Monitoring Design and Application: An Examination into Monitoring's Influence on Popular Music Live Performance

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Abstract

The advancements in popular music live performance production technology have progressed rapidly in the popular music landscape over the last 20 years. Subsequently, performers and audio engineers are now faced with a vast array of monitoring system design options in today's live performance field.

The role of monitoring technology in popular music live performance has been discussed in popular literature, but this topic has not been investigated in any great depth. This dissertation focusses on an examination of the considerations in application for loudspeaker foldback and in-ear monitors in the generation of a quality live performance. This was achieved through a qualitative methodology that utilised an analysis of existing literature and data collection methods that included a survey of 100 musicians and audio engineers and semi-structured interviews of three professional practitioners.

The study found that the application of monitoring technology and monitor mixes was imperative in the enablement of performer comfortability on stage. This study also found an increasing preference towards in-ear monitoring systems over traditional loudspeakers amongst the participants. Furthermore, the findings of the study documented a nexus between monitoring and the manifestation of a quality popular music live performance. High-quality monitoring empowered performers to connect with their performance and engage with their audience.

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Certification

I hereby certify this work is original and has not previously been submitted in whole or part by me or any other person for any qualification or award in any university. I further certify that to the best of my knowledge and belief, these research papers contain no material previously published or written by another person except where due reference is made in the papers themselves.

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Chapter 1: Introduction

The popular music landscape has continuously been intertwined with the development of technology (Moorefield, 2005). As a musician, educator and audio engineer actively making a living in the popular music industry, I am enthralled by the connection between music and technology. The suitability and ensuing accessibility of different technology within the popular music live performance production realm has become considerably more profound since the 1990s (Harrison, Baldwin, & Grafton, 2007). As such, performers and audio engineers are faced with a large variety of design possibilities when it comes to live sound reinforcement[1] equipment. Davis and Jones (1989) explain that monitoring can significantly impact performers, audio engineers and audiences however, the specifics of these influences have not been stringently investigated. This paves the way for suitably creditable investigations into technology's influence on popular music live performance.

When delving into greater specificity regarding technology's influence in this field, it is prudent to consider the role of *monitoring*; this is the focus of this research. In the popular music live performance production context, monitoring refers to the way in which performers are able to hear themselves and others when performing (Audio Engineering Society, 2019c). Currently, there are two primary monitoring apparatuses that are employed by performers and audio engineers: loudspeaker foldback (wedges) and in-ear monitors (IEMs). A loudspeaker is an apparatus which

[1] The amplification of sound sources through equipment such as loudspeakers (Scheirman, 2015).

acts as a transducer[2] to generate sound from an electrical input signal (Borwick, 2001). Foldback is an audio source sent back to performers through loudspeakers to enable them to monitor the sounds they, and others, are producing (Soundcraft, 2001). IEMs are an inner ear earphone designed for nominal audio reproduction directly into the ear whilst "creating isolation from external sound" (Fellows, 2017, p. 1).

The augmentation of large-scale sound reinforcement systems has in turn promoted the importance of monitoring in the modern context (Howard & Murphy, 2008). Following the development of sound reinforcement systems in the 1960s, popular music performers have had an ever-growing need to adequately hear themselves on stage (Sigismondi, 2008). In the 60s, most concerts were being held in smaller venues and performers were able to hear themselves through the main PA; with some exceptions such as, The Beatles (Sigismondi, 2008). However, with rock and roll becoming increasingly popular and consequently, attracting greater audiences, popular music performers began to struggle to articulate themselves on stage (Mauch, MacCallum, Levy, & Leroi, 2015; Sigismondi, 2008). This was mainly due to the sheer number of people attending such concerts and the fact that sound reinforcement systems had to generate levels louder than the audience (Krebber, 2008).

Audio engineers in the popular music live performance production setting are often principally responsible for the mixing of a performance for the audience

[2] A transducer "converts energy from one form into another" (Song & Lee, 2008, p. 11)

(Swallow, 2010). This is known as mixing front of house[3] (FOH) audio. However, it is a separate skill for an audio engineer to be able to mix a performers monitors; this could be vastly different from the FOH mix (Berman, 1999). It is therefore imperative for audio engineers to have a comprehensive knowledge of mixing fundamentals (Gibson, 2005). Similar to a producer/engineer in the recording studio, it is important to consider that the monitor mix has to accommodate the artist in order to provide them with a comfortable environment to perform in (Howlett, 2012).

Rationale

Live sound professionals are required to work within different music venues and environments on a weekly basis. As such, they are confronted with a vast array of monitoring system designs, application possibilities and realities of these designs. The capabilities and importance of these systems and the influence they have on a live performance is often overlooked by many performers and audio engineers. As Davis and Jones (1989) state:

> Stage monitoring systems are one of the important keys to a successful show. Sound reinforcement practice has evolved to the point where even small music clubs usually have some type of monitoring system, and large-scale concert monitor systems can be very elaborate. Despite their wide-spread use monitor systems are the subject of a lot of misunderstanding - particularly

[3] The term front of house (FOH) is derived from theatre terminology and is thus defined as, "the public areas of a theatre" (Theatre Projects Consultants, 2019, p. 4). When discussing FOH in live sound reinforcement, the reference is to the area in which the audience is located.

> among musicians, who are the very ones to benefit most from a good monitor system (p. 178).

Davis and Jones (1989) also claim that a high-quality monitoring system supports the delivery of a quality live performance on stage which also impacts the clarity of the FOH mix.

Analogous to Davis and Jones' (1989) perspective, as a professional live audio engineer, I have also noted the importance of monitoring systems in the manifestation of a quality live performance. There has been little academic study undertaken concerning monitoring and its connection to popular music live performance. The current knowledge pertaining to this field is constrained primarily to professional based texts (see, for example, Ballou, 2008, Berman, 1999, Davis & Jones, 1989, Watkinson, 2013). Supplementary texts can be used to examine some of the fundamental skills used during live sound engineering through studio sound engineering discourse (see, for example, Gibson, 2005, Katz, 2004, Moylan, 2014, Owsinski, 1999). This is valuable technical information for the reader and informs fundamental understanding of sound engineering practices that are appropriated in both record production and live sound contexts. However, there is a noticeable literary void concerning monitor mix design and application in conjunction with the generation and cultivation of a quality live performance.

Aim

The purpose of this research is to provide deeper insight into the influence monitoring has on popular music live performance. This will be framed within an investigation of the various perceptions and considerations of using wedges and IEMs. The importance of a suitable monitoring system will also be discussed through

an inspection of the various elements that positively and negatively influence the manifestation of a quality monitor mix. This research will be situated in a variety of popular music live performance settings that include small pub or club systems, to mid-range portable systems and international touring standard monitoring systems. As a result, this research seeks to inform the scholarly discourse of the considerations for monitoring systems in today's popular music live performance environment. This will be formulated through the scrutiny of monitoring system designs, applications and subsequent impact on the delivery of quality live performances.

Thus, the central research question in this dissertation contemplates: *what are the considerations in application for loudspeaker foldback and in-ear monitors when designing monitor mixes that promote a quality live performance?*

In order to propose a response to the central research question, the ensuing sub-questions will be targeted:

I. What are the principal advantages and disadvantages of loudspeaker foldback and in-ear monitors?
II. How does the role of a monitor mix influence a quality live performance?
III. What are popular music performers' and audio engineers' perceptions of a quality live performance?

Definition of Terms

It is often necessary to provide clarity in dissertation writing as some terms can have fluid meanings in many different contexts. Therefore, the central terms of this research are defined here. The terms *monitoring, loudspeaker foldback* and *in-ear monitors* have already been defined above. The term *popular music live performance*

is appropriated from Jones and Rahn (1977) and Emmerson (2007). Jones and Rahn (1977) explain that the term *popular music* is "bound to change with the culture in which it is embedded" (p. 81). As such, this research is firmly located within the broad scope of popular music. Popular music is represented by its variety of acoustic and electronic genres that include examples such as rock, pop, hip-hop, R&B and blues. Consequently, this study detaches itself from genres such as jazz, classical and musical theatre. Emmerson (2007) elucidates that a *live performance* consists of the "presence of a human performer … who produces sounds mechanically; or who produces sounds on electronic substitutes" (p. 90). The presence of a popular music performer coupled with technological facilitation (or reinforcement) of the sounds produced, will form the definition used in this dissertation for *popular music live performance*.

