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The Mastering Engineer: Manipulator of Feeling and Time

Alexander Hinksman

Other contributors have responded to Mary Oliver's prompt with valuable considerations of the roles phonetics and their so-called 'felt qualities' play in the construction and performance of popular songs. These phonetics can have *pitch*, they can be delivered at a particular *loudness* and they can also contribute to a sense of *rhythm, meter* or *tempo* as the songs in which they reside play out over time. Neuroscientist Daniel Levitin (2008: 71; 111) defines these five parameters, along with *harmony* and *melody*, as the factors that structure sound into music. He argues that when the parameters are in a state of obvious and controlled flux, a listener's expectations are challenged and so a listener responds to the music on an emotional level (also see Ball 2010: 281-282; Clynes 1982: 27-29). With this concept in mind, it is therefore important to consider how, in the context of *recorded* popular music, all of this is reconfigured and finalised by 'mastering engineers'. In this sense, they shape the listener's emotional response to every major recorded music release heard at home, on the Internet, or through the airwaves.

This contribution will draw on my own experiences in music production and research, citing relevant technical literature where appropriate. It will first describe how, at the 'micro' level, the mastering engineer can affect the felt qualities of a vocal performance in a recording. "The vocal is the central element", explains *Stonebridge Mastering* owner Gebre Waddell (2013: 107). "Mastering is best performed with this in mind. The vocal quality almost never should be sacrificed." Secondly, this contribution will position the mastering engineer as an agent for controlling a vocal's "temporal oranigzation" [sic] - that which, at the 'macro' level, Negus (2012: 483) would argue is "fundamental to [music's] creation and reception".

Understanding Mastering

Anderton, Dubber and James (2012: 23-44) outline the recorded music assembly line that formed in the latter half of the 20th century; pre-production, tracking, mixing, mastering, through to manufacture at the tip of the funnel (also see Waddell 2013: 1). Taking these authors' outline one step further and envisaging the assembly line as a 'funnel' helps make sense of the impact mastering has on recorded music. Often, as is the case with many of the acts that reap major portions of recorded music industry revenue, the aforementioned processes are carried out in separate locations and by separate engineers, who identify as specialists in any of these fields. Audio mastering is typically understood by music listeners, industry professionals and mastering engineers themselves as the process of a single practitioner sonically fine-tuning, polishing and fixing a selection of recordings deemed 'ready' for release. The mastering engineer also prepares their metadata, their sequence on an album and also their relative volume, prior to distribution in a variety of formats (see

Anderton, Dubber and James 2012: 67; 73; Hepworth-Sawyer & Golding 2011: 241-244; Katz 2002: 11-12; Owsinski 2008: 5-8; Waddell 2013: 1-5; Wyner 2013: 1-8).

To offer a brief historical context, the specialist knowledge required to 'cut' master lacquer and transfer audio from tape gave rise to dedicated mastering engineers or vinyl 'disc cutters' in the mid 20th century (see Horning 2013: 71; 85; 111-114; Owsinski 2008: 4; Waddell 2013: 143; 194-197). Mastering then evolved from this 'electric age' practice, as Dubber (2012: 18-30) may term it, to a contemporary 'digital age' practice, owing to the introduction of compact disc in the 1980s and the later proliferation of portable digital formats. Yet, a recent resurgence in vinyl record sales has not left (and will not leave) the practice of 'cutting' a record redundant.

It is useful to consider the contemporary mastering engineer as a conduit and critic figure; the process of mastering a 'bridge' (Katz 2002: 11) or 'gateway' (Nardi 2014) between production and consumption. Esteemed mastering engineer Bob Katz (2002: 11, my emphasis) defines 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". To outline mastering in this way is to suggest that a mastering engineer's work should, in the interests of artistic integrity, *enhance* the felt qualities of recordings and vocal performances within these recordings.

Mastering can make an extreme, subtle or surgical difference to a recording. Furthermore, as Bregitzer (2009: 184) aptly explains, "there are no hard-and-fast rules" for mastering; "there is no standardized [sic] method of mastering", to also quote Gebre Waddell (2013: 3). Nevertheless, contemporary practice will encompass any of the analogue or digital signal processing phases in the simple list below (also see Katz 2002: 25-26; Owsinski 2008: 13-14; Waddell 2013: 8; Wyner 2013: 35-36).

