening experience on-the-go and via the likes of *TIDAL* or *Amazon Music*. Engineers with sufficient monitoring systems or, less ideally, headphones can use the '*Dolby* Atmos Production Suite' or '*Dolby* Atmos Mastering Suite' software to place various channels of audio at specific points in a virtual space. To make use of the more advanced mastering suite, engineers would require a separate, approved and dedicated Mac or Windows system for rendering. This dedicated system would connect to the engineer's main computer and DAW via 'Dante' or 'MADI' interface connection. Currently, there is no requirement for engineers to operate out of 'certified' studios when working with Atmos for music. Whilst this does suggest that mix and mastering engineers can work with Atmos from wherever in the world, the cost of doing so is far from cheap. An Atmos loudspeaker and rendering setup forms a large investment. Moreover, the time it takes to create deliverables would result in clients needing to pay a premium. *Production Expert* (2021, online), who produces varied content for those engaging in audio and production, suggested the following:

> Yet again it seems that the music production community is being exploited while big corporations make a fortune. Atmos is a fantastic creative opportunity that Dolby has developed for us to add *value* to our work.
>
> Let's work together as a professional community to make sure we're not the ones left picking up the bill while others benefit. That's not an opportunity, that's a scam!

[1] My understandings of the Atmos format were informed via *Dolby Laboratories, Inc.* 2021, online; *Mastering The Mix* 2021, online; Proper & Legvold 2020; Roberts 2021b, online; *Wikipedia* 2021i, online.

Moses and Garber discussed *Apple*'s 'Spatial Audio' in a June 2021 episode of *The Attack & Release Show* (see Moses & Garber 2021b). Both engineers conveyed how, although *Apple* partnered with *Dolby,* Spatial Audio should not be considered the same as Atmos. The podcast prompted me to question whether the likes of Spatial Audio might actually offer something greater in every instance, sonically speaking, as could be interpreted through much of the marketing. Some may say that well-recorded, mixed and mastered songs played in stereo sound better than poorer productions heard via the proprietary Spatial Audio algorithm. Nonetheless, we can anticipate that other streaming platforms will seek to roll out their own equivalents of Spatial Audio, and there will be some variance in approaches used for engendering multi-dimensional listening experiences through upmixing stereo.

There are currently a lot of unknowns surrounding Spatial Audio and, where recorded music is concerned, other more established immersive audio formats such as Atmos are still in early stages of adoption. Questions might certainly be raised regarding whether immersive audio could be of greater benefit to streaming platforms than to artists. I will pose again that rates of consumer adoption will likely depend on various social and cultural factors. We might ask, 'does the consumer care about immersive audio?' Older generations of mastering engineers will have experienced the emergence of immersive formats purported to overtake stereo in the past, only to find that few of them caught on in a big way. Proper and Legvold (2020: 40) would contest that "When done right, immersive audio is an even greater improvement over stereo than stereo was over mono and", they add, "it's our contention that immersive is the future of audio, despite the music industry being rather late to the party." I conclude that the development and implementation of immersive audio is something else that mastering engineers will be paying close attention to and intervening with going forward.

*

In rounding up a consideration of the future of mastered audio in society, I cannot disregard other discussions and studies that have formed around services such as *LANDR* and *eMastered*, each of which are gaining popularity for offering low-cost and automated stereo mastering via the Internet. These services all sprung to the fore alongside the ongoing development of standards for content delivery such that