The definition of *monitor mix* will be adapted from Terrell and Reiss (2009) and Davis and Jones (1989). They explain that a monitor mix is the combination of on stage sound sources sent back to a performer so they can hear themselves and others in a performance. Such mixes are tailored to suit each, or groups of, performers.

Chapter Structure

This dissertation is structured to encompass five chapters. Chapter 2 presents the relevant literature surrounding this research which is categorised into three key sub-headings:

1. Technology and its role in monitoring.
2. Application of monitoring: The function of the monitor mix.

3. Perceptions of a quality live performance: Musical proficiency and creative considerations.

Chapter 3 will outline the principal research paradigm and justify the methodology chosen for this dissertation; a qualitative investigation. The research design will be discussed, the data collection methods will be explained and the research participants will be identified. Chapter 4 will present the data collected from the various methods and utilise a thematic analysis (Braun & Clarke, 2006) in conjunction with the literature to triangulate and generate seminal themes that will inform a response to the research questions. Chapter 5 will then present the research findings and address the research questions. The final chapter will also summarise the significant results of this research, discuss limitations and table future research possibilities in this area.

Chapter 2: Literature Review

This literature review will examine and discuss literature that is relevant to the design and application of monitoring to promote a quality live performance. Due to the scarcity of scholarly material that addresses this specific topic, this chapter will make use of professional texts in order to demonstrate the void where supplementary research should be undertaken. Relevant professional discourse can be obtained from a variety of informative sources including professional texts, online forums, trade magazines, online blog publications and online videos/tutorials. The literature of this field is situated in three areas:

1. Technology and its role in monitoring;
    i. Loudspeaker foldback (wedges).
    ii. In-ear monitors (IEMs).
2. Application of monitoring: The function of the monitor mix;
    i. Monitor mix fundamentals.
    ii. Technical considerations.
    iii. Crafting a monitor mix.
3. Quality live performance;
    i. Musical technique.
    ii. Creative considerations.

Technology and its Role in Monitoring

Sound reinforcement technology has become an integral part of everyday society; be it in a professional audio context or otherwise (Davis & Jones, 1989). Such technology is evident in the workplace through examples such as audio conferencing,

or simple background music and store announcement platforms (France, Anderson, & Gardner, 2001). It is also prominent in the home environment with an example such as an FM radio or in today's context, the use of audio technology in 'smart homes' (Davis & Jones, 1989; Vacher, Portet, Fleury, & Noury, 2011). Similarly, as audio technology in the everyday environment has developed over time, so too has technology pertaining to monitoring. Popular music performers and audio engineers currently have many choices when it comes to monitoring design and application. However, budget considerations can often impact the design of a monitoring system because the difference in price between low-end and high-end systems can be tens of thousands of dollars (Sigismondi, 2008).

In order to design a monitoring system, audio engineers and performers need to assess what monitoring technology is most suited to aiding them in generating a quality live performance. As established previously in Chapter 1, there are two main types of monitoring apparatuses used in popular music live performance: loudspeaker foldback (wedges) and in-ear monitors (IEMs). Loudspeaker foldback is also known as a: foldback speaker, monitor speaker, monitor cabinet, stage wedge/monitor or a wedge (Watkinson, 2013). When discussing technology and its role in monitoring, previous literature predominately identifies the factual characteristics applicable to the equipment (Biederman & Pattison, 2014). However, in order to understand technology's role in monitoring, one must contextualise multiple texts from varying fields that inform this discipline (Mateos & Solé, 2009).

Loudspeaker foldback (wedges).

The most common (and arguably, most traditional) monitoring design is that of the loudspeaker foldback or wedge (Sigismondi, 2008). Sigismondi (2008) explains that loudspeaker foldback came about in the 1960s through the flipping of certain front of

house (FOH) speakers 180 degrees (or 'folding them back') in order to face the band. FOH speakers face the audience so they are able to hear the on stage audio sources which are captured through microphones and direct injection boxes[4] (DI box) (Musib, 2013). This concept was refined when a wedge-shaped loudspeaker was manufactured to have a low profile and face performers directly in close proximity to them; generally, on the ground from the front, sides or behind (Terrell & Reiss, 2009). The wedge (Figure 1) was designed in order to provide the performer with a personalised monitor mix with focussed dispersion[5] whilst still achieving clarity on stage (Davis & Jones, 1989). This was a major step forward for sound reinforcement technology and as such, the influence that a monitor mix began to have on popular music live performance was initiated (Coules, 2015).

Figure 1. L-Acoustics X15 HiQ (L-Acoustics Group, 2019).

[4] A DI box converts the impedance of an instrument or un-balanced input source in order to connect to a mixing console (Pack, 2018).

[5] The diffusion of sound waves (Murison, 2018).

With the introduction of wedges, performers were able to have a duplicate mix of the FOH levels with no personalisation (Coules, 2015). Sigismondi (2008) justifies that this was due to mixing consoles[6] of the time not having enough outputs[7] to accommodate personalised monitor mixes. As monitoring technology developed in the modern landscape, performers and audio engineers often employed the use of a secondary mixing console, independent of the main (or FOH) console (Davis & Jones, 1989). This was known as a monitor console and it was designed to distribute individual monitor mixes to each performer (Eargle & Foreman, 2002). This enabled each performer to have their own personalised and separate mix which was distributed to their wedges.

The ability to customise what performers hear on stage is imperative in the current popular music landscape (Mellor, 2005). This is due to many performers employing the use of backing tracks whereby external sound sources, such as backing vocals and keyboards, are pre-recorded and then played alongside live instrumentation (Burton, 2013). Benediktsson (2009) explains that good monitoring has a direct correlation with the quality of a live performance. If a performer cannot hear what they are doing, they a liable to make more mistakes; being able to hear oneself is the primary focus of monitoring (Benediktsson, 2009). As such, with the increase in flexibility around monitoring, its role in generating a quality live performance has become more profound (Benediktsson, 2009).

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[6] Mixing consoles, also referred to as a 'mixer', 'mixing desk', 'console' or 'board' among other colloquial terms, is a device which has various controls to help combine, distribute and monitor audio signals (Mueller & Rettinger, 1945).

[7] Also referred to as an output bus, auxiliary send or monitor send/output is designed to send audio signal out of a device, in this instance, a mixing console (Carrascal & Jordà, 2011).

This dissertation does not allow the scope for considerable detailing of the literature pertaining to loudspeaker design. However, to gain an understanding on speaker enclosures, low and high frequency drivers, crossovers and wiring, literature from Borwick (2001), Davis and Jones (1989), Kikuvi (2014) and Morgans (2005) cover this topic well. More generally, loudspeaker foldback has a variety of design options; each speaker is designed for different performers within a band or ensemble (Benediktsson, 2009). Live sound engineering handbooks are useful in discerning the different monitoring configurations pertaining to loudspeaker foldback for popular musicians (Thompson, 2018). One important loudspeaker design consideration is the size of the low frequency driver (Davis & Jones, 1989). The low frequency driver generally consists of an electromagnetic structure which drives a cone diaphragm that produces low frequencies[8] (Borwick, 2001). The diameter of the low frequency driver in live sound reinforcement is generally 12, 15 or 18 inches (“) (Davis & Jones, 1989). The larger in diameter that the cone diaphragm is, the lower the frequencies it can produce (White, 1952). In a rock ensemble, a typical loudspeaker design for a vocalist or guitarist could consist of multiple loudspeakers with 15” low frequency drivers facing them from a front-on, or side position (Davis & Jones, 1989). A speaker such as the X15 HiQ (Figure 1), made by L-Acoustics is an industry standard choice (ProSoundWeb, 2019). In contrast, a drummer could employ the use of an 18” low frequency driver in their speaker cabinet (Self, 2012).