- Harmonic simulation (tube or tape emulation)
- Equalisation
- Compression
- Stereo-field enhancement
- Digital limiting
- Dither
- Noise shaping
- Editing

(see Bregitzer 2009: 184)

Before considering the effect each processing phase can have on a vocal performance, it is crucial to stress that each phase should be considered optional rather than essential. My research findings would suggest that numerous engineers could take issue with the above and most certainly the suggested flow of signal, prior to 'digital limiting'. Nonetheless, my research has proven that contemporary signal flow will fundamentally comprise the above.

Anderton, Dubber and James (2012: 65) note how, according to Leyshon (2009), the music production industry has also disintegrated vertically. A mastering engineer can still operate in a dedicated or 'specialist' studio equipped with analogue hardware to carry out the above.

They may also operate in a project studio, a home, a bedroom or wherever laptop and user can work together. In part, this owes to recent advances in home computing and recording, algorithmic digital signal processing design, and Internet connection speeds. The signal processing phases are often carried out within software 'digital audio workstation' environments (see Bregitzer 2009: 186-209; Hawkins 2002; Wyner 2013: 9-13).[3]

This all demonstrates how, at the tip of the production funnel and for better or for worse, both specialist and amateur have agency to veneer recorded music industry output with their own distinctive sonic watermark. To quote Gebre Waddell (2013: 25):

Selecting and understanding the equipment [...] is part of what makes studios unique. [...] Some studios seek a balance between color [sic] processors and clean processors. [...] It is important to remember that while equipment is important, the greatest influence on the sound comes from monitoring, acoustics, technique and skill.

Through this and also my own extensive research findings, I argue that sonic and acoustic temperaments of both equipment used for mastering and rooms in which mastering takes place all together impress upon the felt qualities of recordings heard by music listeners (see also 26-72; Katz 2002: 75-82; Owsinski 2008: 13-32; Wyner 2013: 9-24). The engineer's capacity to interpret sound has just as much potential to impact on a recording, and this figure may today be a conceived specialist, a home recording enthusiast, musician or laptop owner. The concept of 'colour' will be explained later in the prose.

When understood in this way, it is extraordinary to consider that mastering, as Nardi (2014: 8) rightfully notes, has lacked substantial consideration from scholars. The existing stock of technical literature on mastering is comparatively sparse when compared to the abundance addressing 'music production' in a more general sense. Bregitzer (2009: 183) acknowledges that the so-called 'dark-art' of mastering "is most often shrouded in mystery" and also argues that "[m]any inexperienced clients may not even know that mastering a recording is required". Hepworth-Sawyer and Golding (2011: 241) state that mastering engineers "enjoy a 'dark art' status"; that "the guarded secret of mastering is kept behind closed doors in a cloak of mystery."

If music stirs our emotions and a vocal within a recording has so-called 'felt qualities' to aid with this, it is crucial that the process and the potential impact of mastering is understood. This contribution will now explain, in the simplest terms, how the lesser-known but critical process can resculpt a vocal delivery in a recorded popular song.

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[3] Stating that contemporary recorded music production has only now, for the first time in history, become an accessible or non-corporate convention would be problematic. Horning (2013) informs us that 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 would later embrace multitrack-recording. By 1932, home recording rose to a level of popularity that made "Radio-Craft [publishing] Home Recording and All About It" justifiable.

Manipulating Feeling

Observe the air-like qualities of the aspirated 'h' in 'hair'. 'Harmonic simulation' (implying that this is carried out in the digital domain) will emulate the tonal qualities, often termed 'the colours', that hardware devices such as tape machines can impress on an audio signal. This owes to their unique circuitry and design. Tube and tape emulation, or 'actual' tubes and tape, can be used to saturate and distort a recording to offer the scientifically destructive albeit artistically favorable effect (when appropriate) of generating harmonic content from the source (see Owsinski 2008: 15-16; 27; Waddell 2013: 26; Wyner 2013: 22-24). This may lessen the distinguished difference between existing high frequency aspirates and higher-frequency harmonics that subtly arise out of lower frequency vowel sounds, liquids and mutes. Emulations of these hardware devices also emulate their tendency to 'roll-off' high frequency 'air' - that which could be lost from 'hair'. They may also reduce the dynamic range of an audio signal's amplitude, as would a compressor (see Bregitzer 2009: 199-200; Waddell 2013: 45; 92-94; Wyner 2013: 19; 30; 81).