I have detailed, and some detailed histories of *LANDR* specifically can be read via Sterne and Razlogova (2021). I have noted that the development and growth of big data, automated services, artificial intelligence (AI) and machine learning can be discussed in ways that position future digital technologies as a threat to particular forms of engineering work and what Birtchnell and Elliott (2018: 79) might describe as "'no-collar' jobs in creative industries". Collins et al. (2019) put forward their own study titled *Mastering 2.0: The Real or Perceived Threat of DIY Mastering and Automated Mastering Systems*. One mastering professional out of Collins et al's 21 survey respondents predicted that automated services "will consume 80% of most mastering studios [sic] client base within the next 5–10 years" (270). We could deduce that the professional had been referring to a particular segment of the market – Bitchnell and Elliott (2018: 83) had earlier reflected on the increased accessibility of digital affordances for music production and how this sparked "a wave of amateurs" that began offering "budget audio mastering services" towards the end of the 2000s. Bitchnell and Elliott argued, "AI competes with this bottom end of the audio mastering market since it has an advantage over many amateurs unable to create an effective listening space." In spite of all this, I support that such developments and growths pose much less of a threat when the job in question, regardless of where it takes place, is more widely understood and understood as creative (see also Collins 2019: 269-270).

Birtchnell and Whelan (2020: 245) concluded that the rise of automated mastering for digital audio has certainly evoked a discursive shift amongst mastering engineers. They explain, "AI engages in 'big data' sets, such that an AI music mastering service could adjust a particular piece of music relative to all the other music it has encountered. AI learns, and knows more than a human could. According to the marketing, AI has a formal, objective, quantitative understanding of how to get your music sounding the best, relative to (all) other music." Birtchnell and Whelan also stated, "To offset this phenomenon, audio mastering engineers turn to the 'human' aspects of their craft, through heightening their links to local creative scenes and genres and offering charisma and an 'experience'" (see also Birtchnell 2018). In the same publication, these scholars drew upon their own interview-based research to construct a vignette. This demonstrated how "audio mastering is shifting towards artistic and creative endeavour through the privileging of the performativity and

improvisation of mastering with tools that require haptic control and audible perception, akin to musical instruments within digital technology-mediated environments" (2020: 244). Birtchnell and Whelan positioned the adoption of analogue equipment as a resistance to digital software-based tools and automated services (244-5). Hodgson (2020: 232-3) recently implored his fellow mastering engineers to advertise their work, and not their technical expertise or equipment. He said, "The artistry of audio mastering is all we have left. And it's the best part of our job, as far as I'm concerned."

At the mastering conference, Piotrowska (2018) presented a technical paper titled *Objective and Subjective Evaluation of Automatic Mastering Compared to Mastering Engineer's Musical Product Creation*. Piotrowska had herself been motivated to explore the topic of 'automatic mastering', having observed the development and growth of over 15 different services offering low-cost alternatives to hiring a specialist engineer at the time. I myself have observed *LANDR*, *eMastered* and *CloudBounce* as essentially the three most popular or most talked about of these algorithmic and rule-based services at present. Each offers a varied pricing plan, and the likes of *LANDR* and *eMastered* require comparatively little knowledge of the creative or technical basics traditionally needed to master a recording. A user, say a musician or mix engineer, has to first upload their song for mastering. They might consequently be given access to a few options, 'styles' and highly simplified compressor or equaliser settings to hear and choose from. The user would be able to compare any digital processing side by side with their original and reference mixes (see also Collins et al. 2019: 262; Sterne & Razlogova 2021: 10). We can acknowledge how all this contravenes the very nature of mastering as a process undertaken by those who have made it their discipline *only* to master, rather than mix recordings, in a familiar space and with familiar equipment. Via the *LANDR* (2021, online) website, prospective users are introduced to 'Synapse', described by the company as "an evolution in music mastering." *LANDR* state:

> With years of research, 19 million mastered tracks and over 1 million hours of music, Synapse is the most sophisticated AI-powered mastering engine yet.

> Improved clarity, smarter compression and superior loudness give your music instant, professional polish at a price that works for your budget.

In the introduction to my thesis I cited Shelvock (2017: 201), who stated, "phenomenological evaluation of a record's timbral and dynamic configuration informs every audio mastering session." He added, "An exception may be LANDR's automatic mastering service. However, this service has yet to be accepted within elite production circles." Shelvock further added, "amateur recordists and musicians also avoid [*LANDR*], often commenting that humans simply do a better job." Birtchnell (2018: 14) has said, "Since LANDR's results are not yet on a par with 'professional' level audio mastering (judged, for instance, by how many songs mastered by LANDR end up on popular music charts) there is still a way to go until AI properly challenges human careers or indeed involves professionals in this algorithmic culture as a convivial alternative to taking their clients."