[8] Frequencies, when referred to in a popular music live performance production context, relates to the concept of the frequency spectrum and the measurement of cycles per second in Hertz (Hz). In simpler terminology, the commonly referred to terms of bass, middle and treble, apply on a macro level when referring to audio frequencies (Chowning, 1973).

This is because drummers quite often like to hear their bass drum, also known as a kick drum (Herring, 2012). The bass drum produces low frequencies and to reproduce these frequencies, a larger low frequency driver is required (Snow, 1931). As such, for a drummer, a loudspeaker with an 18" low frequency driver would be an optimal choice (Benediktsson, 2009).

In order to design and apply a monitor mix that promotes a quality live performance, a comprehensive knowledge of the technology relating to loudspeakers is vital to an informed audio engineer's skillset (Spirit Studios, 2018). The discourse surrounding this field of monitoring design illustrates a technological perspective and provides basic reasoning around the deployment of loudspeakers. However, a thorough consideration of the role of technology, alongside application and the quality of a live performance, is an area yet to be considered.

In-ear monitors (IEMs).

IEMs are a component of a monitoring design referred to as, personal monitoring systems (Sigismondi, 2008). When referring to IEMs in popular music live performance production, popular music performers and audio engineers are referring to the IEM system itself, not specifically the inner ear earphone unless specified otherwise. Inner ear earphones can be custom fit to suit individuals (Figure 2) and this requires ear impressions/moulds. The second type of inner ear earphone is universally fitting (Figure 3) and can be purchased and worn immediately by anyone.

Figure 2. 64 Audio A5 Custom In-Ear Monitors (64 Audio, 2019).

Figure 3. Westone UM PRO 50 Universal-Fit In-Ear Monitors (Westone, 2019).

IEMs were first established as a concept in the 1980s by audio engineer, Chrys Lindop, most known for his work with Stevie Wonder among many other artists (Frankson & Lindop, 2018). Lindop developed a wireless system for Stevie Wonder which included "a FM radio station transmitter … a pocket FM receiver, an Aphex Dominator multi-band limiter and a set of Sony Walkman earbuds" (Frankson & Lindop, 2018, p. 2). After heavy development and modification, IEMs have become much more accessible and affordable in the music industry over the last 15 years (Burton, 2013). IEM systems come in two formats: a hardwired system and a wireless system (Sigismondi, 2008). The hardwired system uses cabling to connect the mixing console (monitor or FOH) directly to an earphone amplifier, which then powers the actual IEMs (inner ear earphone) (Shure Incorporated, 2015). A wireless system uses a radio frequency (RF) transmitter and a receiver to convey audio wirelessly to a belt pack (worn by the performer) which powers their IEMs (inner ear earphone) (Shure Incorporated, 2015). The literature concerning IEMs, is somewhat deficient, however, some texts have highlighted the benefits they present in direct contrast to loudspeaker foldback (Federman & Ricketts, 2008). Sigismondi (2008) cites that the four main benefits of using IEMs are, superior sound quality, portability, mobility and personal control. He goes onto identify that IEMs also aid in the conservation of performers' hearing and a reduction in vocal strain. As IEMs are a more recent technology than loudspeakers, there is minimal literature available to inform this study. Further investigation into their design, application and influence on live performance is required in order to foster understanding in this field.

Designing a monitor mix for IEMs is highly individualistic and dependent upon the quality of the IEM system and the performer's needs. Burton (2013), argues that the role of the monitor mix (and thus, the monitor engineer) is the most

important variable in the design of IEM mixes. Therefore, the literature surrounding this area approaches this topic from a standpoint that discusses monitor mix application (see, for example, Gibson, 2005, Izhaki, 2008, Moylan, 2009a, 2014b, Owsinski, 1999a, 2009b, Senior, 2011, Swallow, 2010). Mulder (2010) suggests that monitor mixes promote a quality live performance and this consequently endorses the importance of the function of the monitor mix.

Application of Monitoring: The Function of the Monitor Mix

Mellor (2005) attests that monitor mixing is now just as important as FOH mixing when engaging with popular music live performance. Due to the availability and sophistication of different monitoring designs, considerations surrounding the application of monitor mixing is crucial (Berklee College of Music, 2019). One must consider how these salient points (monitor mix importance, monitor mix design and monitor mix application) work together within the function of the monitor mix.

Monitor mix fundamentals.

Monitor mix requirements are generally incredibly subjective and require precise tailoring in order to suit the needs of the individual performer (Laveglia, 2019). This ensures performers are in the most comfortable environment in which to perform on stage (Pell, 2019). As such, audio engineers (monitor engineer or person responsible for controlling the monitoring system) must foster a positive, understanding and empathetic relationship with the performer (Burgess, 2013; Gross, 1997; Swallow, 2010). In order to maintain such a relationship, the monitor engineer must have adequate verbal and non-verbal communication skills and suitable interpersonal skills (Swallow, 2010). Additionally, audio engineers should establish with performers what hand signals they prefer to use during a live performance to indicate

a request of alteration in their monitor mix (Gross, 1997). After designing a monitoring system suitable for the needs of performers, the monitor engineer must consider any known monitor mix prerequisites that have been conveyed (Mellor, 2005). These are often general requirements that certain performers prefer (such as, vocals loud and everything else quieter). Ideally, if a performer can hear themselves clearly, hear the other band members and as a result, feel comfortable and connected to their performance, the monitor mix has achieved its primary goals (Sigismondi, 2008). This investigation into the influence of monitoring on a quality live performance will deconstruct this even further.

Technical considerations.

When employing the use of wedges, audio engineers must consider the correct placement of loudspeakers (Davis & Jones, 1989; Mulder, 2010). For performers to experience a clear stage sound, whereby they can hear themselves and others, the positioning of wedges should generally follow three primary rules. Laveglia (2019) cites that an audio engineer should:

1. Aim the loudspeaker(s) at the performers face.
2. Avoid facing the loudspeaker(s) directly at the capsule of a microphone.
3. Avoid pointing the loudspeaker(s) at acoustic instruments (such as a grand piano) (p. 2).

Similarly, when using IEMs, audio engineers must ensure that each wireless IEM system is receiving RF appropriately (Grini, 2006). This is achieved by

choosing the most appropriate RF antennas and paddles[9] suitable for the size and location of the venue (RF Venue, 2016). Correspondingly, audio engineers must scan for the best frequencies available to transmit on; this will alter in different locations (Shure Incorporated, 2013). Lack of consideration of these parameters will see performers experiencing disconnections on stage (Burton, 2013). This can be exceptionally detrimental to a performance if the performer is unable to hear themselves; especially if playing electronic instruments with no on-stage amplification (digital stage pianos for example).

Crafting a monitor mix.

Delving further into what a typical monitor mix should incorporate, Davis and Jones (1989) provide an informed point of view on the potential monitor mix requirements for members of a rock ensemble:

> In order to stay on key and on cue, for example, the lead vocalist needs mostly to hear the background vocalists, along with perhaps a bit of the keyboard and guitar. Similarly, the bass player needs to hear the kick drum, and the drummer needs to hear the bass. The guitar player needs to hear both, while the keyboardist might need to hear the lead vocal and the guitar (p. 178).

The use of equalisation (EQ)[10], compression[11], panning[12] and effects (FX)[13] can heavily shape the quality of a mix (Izhaki, 2008). A thorough understanding of audio

[9] Large antennas in the shape of a 'paddle' used to improve RF range.