More typically, mastering engineers use 'equalisers' to alter the tonal balance of an audio signal within the range of human hearing. This is 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)

Consider the low and percussive quality of 'b' in bring or 'p' in picture. In my own experience, using an equaliser to attenuate a curve of frequencies centered around ~275Hz will help alleviate perceptually 'muddy' characteristics from a recording. Plosive sounds that characterise mutes or 'stop consonants' are often present in this range and can be accentuated when vocalists use microphones in close proximity (see Eargle 2005: 64; Howard & Angus 2001: 332). In excess, this action can weaken any sense of rhythm, meter and timbre deriving from plosives in this frequency region.

Observe the piercing 'sss' that accompanies 'st' in 'stop' or 'sp' in 'spat'. Also notice how these sounds are more prevalent when whispering. Any sibilances that characterise certain aspirates are present in the 3-10kHz range. To attenuate or boost around this range will either reduce or accentuate whatever felt qualities these aspirate sibilants offer (see Bartlett & Bartlett 2009: 297; Bregitzer 2009: 169).

Psychobiologist Manfred Clynes (1982: 143-144) acknowledges a study undertaken by Kotlyar and Morosov (1976). The study proved how performer emotions are particularly exposed through natural differentiations in amplitude. The communication of living emotion through music may be referred to as 'essentic form' (see Clynes 1982: 51-2; 64-65; Ball 2010: 267-269).

It is therefore remarkable that a 'dynamic range compressor' condenses the dynamic range of an audio signal's amplitude and enables the engineer to sculpt or shape dynamic content. On a vocal, the difference in amplitude between various aspirates, liquids and mutes can therefore be lessened or shaped by such processing; their emotional impact can be adjusted. A specific type of compressor, known as a 'de-esser', allows the mastering engineer to suppress a particular band of frequencies. Unlike equalisation, suppression happens only as frequencies surpass a particular threshold of amplitude. These tools target sibilant sounds at the higher end of the frequency spectrum, which often penetrate through a recording to the point of distortion, distraction and discomfort. The de-esser will directly impact on the listener's perception of sibilant and aspirate sounds. Excessive use of a de-esser will however introduce artificial lisping effects (see Waddell 2013: 44; 98).

Stereo-field enhancement involves the use of tools such as 'elliptical eq' to alter how particular frequency bands are distributed in the stereo spectrum. Before the introduction of digital formats, mastering engineers would 'mono' any sub-bass or lower bass frequencies to ensure cutter heads and playback styluses would not skip when working with cutting lathes or when playing from vinyl (see Owsinski 2008: 88; 257; Waddell 2013; 143; 194-197). This also resulted in recordings having a perceptually 'tighter', conceivably more pleasant low end and so, to a degree, the process persisted out of preference rather than necessity. The vocalist may be concerned with how this process can enhance the perceived 'punch' of lower frequency notes and plosives. Today's engineers can also widen the stereo image in the higher frequency spectrum to increase spatial depth in a recording. "Low frequencies are usually localized [sic] by the listener from every direction", explains Bregitzer (2009: 200). "The higher the frequency, the more we can perceive directionality", and so widening the stereo image has greater impact on the listener's spatial perceptions at this end of the spectrum (also see Moylan 2008: 64; Waddell 2013: 90-92). In doing this, harmonic resonances and formants that derive from liquids or mutes, and also the fundamental spectral elements of any aspirates, are all together perceived differently, owing to their exaggerated distribution in the stereo field.

The last creative mode of signal processing is typically carried out using a 'limiter'. A limiter may be used to increase the amplitude of the signal, whilst preventing any peaks from exceeding the maximum output volume and distorting. This can raise apparent loudness and yet reduce dynamic range across the entire frequency spectrum. As with compression, the difference in amplitude between various aspirates, liquids and mutes can be lessened through such processing; their rhythmic impact adjusted once again.