My own research has reinforced that professional mastering engineers still remain in high demand. Their expertise is recognised in ways that ensure them healthy flows of work in spite of somewhat standardised and sonically questionable offerings from *LANDR*, *eMastered* or *CloudBounce*. Collins et al. (2019: 263) stated how, at their time of writing, "LANDR cannot differentiate between problematic high frequencies caused by vocal sibilance or a crash cymbal." In spite of all this, these services do remain a contentious subject. By their very existence, and in light of their ongoing development, debate as to whether or not mastering could be automated and standardised to much greater degrees of uptake or appreciation in the future remains open. Yet, when mastering is understood as creative work, a musical feat in and of itself involving humans who navigate their culture in the ways identified through this thesis, then the suggestion of processes being fully automated or standardised in the future holds much less weight.

Reflecting on their own research activities, Collins et al. (2019: 270) stated, "It is extremely unlikely that [digital] technologies will entirely replace and eliminate professional roles such as that of the mastering engineer." They also said, "LANDR will not usurp Abbey Road, but it is not designed to. Rather it provides an alternative for musicians, especially those constrained by budget, as the price point and fast turnaround are compelling." Sterne and Razlogova (2021: 3) declared, "Musicians

with no financial backing, or who are churning out material, may find LANDR to be a cost-efficient solution. Other users and observers, including some audio professionals, do not." I myself propose that we might marvel at the challenges overcome and growths being made on the way to simplifying or making accessible the process of mastering through automation and algorithm. Yet, a continuation of these engineering achievements may well do little to gratify audiences who yearn to see artistic accomplishment through the production of music they enjoy. In a world where there are synthesizers and drum machines, there are listeners who enjoy acoustic guitars and singers who stay clear of auto-tune. In tomorrow's world of driver-less vehicles, there will be some who still wish to grip hold of the steering wheel. Mastering, aside from being a creative industry, is a people industry and there are many who cannot stand self-service supermarket checkouts. They enjoy life's conversation.

Big data, automation, artificial intelligence and machine learning might actually be of service to the mastering engineer, if certain technologies are developed and harnessed in positive ways going forward. Innovation in these areas might actually expand the realms of possibility for mastering engineers, and artificial intelligence or machine learning could lead to more advanced forms of audio processing, restoration, correction and enhancement. Making use of these innovations in practice might still require the synergy and creative interjection of adept engineers. Before applying advanced or AI-led processing, the engineer might still perform phenomenological assessments and judgments that are contingent on taste and a few socially negotiated points of reference - all of which are fluid and correlated to various cultural phenomena. Another positive way of embracing big data, automation, artificial intelligence or machine learning is from the perspective that innovation in these realms can lead to improved working lives and reductions in process complexity for those operating in whichever industry. The likes of automation and AI should not necessarily be deemed nefarious or threatening, and they should not necessarily be associated with unhealthy or dystopian capitalism. Future innovation in these areas might help and encourage mastering engineers to reinvent what they do, or carry out their everyday responsibilities in better ways. It might lessen their need to engage in the less creative of tasks, thus allowing them to dedicate more fully to their artistry and take on greater volumes of clients who

would be satisfied by faster turnarounds. I suggest that these assertions would align with some conclusions brought forward through Birtchnell's (2018) own research into AI in mastering. Birtchnell's conclusions would also align with some of the wider arguments underpinning my thesis. In his paper, Birtchnell positioned mastering as "affective labour" (4) and a "creative culture" (7). He concluded, "AI in the cultural industry of audio mastering will need to strive toward human-centred algorithm design, encompassing both critical listening and creativity, in collaboration with humans rather than through attempts to replace them" (13; see also Tsiros & Palladini 2020: 400) Birtchnell also reflected, "Diverting from estimations of the displacement of labour through simulation of human skills, I instead highlighted the ability of humans to forego or augment aspects of orthodox practice in order to accommodate alternative methods of performing labour effectively" (14).