[10] The process of increasing (boosting) or reducing (cutting/attenuating) different frequencies (Wavelength Media, 2019).

signal processing[14] is imperative for a monitor engineer. The use of EQ, compression, panning and FX is thoroughly documented in texts pertaining to popular music record production (see, for example, Gibson, 2005, Izhaki, 2008, Moylan, 2014b, Owsinski, 1999a, 2009b). These texts help to inform performers and audio engineers wishing to understand monitor mixing in greater detail. Specific to wedges, it is important to apply an appropriate EQ designed to prevent acoustic feedback and ensure the wedges sound pleasant for performers by attenuating different frequencies (Chevalier, Gibson, Gilbert, Millington, & Murphy, 2013). Acoustic feedback (or simply, feedback) is an audible sustained 'ringing' frequency/tone; generally unwanted in live sound reinforcement (Chevalier et al., 2013). To facilitate an appropriate stage sound, audio engineers can make use of a graphic EQ (GEQ) and parametric EQ (PEQ) (Gibson, 2005).

Furthermore, when mixing for IEMs, the use of EQ, panning and FX are profoundly important in generating the most appropriate monitor mix for the performer (Lent, 2017). Sigismondi (2008) explains that some vocalists "feel they sound better with effects on their voices" and thus the use of "reverb [FX] can add depth to the [monitor] mix, which can increase the comfort level for the performer" (p. 1431). In addition to EQ and FX, compression can also be used to prevent audio

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[11] The reduction in dynamic range of an audio signal (Audio Engineering Society, 2019a).

[12] The "placement of different sound sources in [a] space" to any position between the left and right. (Tzanetakis, Jones, & McNally, 2007, p. 1)

[13] Broad array of alterations that can be applied to an audio source. Reverb, delay and chorus are all common effects (Audio Engineering Society, 2019b).

[14] Audio signal processing refers to any devices used to process and alter audio signals (EQ, compression, reverb and delay are all audio signal processors) (Sigismondi, 2016).

sources from losing clarity in the IEM mix (Sigismondi, 2008). Moreover, compression can protect IEM users from loud transient spikes which could damage their hearing (Sigismondi, 2008). The creation of a detailed 'stereo image' in a performers head is essential when mixing IEMs (Davis & Jones, 1989). When monitor engineers utilise FX and stereo panning to create spatiality and depth in a monitor mix, performers have an enhanced visual representation of their sonic[15] environment (Gibson, 2005). Moreover, the use of audience microphones to capture the ambience of the venue and crowd can provide performers with an even greater detailed, visual representation when using IEMs (Frink, 1999). A monitor engineers' ability to construct appropriate monitor mixes can assist performers in feeling comfortable on stage (Mellor, 2005). Although the application and ensuing function of the monitor mix is documented, its connection to the quality of live performance is yet to be investigated in detail.

Unlike mixing FOH audio, which is mixed to the creative preference of the FOH audio engineer, the monitor mix must always seek to serve the performers requirements (Mellor, 2005). Swallow (2010) expands on this concept by explaining that the role of the monitor engineer is one of the most difficult in audio engineering. Nevertheless, mixing monitors for a performance can also be heavily fulfilling. According to Swallow (2010), "when performers have a great show, the monitor engineer will have a great show" (p. 5). Therefore, when cogitating the considerations in application for loudspeaker foldback and in-ear monitors, it is absolutely imperative for monitor engineers to react instinctively to performers' needs. Together with intuition and an aptitude for technology, monitor engineers are

[15] Sonics in popular music live performance production refers to sound.

able to connect with the performers and the performance itself (Tough, 2009). This validates that an engaged monitor engineer can almost be 'performing' a monitor mix; much alike a musician performing on stage. Similar to Anthony's (2017) concept of *performing* a mix in record production, monitor engineers who connect with the music and the emotion it purveys, are able to perform with the technology they use. This facilitates the manifestation of aesthetically informed mixes that support the performers' intentions. Whilst the application of monitoring is thoroughly discussed in literature, there is minimal work that provides evidence-based research regarding the application of monitoring and the delivery of a quality live performance.

Perceptions of a Quality Live Performance

Discussions surrounding quality live performances and the details that are encompassed within, has proven to be a subjective topic (Persson, 1993). Therefore within the approach of this research, both musical proficiency and technical considerations will be considered alongside the creative discernment of the performer (Juslin, 2003).

Musical proficiency.

Popular music performers are able to make use of a range of acoustic instruments and digital technology such as computers and drum machines to augment a live performance (Bennett, 2017; Hugill, 2012). The engagement with such technological devices corroborates the significance of the interaction between performers, instrumentation and technology (Hugill, 2012). Accordingly, musical technique is assessed whilst evaluating the *quality* of a live performance however, a holistic perspective which consists of technical, musical and emotional affordances is

beneficial (Mills, 1991). McPherson and Schubert (2004) outline that a *quality* musical performance is one which demonstrates proficiency in: "technique, interpretation, expression and communication" (pp. 63-64). These four terms can be used as headings when analysing skills in these areas:

1. **Technique**
    a. Rhythmic accuracy; tempo and timing
    b. Pitch accuracy
    c. Instrumental fluidity and understanding
2. **Interpretation**
    a. Use of dynamics
    b. Timbral/tonal understanding and consideration
    c. Reading and arrangement accuracy (where applicable)
3. **Expression**
    a. Articulation and expression relevant to instrument, voice and technology
    b. Textural consideration (layering)
4. **Communication**
    a. Overall cohesion
    b. Eye contact and non-verbal communication with performers

(Board of Studies, 2009, p. 10; Duerksen, 1972, p. 269; McPherson & Schubert, 2004, pp. 63-64).

These concerns impact the interpretation of the quality of a live performance. However, a creative holistic outlook is integral in conjunction with these considerations (Mills, 1991).

Creative considerations.

A performer's perspicacity on the quality of their own live performance is also important; both instrumental and vocal expression is an essential medium in this instance (Minor & Hausman, 2004). Auslander (2008a) explains that live performance embraces "the feeling of always being connected to other people, of continuous, technologically mediated co-presence with others known and unknown" (p. 111). Moore (2002) and Baym (2018) explain that a quality live performance is one where a connection is made between performer and audience. Such a connection is a two-way link and a quality live performance authentically gives "people access to an experience" (Moore, 2002, p. 217). The ability for a performer to communicate (orally and instrumentally) feelings and emotions aids in the generation of quality and authenticity in a live performance (Moore, 2002). The emotional response that a quality live performance may generate for performers can endear itself to a specific mood or feeling (Moylan, 2014). Furthermore, an audience's perception of quality and the emotions that they interpret can play a similar role (Moylan, 2014). This is best explained by Moylan (2014):

> Music communicates emotions easily. One of the reasons many people listen to music is for emotional escape, relief, or a journey to another place. Music may … create a more general and hard to define (yet convincing) feeling or emotive impression (p. 62).

A holistic perspective, underpinned by a performer's enjoyment, confidence and engagement with an audience, is vital to understanding the makeup of a quality live performance (Mills, 1991). The concept of psychoacoustics illustrates why a holistic understanding of a quality live performance is important: "the concepts of pitch, loudness, timbre, etc. are subjective, and they are auditory perceptions in our heads.

Psychoacoustics investigates these subjective quantities (i.e., our perception of hearing)" (Zhang, 2008, p. 43).

This ideology places the performer as a judge of quality. Therefore, when discussing quality in live performance, a consideration of both musical proficiency, connection with the audience and satisfaction from the performer is essential. However, further research is required in order to ascertain the connection between monitoring and a quality live performance.

This literature review has identified three fields that both inform and help to situate this study: technology and its role in monitoring, application of monitoring and perceptions of a quality live performance. The discourse in this field is able to advise on the technological mechanisms relating to the design and application of a monitor mix, integral for a quality live performance. However, there is insufficient literature regarding monitoring's role in promoting a quality live performance. As such, this is the specific gap in the literature that this research intends to fill. The next chapter will outline the methodological approach that will be utilised as a part of this investigation.