'Dither' and 'noise shaping' should always proceed the aforementioned processing. They are, for the sake of argument, non-creative and imperceptible processes applied in the interests of good housekeeping for a world of digital audio (see Waddell 2013: 94-95). Bregitzer mentions 'editing' to indicate the process of track ordering, leveling and applying fades; a creative activity though not a process of manipulating the sonic or emotional content of entire tracks.

Manipulating Time

Reflecting on Alperson (1980: 408), Negus (2012: 483-484) considers music and each musical constituent as a function of time; "temporal organization [sic] is fundamental to [music's] creation and reception", he argues. I consider 'temporality' an appropriate term to describe how music or vocal performance can radiate an obvious sense of rhythm and metre against the clock. Reflecting on the writings of Storr (1997), Sacks (2007: 244-246) suggests rhythm is a means of bringing a group of people together, synchronising their movement and minds. He also explains how memorising a series, the alphabet for instance, is made easier through meter and rhythm (237). EDM scene veteran Rick Snoman would later emphasise the significance of rhythm and temporality to the genre 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. […] [I]t 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)

I suggest the terminologies 'flow' and 'trance' may be used synonymously to describe how, in Negus' (2012: 483) terms, music induces 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" (see Csikszentmihalyi 1990; Pursuit of Happiness 2015). If an obvious sense of rhythm and meter can stimulate lasting states of 'flow' or 'trance' in listeners, who will then become more attuned to those occupying the same space, then it is important to consider how the mastering engineer and the processing techniques they employ can impact on rhythmic and metric qualities in recordings and vocal performances.

It is through the brain's ability to interpret diverse sound intensity in rhythmic patterns that it detects meter, be them in an entire recording or just a vocal performance (see Ball 2010: 209-210; Levitin 2008: 172). In detriment to this, sounds of a similar intensity are grouped together by our auditory system (see Ball 2010: 142-144; Clynes 1982: 119; Levitin 2008: 81). Aggressive application of compression and limiting can considerably narrow the dynamic range of a vocal take in the mastering stages of record production. This will decrease its clear essence of pulse, punch, rhythm, metre and thus temporality at the macro level. The capacity of a performance or recording to induce states of flow and trance in the listener will consequently diminish. Strikingly, Katz (2002: 86-132; 185-196), Milner (2010: 237- 292), Rowan (2002) and Vickers (2010) all observe how such processing has been exploited at an increasingly profound level, following the introduction of digital formats. This has given rise to a so-called 'loudness war', whereby recorded music industry personnel ensure new music releases are competitive in terms of apparent loudness.

To conclude

The goal of both producer and mastering engineer is often to deliver recordings through which audio engineering 'work' to bring a vocal performance to the listener is concealed, unless exposé is deemed creatively appropriate. This is not to say an engineer's hallmark sound, aesthetic choices or their ability to creatively manipulate audio should not prevail. It is evidence of, quite literally, 'work' undertaken to construct their signatures and showcases that is suppressed. The engineer will work to disguise evidence that the vocalist ever stood in front of a microphone or that a dynamic range compressor was used. If mastering is done correctly then it should, for the most part, go undetected. Nevertheless, it is important that music listeners, songwriters and singers to recognise the lesser-known figure at the tip of the production funnel. This figure may now be a professional or an amateur. As this contribution has explored, both have agency to distinctively shape the listener's emotional response to and temporal perception of 'felt qualities' in a vocal performance across an entire recording.

Alexander is currently a PhD candidate at *Birmingham City University*. His doctoral research offers a wider investigation into the technical operations of professional mastering engineers. The research in-progress has been presented at the *Birmingham Centre for Media and Cultural Research* and Alexander has conducted a stockpile of lengthy interviews with a broad succession of internationally renowned engineers. They themselves and also their associated projects have collectively earned extensive arrays of *GRAMMY, BRIT, MPG, TEC, Mercury Prize* and *MOBO* awards or nominations. The research has also involved invitation to US *Grammy* Award-winning mastering engineer Vlado Meller's mastering workshop in Charleston, South Carolina.

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