Christian Steinmetz (2021a, online) is a PhD candidate at *Queen Mary University*'s *Centre for Digital Music* in London. He researches "applications of machine learning for audio signal processing with a focus on high fidelity audio and music production". In blog post preceding his appearance on a May 2021 episode of *The Attack & Release Show*, Steinmetz (2021b, online) expressed that "automated audio engineering tools (e.g. LANDR) are a net positive for the [audio engineering] field, as these tools improve the baseline level of quality of productions, which in turn pressures artists to innovate and differentiate themselves for these 'algorithms', or potentially find ways to break them in interesting ways." Steinmetz acknowledged that various forms of computer-aided or automated art have been met with criticism (see Taylor 2014), and he positioned "the birth of photography as a parallel to what may unfold as our audio/music production tools become more powerful." Steinmetz (2021b) quite aptly explained:

> The camera removed a significant amount of prerequisite skill in creating visual artifacts. At this time, some painters felt threatened by this technology, and other strongly criticized it, claiming that photography was not an art form. These criticisms are not wholly different from those of automated music production that may be heard now. However, today, we see that this is a near-sighted view. Photography is an art form with significant depth, and is now widely appreciated in the world of art. […]

> In the face of photography, painters had to innovate, and we saw the abandonment of realism in favor of other forms where the camera struggled, which led to impressionism, expressionism, surrealism, cubism and others

Hertzmann (2018) claimed, according to Steinmetz (2021b), "even as the role of technology increases in artistic works, art is defined by social agents, i.e. the people behind those machines who set them into motion." Looking to the future, I myself suggest that we can imagine even greater forms analogue modeling in the realms of digital signal processing design. We might too imagine systems that gradually 'learn' a mastering engineer's creative decision-making processes or sense of taste. An intelligent system could be exposed to a specific engineer's dealings with a huge and varied spectrum of source audio over time. As a result, the engineer's unique creative aptitudes or sonic signatures could be immortalised and monetised. This would make simple 'artist presets' a thing of the past. Birtchnell and Elliott (2018: 83) described how "celebrity" US mastering engineer Colin Leonard launched his own automated analogue mastering service named *Aria*. Birtchnell and Elliott described the online service, still active today, as "a fully automated system based on an algorithm, which processes sound through [Leonard's] studio's signature toolchain, returning the master to clients within minutes and featuring no human intervention or listening." In spite of all this, I attest that anyone with an interest in the craft will not be deterred from learning to master and self-actualising as a creative expert through hands-on work. I often think back to the first interview I conducted for my research. The interview had been with Robin Schmidt, and I concluded by asking the engineer why he chooses to master audio for living. His response was, *'Oh, because it's the best job in the world.'* Birtchnell (2018: 14) also and aptly posed an idea with which I wholeheartedly agree. He said, "If creative AI emerges of a quality indistinguishable from human levels of achievement the ramifications for societies would be so significant that upheaval in the music industry would pale in comparison to other aspects of human experience."