Chapter 3: Methodology

This research aims to examine the considerations in application for loudspeaker foldback and in-ear monitors when designing monitor mixes that promote a quality live performance. Chapter 2 of this dissertation has documented the literature that outlines pertinent information concerning the role of monitoring technology, the application of monitoring and perceptions of a quality live performance. To inform a response to the research questions, the ontology[16] and epistemology[17] of popular music live performance needs to be considered. Popular music performers and audio engineers' insight and acuities regarding live performance and monitoring may differ from each other. There may be differing preferences and reasoning and therefore, this research is situated within an interpretive research paradigm. Cohen, Manion and Morrison (2000) explain that the "central endeavour in the context of the interpretive paradigm is to understand the subjective world of human experience" (p. 22). As a result, the data collected as a part of this research may be distinctive and subjective to the individual.

Research Design

To propose an answer to the research questions of this dissertation, a qualitative methodological design will be employed. Merriam and Tisdell (2016) propose that

[16] Knowledge and assumptions concerning the nature of a phenomena being examined (Bryman, 2008; Cohen, Manion, & Morrison, 2000).

[17] How knowledge is formulated, "acquired, and … communicated to other human beings" (Cohen et al., 2000, p. 6).

qualitative approaches seek to comprehend how people understand, formulate, or derive meaning from their world and their experiences. Fittingly, qualitative investigations allow for efficient descriptions of the situation being examined (Lim, 2011). Merriam and Tisdell (2016) state that qualitative research places emphasis on "how people interpret their experiences, how they construct their worlds, and what meaning they attribute to their experiences" (p. 6). Additionally, due to my professional experience as a musician and audio engineer, a qualitative research design will allow me to interpret the data through a practice-based analytical framework (Adelman, Jenkins, & Kemmis, 1976; Cohen et al., 2000; Kahlke, 2014).

Qualitative research refers to "any kind of research that produces findings not arrived at by means of statistical procedures or other means of quantification" (Strauss & Corbin, 1990, p. 17). Creswell (2013) explains that qualitative research "begins with assumptions and the use of interpretive/theoretical frameworks that inform the study of research problems addressing the meaning individuals or groups ascribe to a social or human problem" (p. 44). Qualitative research also aims to obtain broad-ranging responses in the data collection process (Ritchie, Lewis, & Elam, 2003). Bryman (2008) further recognises that qualitative research provides contextual understanding on the tendencies, principles and beliefs of the participants in the study and this seems very suitable for the diverse perceptions that may be collected as a part of this study. Moreover, qualitative research incorporates the researcher as a key instrument in the study (Creswell, 2013). Thus, a qualitative methodology will facilitate analysis of complex environments (such as live performance environments) effectively due to the level of detail required (see, for example, Auslander, 2008b) (Creswell, 2013).

There are numerous advantages for employing a qualitative approach in the context of popular music live performance. Nisbet and Watt (1984) rationalise that qualitative studies are more accessible to a larger audience as they are easy to understand and comprehensible by academics and non-academics alike. As this research aims to inform the academic and non-academic communities, this particular advantage appears appropriate. Similarly, qualitative studies are able to be conducted by a single researcher and can provide discernment over situations of a comparable nature (Nisbet & Watt, 1984). However, it is important to note the limitations of qualitative research. Qualitative research results can sometimes reflect researcher bias and lack critical insight, reliability and validity (Hsieh, 2004; Nisbet & Watt, 1984). The use of a clear research question and subsequent triangulation of data is a way to overcome these issues (Casey & Murphy, 2009). These measures will be followed in the methodological approach detailed below.

Data Collection

To achieve a detailed and in-depth analysis required for qualitative research, Yin (2012), when describing case study data collection, explains that qualitative investigations triangulate and establish "converging lines of evidence" with the aim of making the research findings "as robust as possible" (p. 13). Creswell (2013) further suggests that the chosen data collection methods for a qualitative investigation should involve "multiple forms of data such as interviews, observations and documents, rather than rely on a single data source" (p. 45). This will consequently promote the validity and accuracy of the study (Yin, 2012). The ensuing conclusions are then able to be presented through a holistic narrative which contextualises the research into a meaningful context (Bell, 2002).

Data collection methods: Survey and semi-structured interviews.

Figure 4 identifies the sequence of data collection methods that will be employed as a part of this study. This qualitative investigation will be set up by the use of a quantitative data element (within the survey) to profile the participants of this study and position the landscape of this research (Mason, 2002).

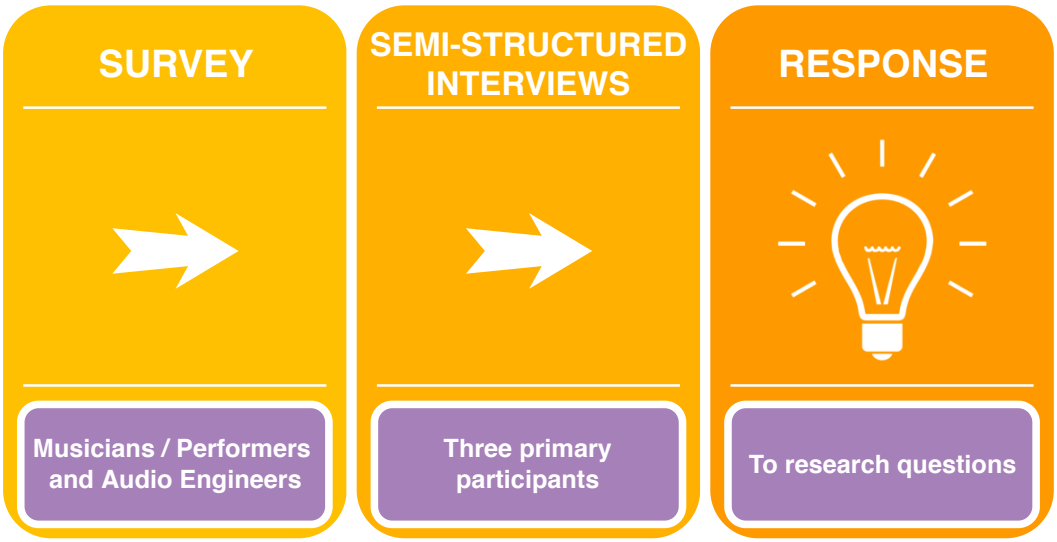

Figure 4. Sequential data collection methods.

The chosen methods for this study will be an anonymous, internet-based survey of 100 performers/musicians and audio engineers and a semi-structured interview of three primary participants. This survey will be conducted over a period between July and August 2019. The survey is best suited as the initial method in this research as it will allow for the collection of data that describes "the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationships that exist between specific events" (Cohen et al., 2000, p. 169). The survey data will be used to develop an understanding of the participants' perception and insights on the key concerns of this research; monitoring design, application and the perceptions of a quality live performance. Similarly, a survey will

allow for robust management of data within: 1. Closed questions (profiling the participant group); 2. Likert scale questions[18] (positioning the landscape of the research) and; 3. Open questions where participant responses may be as brief or detailed as the respondent wishes (Bryman, 2008). These open questions will be analysed to generate a response to the research questions. The survey questions will be informed by the relevant scholarly literature and my knowledge as an industry professional. Suitably, the questions created for this survey will target the primary and secondary research questions of this study.

A semi-structured interview (see, Bryman, 2008, p. 438) of three primary participants will then be used as the second data collection method for this study. This method will be conducted in accordance with Creswell's (2013) approach where it is stated that researchers should "conduct a semistructured interview, audiotape the interview, and transcribe the interview" (p. 160). The interview questions will be informed by the relevant scholarly literature and additionally formulated through an analysis of the survey responses. This is intended to facilitate a systematic approach to data collection which is deemed pertinent to this qualitative investigation (Creswell, 2013). Appropriately, this is useful in following up profound statements, providing insight on certain perceptions and generating a deeper analysis congruent with how a participant responds (Cohen et al., 2000; Kerlinger, 1970). The interviews will all use the same questions and will be delivered in the same sequence (Patton, 1990). However, due to the semi-structured nature, subsequent unique

[18] Five-point scale questions used to identify the intensity of an attitude towards a specific area (Bryman, 2008).

follow up questions will be used to enhance individual participant's perceptions as required.

Data Analysis

Qualitative data analysis should identify themes, categories and patterns in order to answer the research questions of a study (Merriam & Tisdell, 2016). Following the completion of the data collection, the data will be coded in accordance with Bryman's (2008) framework. This framework includes the categorisation of the data into an index of terms. Subsequently, a thematic analysis of the survey responses will be conducted. Creswell (2013) explains that in qualitative research, themes "are broad units of information that consist of several codes aggregated to form a common idea" (p. 186). To conduct an analysis of the data collected, Braun & Clarke's (2006) inductive thematic approach has been adopted. Braun & Clarke (2006) describe thematic analysis as a "method for identifying, analysing and reporting patterns (themes) within data" (p. 79). Thematic analysis is widely used and is renowned as an effective approach to interpret data (Braun & Clarke, 2006). The thematic analysis will be performed by myself (informed by my industry experience) and used in conjunction with key points discussed within the literature to triangulate and generate seminal themes that will inform a response to the research questions.

Participant Selection

The survey participants will be chosen based on an adaptation of Cohen et al.'s (2000) random cluster and volunteer sampling approach. I will disperse my survey to appropriate Facebook groups (for example, Live Sound Engineers of Australia,

Bachelor of Popular Music Noticeboard, Far North Coast Music Scene, Gold Coast Musicians Network) and use an additional bulk email to all popular musicians/performers and audio engineers that I have in my contacts. This will ensure that a vast number of people have access to respond to this survey.

The interview participants of this study will be chosen based on an adaptation of Creswell's (2013) purposeful sampling approach whereby all three primary participants will be required to have "experience of the phenomenon being studied" (p. 155). Analogously, these participants will be chosen to "best answer these [interview] questions" (p. 164).

To validate the credibility of this research, it will be imperative to source survey participants from a wide variety of backgrounds in performing and audio engineering in order to best gain an understanding on their perceptions of monitoring and its impact on popular music live performance (Yin, 2012). This in turn, aids in the relevance of this research to the popular music live performance and live sound engineering industries.

Primary Participant Overview

Each primary participant was given the option to be referred to by an alias (such as, Participant A; B; C) or by their full name however, all three agreed in writing to have their full names included in this dissertation. Primary participant one is Sam Vallen who is an international touring musician, best known for his progressive metal band, Caligula's Horse. Sam is also a producer, mix engineer (record production) and a lecturer in audio engineering. Primary participant two is Ben Quinn who has worked internationally as an audio engineer for over 20 years. Ben has worked with large

popular music live performance production companies as an audio engineer at festivals such as Livid and Big Day Out. Additionally, he has substantial experience in theatre based live performance production at the Queensland Performing Arts Centre (QPAC) and HOTA, Home of the Arts (formerly Gold Coast Arts Centre). Primary participant 3 is Alan Park who is an international touring musician best known for his work as Sir Cliff Richard's Musical Director and Pianist for over 24 years. Originally a classically trained pianist, Alan has performed with 10cc, Beggars Opera, Elaine Paige, The Everly Brothers, Jeff 'Skunk' Baxter (The Doobie Brothers, Steely Dan), Manhattan Transfer, Michael McDonald (The Doobie Brothers) and Nik Kershaw among many others. These primary participants are suitable for this research as they are all highly experienced and credible professional practitioners. Furthermore, they are able to inform on both performing and audio engineering perspectives.

Ethical Considerations

Ethical clearance was attained for this study under Griffith University reference number: QCM/09/12/HREC. This document informed participants of any risks, benefits, privacy and confidentiality of their involvement (Cohen et al., 2000; Simons, 2005). Each survey participant will be required to acknowledge an informed consent package (see Appendix A) before completing the online survey. Equally, each primary participant will be asked to sign an informed consent document before being interviewed. Throughout the presentation and analysis of data, each survey respondent will be referred to by a number. This will be formulated from the order in which the participants complete the survey. Similarly, each primary participant will be referred to by their first name.

Limitations

A primary limitation of this study, due to the scope of honours, was geographical restriction. As I was unable to expand my research scope outside of Australia when conducting data collection, a broader international variety of responses reflecting the perceptions of monitoring could not be obtained. Nevertheless, due to the credibility and international exposure of the primary participants, this does not severely hinder the research.

This chapter has outlined the overarching research paradigm, methodological approach, data collection and analysis that will be employed in this research. The ensuing data presentation and findings chapter will apply these processes and develop a response to the research questions.

Chapter 4: Data Presentation

Chapter 3 of this dissertation discussed the research design, methodological approach and the analytical procedures to be employed in this study. This chapter presents the data that was collected in the anonymous, internet-based survey of 100 performers and audio engineers, and semi-structured interviews of the three primary participants. Initially the profile of the survey participants will be presented in order to situate the landscape of this research. Then the qualitative information gathered in the survey responses and interviews will be discussed to facilitate the rationale behind the thematic analysis. Moreover, this chapter will then provide a list of key themes discovered in the survey, interviews and the literature review.

Survey: Participant Profiling

The survey (see Appendix B) received 100 responses from both male and female participants involved in the popular music live performance industry. These participants were from a diverse age range spanning from 12 to over 35 years of age. The respondents were situated within a variety of popular music genres. The largest genre identifications were rock (N = 69), pop (N = 49) and blues (N = 31). Within the 100 participants, 58 indicated they were a musician/performer and 80 identified as an audio engineer. Similar to Pras and Guastavino's (2011) investigation into the role of a musician as an audio engineer in the recording studio, this study engages musicians and audio engineers with popular music live performance production practices. This resembles the reality of the popular music live performance industry.

The participants of this survey were situated in a vast array of experience tiers and backgrounds. The thorough diversification of the participant pool is evident in the below pie chart (Figure 5) which identifies the level of experience and background of the participants in either live performance or live sound or both fields:

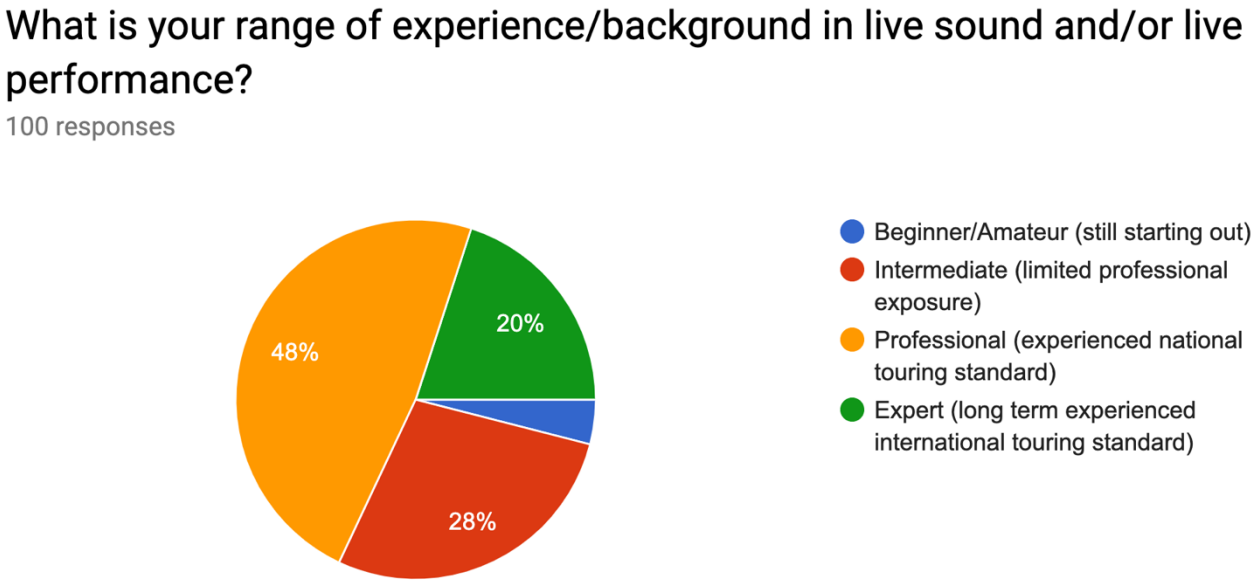

Figure 5. Experience/background of survey participants.