AES UK Mastering Conference 2018 22-23 September 2018

Day	Program	Speaker	Topic	Rooms	Length
Saturday					
10:00	Registration & Coffee		Welcome packs!	Regent St. Foyer	
10:50	Opening	Conference Chair	Opening statement	Fyvie Hall	
11:00	**Keynote 1**	**Guenter Loibl (Rebeat)**	HD Vinyl, a next general vinyl technology that offers a universal improvement to the industry's most classic format.	Fyvie Hall	45 mins
11:45	**Technical Paper Presentation**	Friedemann Tischmeyer	"Transient Vitality" and Current Loudness Measurement Metrics - A practical overview of the range of existing dynamic metering metrics will be presented, while highlighting the advantages and disadvantages of each method referenced to current best practices. "Transient Vitality," the dynamic structure of transient events, and the limits of TPL when considering Transient Vitality, will also be discussed.	Fyvie Hall	20 mins
12:05	**Technical Paper Presentation**	Mike Exarchos (aka Stereo Mike)	Exponential Spatial Merging as Sample-based (Re)Mastering in Contemporary Hip-Hop Practice. This research focuses on the merging of past and present spatial illusions exploring how hip-hop producers negotiate the dimensions of 'depth', 'height' and 'width' imprinted onto masters used as sampled sources,	Fyvie Hall	20 mins
12:25	Lunch			Deep End	
13:30	**Sponsor Technical Paper Presentation (MQA)**	**Bob Stuart (MQA)**	MQA technology is licensed by labels, music services, and hardware manufacturers worldwide and so, at some point, you may be asked to deliver or work on an MQA project.	Fyvie Hall	30 mins
14:00	**Sponsor Technical Paper Presentation (PSI Audio)**	**Roger Roschnik (PSI Audio (AVAA))**	The application of low frequency absorption by velocity control for mastering and post production facilities	Fyvie Hall	30 mins
14:30	**Sponsor Technical Paper Presentation (Prism Sound)**	**William Rowe (Prism Sound)**	Prism Sound Vetfile - Explanation of it's essential technicalities, whilst demonstrating the potential value that this application has to offer the mastering community.	Fyvie Hall	30 mins
15:00	Coffee & Networking (Trade Stands)			Deep End	
15:25	**Keynote 2**	**David Bell (Whitemark)**	Aspiration is to bring together all aspects of technical and environmental design from the very beginning of each project so that all influences are given the correct balance from the outset. This key philosophy supports every project undertaken.	Fyvie Hall	45 mins
16:10	**Technical Paper Presentation**	Rob Toulson, Justin Paterson & Russ Hepworth-Sawyer	Mastering Music for Multi-Stem and Interactive Applications.	Fyvie Hall	20 mins
16:30	**Technical Paper Presentation**	Magdalena Piotrowska	Objective and Subjective Evaluation of Automatic Mastering Compared to Mastering Engineer's Musical Product Creation.	Fyvie Hall	20 mins
16:50	Coffee & Networking (Trade Stands)			Deep End	
17:15	**Q & A with Darcy Proper**	**Darcy Proper (Mastering Engineer)**	Over the years, Darcy has been honoured with 4 Grammy awards and 10 nominations and has won several other awards for her work. She has had the pleasure of mastering historical reissue projects for such prestigious artists as Billie Holiday, Louis Armstrong, Frank Sinatra, Tony Bennett, Dave Brubeck, Stephen Sondheim and Johnny Cash.	Fyvie Hall	45 mins
18:00	**Panel Discussion**	Q & A Panel hosted by Rob Toulson	Guenter Loibl (Rebeat), Bob Stuart (MQA), David Bell (Whitemark), Darcy Proper (Mastering Engineer), Crispin Herrod Taylor (Crookwood)	Fyvie Hall	45mins
18:50	**Wine Reception in Regent St. Foyer**		Networking opportunity and Acustica Audio plugin give away!	Regent St. Foyer	60mins
20:30	Close				

Cont...