As performers and audio engineers of all experience tiers engage with monitoring, it is important for the validity of this research to ensure a wide variety of perceptions are documented. Therefore, this participant population seems suitable.

Survey: Situational Landscape

The following quantitative data derived from the Likert scale questions provided the details of the situational landscape of this research. From here, the qualitative data that was used to respond to the research questions was collected and the subsequent thematic analysis conducted. Survey participants were asked to indicate how likely they were to use in-ear monitors (IEMs) instead of loudspeaker foldback (wedges) during a live performance:

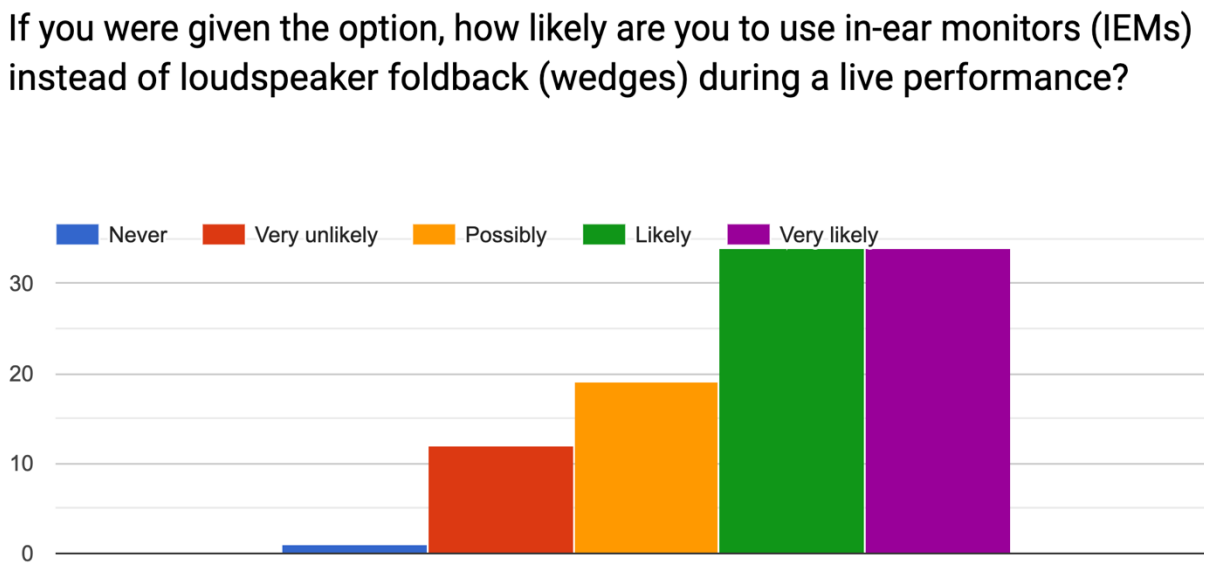

Figure 6. In-ear monitor or loudspeaker foldback preference.

As seen in Figure 6, sixty-eight percent of respondents indicated they were either likely or very likely to use IEMs instead of wedges during a live performance.

To formulate an understanding on the participant interpretation of the importance of monitoring technology and the subsequent monitor mix, two further Likert scale questions were employed. The questions assessed whether participants agreed or disagreed with the following statements and to what extent:

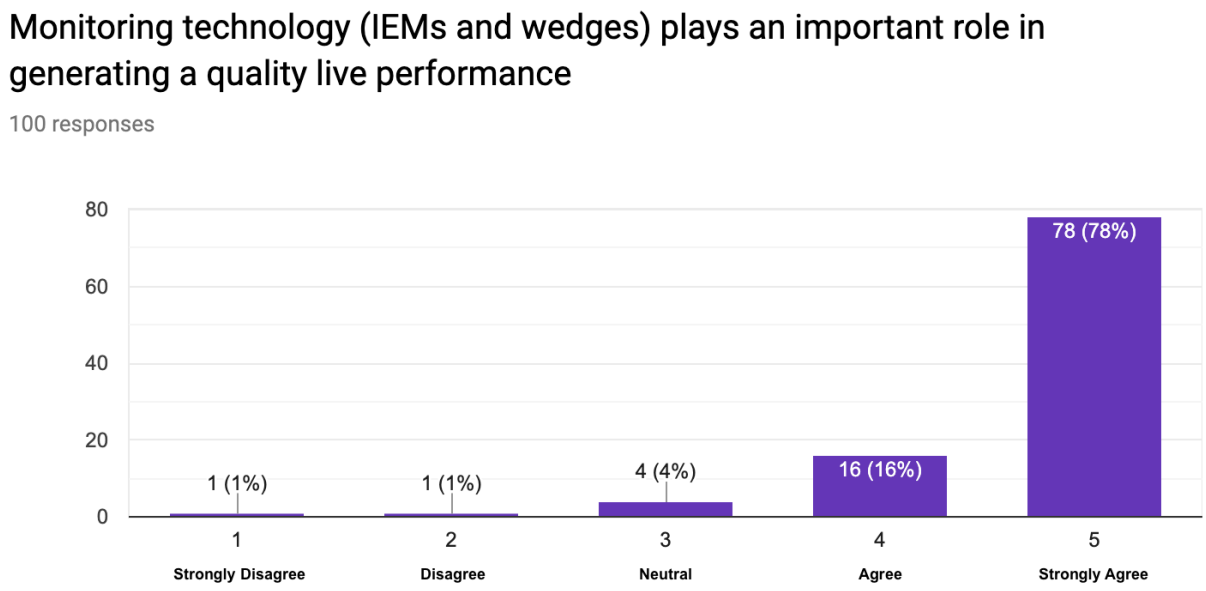

Figure 7. Importance of monitoring technology.

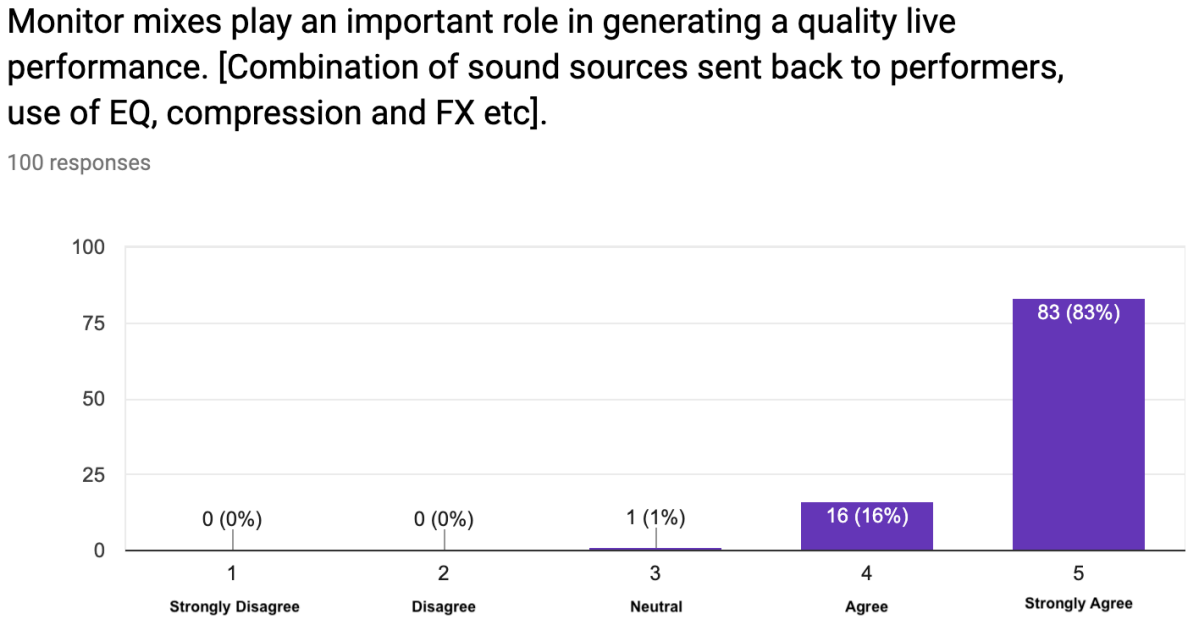

Figure 8. Importance of monitor mixes.