AES UK Mastering Conference 2018 22-23 September 2018

Day	Program	Speaker	Topic	Rooms	Length
Sunday					
09:30	Registration & Coffee			Regent St. Foyer	
10:00	**Technical Paper Presentation**	Dr Andrew Bourbon	Incorporating Mastering Into A Contemporary Music Technology Curriculum	Lecture Theatre	20 mins
10:20	**Technical Paper Presentation**	Alexander Hinksman	Drawing from doctoral research and interview, this paper explores the creative identities of mastering engineers and how these constructions evolved from the mid 20C onward into the present. It studies how practitioners depict their shift from procedural 'disc cutting' practices, towards more creative forms of mastering in the digital age.	Lecture Theatre	20 mins
10:40	**Technical Paper Presentation**	Stephen Bruel	Remastering Sunnyboys - The emergence of digital audio production technologies, enhanced signal processing techniques and commercial demand has contributed to older analogue recordings being remastered and re released. In the process, this has transformed the traditional technical role of mastering and/or remastering to a more creative one	Lecture Theatre	20 mins
11:00	Coffee & Networking (no trade stands)			Deep End	
11:30	**Keynote 4**	**Crispin Herrod Taylor (Crookwood)**	"How to avoid being disrupted, and still be Mastering in 5 years' time" - We're at a turning point for mastering, with continual price and market pressures, and now finally the rise of AI. Crispin HT talks about the background for this change, assesses the dangers, and suggests how mastering engineers can isolate themselves from the oncoming and creeping storm.	Lecture Theatre	45 mins
12:15	**Lunch**			Deep End	
13:15	**Sponsor Technical Presentation (Dangerous Music)**	**Mike Wells (Mastering Engineer at Mike Wells Mastering)**	Future of Digital delivery for Mastering and Mixing Engineers. Based in Los Angeles, California - Mike Wells began his career in mastering in the late 90's, forming Mike Wells Mastering in 2001. An early adopter to audio metadata, Mike was asked to join the Board Of Governors for the NARAS (Grammy) organization to help initiate metadata efforts in 2007. A long standing AES member, Mike has served both as President for the Los Angeles AES chapter, as well as Chairman of Workshops for numerous AES Conventions.	Lecture Theatre	45 mins
14:00	**Keynote 5**	**Mike Cave (Mastering Engineer at Loft Mastering)**	Working with stems - blurred line from mix to master.	Lecture Theatre	45 mins
14:45	**Coffee & Networking (no trade stands)**			Deep End	
15:15	**Q & A with Mandy Parnell**	**Mandy Parnell (Mastering Engineer at Black Saloon Studios)**	Hosted by Katie Tavini (Mastering Engineer)	Lecture Theatre	45 mins
16:00	**Close.**				

(Braddock et al. 2018)

Appendix D: Glossary of Technical Terms

5.1 surround - 5.1 denotes five channels of full spectrum audio, and one channel of lower frequency audio. Playback systems use a front left, front centre, front right, surround left and surround right speaker. A subwoofer speaker is dedicated to the lower frequency audio channel.

Bit depth - "The number of binary bits used to digitally store amplitude measurements of an analog waveform" (Shelvock 2017: 20).

Checksum - "A checksum is a small-sized block of data derived from another block of digital data for the purpose of detecting errors that may have been introduced during its transmission or storage. By themselves, checksums are often used to verify data integrity but are not relied upon to verify data authenticity" (*Wikipedia* 2021g).

dBFS - "Decibels relative to full scale (dBFS or dB FS) is a unit of measurement for amplitude levels in digital systems, such as pulse-code modulation (PCM), which have a defined maximum peak level. […] The level of 0 dBFS is assigned to the maximum possible digital level" (*Wikipedia* 2021h, online).

Harmonic distortion – "the addition of new tones to the audio signal. These distortion products occur at integer multiples of the original signal's frequency and are harmonically related to the original tone. When the signal is a single sine wave (tone) of frequency f1, harmonic tones are f2, f3, etc., at integral multiples of the original tone" (Wykes 2021, online)

Red Book - The 'Red Book' (1980) forms one of a series of 'Rainbow Books' that together set out the technical specifications for a variety of compact disc formats. The 'Red Book' sets out the technical specifications for 'Digital Audio Compact Disc.' Digital audio that conforms to Red Book standard will be 16 bit, sampled at 44.1 kHz (see Pohlmann 2011: 187-235).

Sample rate - “Number of times per second that samples are taken of an analogue signal in a [digital audio converter] (e.g. 44.1 kHz, 48 kHz, etc.)” (Borwick 2001: 608).

Transients - “high amplitude and short duration sounds that occur at the beginning of a waveform” (Shelvock 2017: 27).

Work clock - “Digital audio is represented by a series of samples, each one denoting the amplitude of the audio waveform at a specific point in time. The digital clocking signal — known as a 'sample clock' or, more usually, a 'word clock' — defines those points in time. When digital audio is being transferred between equipment, the receiving device needs to know when each new sample is due to arrive, and it needs to receive a word clock to do that” (Robjohns 2013b, online).