Seventy-eight percent of respondents strongly agreed that monitoring technology plays an important role in generating a quality live performance. A further 83% of respondents strongly agreed that monitor mixes play an important role in generating a quality live performance. The prevalence of monitoring technology in the current popular music live performance industry has allowed performers and audio engineers to consistently engage with such equipment (Howard & Murphy, 2008). As such, there is now an increase in appreciation, rather than misunderstanding (see, Davis & Jones, 1989, p. 178), for monitoring technology and a high-quality monitor mix.

This quantitative data did not provide information to address the research questions. Rather, it profiled the participants and situated the research by presenting a holistic view that monitoring is important in the generation of a quality live performance. The qualitative data that follows discusses the participants' perceptions on monitoring application that promotes a quality live performance.

Qualitative Investigation: Survey Open Questions

The qualitative survey results revealed many perceptions on the key concepts that informed this research. Many of these responses resonated with elements discussed in the literature chapter, therefore the participants' responses will be tabled here and any literature that their responses are analogous with will be inserted as in-text points of reference. Participants were asked to respond to seven open questions concerning: perceptions of a quality live performance, monitoring's influence on a quality live performance, advantages and disadvantages of different monitoring apparatuses and finally, anything else they wanted to add regarding this topic.

Quality live performance.

The first open question asked participants the following: *how would you define a 'quality' live performance?* Survey participant one indicated that a quality live performance is "musically proficient/tight, maintains audience connection and demonstrates professional stage presence". Participant 57 provided a similar viewpoint highlighting musician and audience satisfaction: "musicians playing to the best of their ability; Musicians happy with their performance; Audience happy that they heard a quality performance". Additionally, participant 25 explained that a "quality live performance is one that accurate [*sic*] portrays the song(s). . . . It has minimal errors and creates a strong sense of connection with the audience".

Furthermore, some respondents indicated that popular music live performance production qualities such as, audio, lighting, visual, staging and wardrobe, are also components of a quality live performance. Participant 41 explained that a quality live performance should be judged by "the overall experience given to the audience. When all parts are done well from performer, sound and lighting. A quality live performance is a package delivered by more than just the band". Analogous to this point of view, participant 72 explained that a quality live performance should be "visually attractive (make up, wardrobe and lighting [technician's] duty)".

The responses to this question indicate that several key elements embody a quality live performance. Firstly, musical competence in technique, interpretation, expression and communication are pivotal factors. These responses resonate with some of the literature presented in chapter 2 (Board of Studies, 2009; Duerksen, 1972; McPherson & Schubert, 2004). Secondly, maintaining a connection with the audience, keeping them engaged and providing them with an experience was also

targeted as integral. These concepts are also backed up by the literature (Baym, 2018; Moore, 2002; Moylan, 2014). The third element of a quality live performance cited was musician/performer satisfaction, comfortability and emotional affordances. These responses resonate with the works of (Mills, 1991; Moore, 2002). Finally, popular music live performance production qualities (audio, lighting, visual, staging and wardrobe), also contribute to a quality live performance (Gabrielsson & Lindström, 1985).

Monitor mixes' influence on a quality live performance.

The second open question in the survey asked: *how do monitor mixes promote the generation of a quality live performance?* This asked respondents to build on their definition of a quality live performance and explain if monitor mixes have a performative influence. Participant one explained that monitor mixes promote the generation of a quality live performance "by providing the performer with the most comfortable stage sound possible. To help the [performer] feel comfortable, relaxed and in the best state of mind". Participant 10 provided further insight on this point:

> After 25 years of playing professionally … the sound is always going to affect the way you perform/play. If you are getting a distorted mess through the foldback and can't hear yourself or other band members, you [*sic*] ability to produce a quality performance is diminished greatly. On the other end of that scale, if your monitor mix is clear and you are loving the sound you are producing, it elevates your playing and performance. If the artist/performer is having a good time, the audience will too!

Participant 19 further expounded on the audience's perception:

> The monitor mix will determine how the act believes they are being perceived by the audience. Even though musicians should be able to continue playing with a sub par mix, they will generally begin to think of the audience and worry that the FOH mix is also not giving through the sound they desire to connect with their audience.

Participant 41 outlined that "monitor mixes give the performer the comfort and confidence to deliver their art, if they can't hear themselves it can make it very hard to do their part". Finally, participant 95 explained that "a monitor mix's soul [*sic*] purpose is to sound great for the specific performer, and have exactly what they need to perform to the best of their ability. If it sounds amazing to them, they will bring the energy".

The responses from both performers and audio engineers to this question outline that monitor mixes do play a pivotal role in the generation of a quality live performance. When performers are comfortable and satisfied on stage, they are better situated to generate a quality live performance (Davis & Jones, 1989; Mellor, 2005; Sigismondi, 2008).

Advantages of in-ear monitors.

The next section of the survey asked participants to consider the advantages and disadvantages of the two primary monitoring designs; IEMs and wedges. Appropriately, the first open question of this section asked: *what are the advantages of using in-ear monitors?* Participant 14 explained the advantages of IEMs for performers:

> IEMs allow lower listening levels for the musician, which protects their ears from hearing damage, allowing long term participation in the music industry.

> They also have higher clarity due to isolation from other musicians mixes and stage noise. This means musicians are hearing what they need more easily, and are able to focus on performing.

Participant 10 explained that "the best and probably most obvious advantage [of IEMs] is lack of feedback. If the band members all have IEMs and there is no need for foldback wedges, the [*sic*] eliminates the common problem of feedback when volume is loud". Furthermore, participant six identified that IEMs provide "a discrete way of communicating with a sound technician or to hear a click track[19] with prepared backing tracks. Wireless packs … also allow consistent monitoring across all areas of the stage". Whilst participant 56 summarised the advantages of IEMs:

> 1. Removes the room noise up to -26dB (depending on the in ear brand) this is replaced with stereo ambient micing[20] and therefore controlling the level of the room or environment back into the in ears.
> 2. Thinking stereo - it puts instruments into their rightful place based on the instrument stage layout. So panning and eqing[21] is everything.

Survey responses show that IEMs pose significant advantages for performers and audio engineers. IEMs allow for protection of hearing, greater monitor mix quality, clarity and separation, less acoustic feedback, personal control of monitor mixes and geographical consistency (both on stage and in different venues) (Federman & Ricketts, 2008; Sigismondi, 2008). Moreover, IEMs allow performers

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[19] Also known as a metronome track.

[20] Microphones that capture the natural ambience of a stage and audience. Generally fed back to performers wearing IEMs to generate a more natural listening environment.

[21] The use of an equaliser (EQ).

to use backing tracks and click tracks (Mellor, 2005). IEMs also enable audio engineers to craft a sonic stereo landscape for performers through the use of panning and EQ (Davis & Jones, 1989; Frink, 1999; Gibson, 2005; Izhaki, 2008; Sigismondi, 2008).

Disadvantages of in-ear monitors.

The next question in this section asked: *what are the disadvantages of using in-ear monitors?* Participant 21 provided comprehensive insight:

> Most commonly, lack of inspiration caused by feeling of detachment when no ambient microphones are used to help give performers sense of room/space … likely to cause lackluster and unenthusiastic performance. Also severely limits vocal communication with band members on stage.

Participant 36 highlighted that "the vibe can be lost as you can feel isolated on stage" and participant 61 recognised that IEMs "are relatively fragile" and "they are generally extremely expensive". Participant six highlighted that engagement with an audience can be lost with IEMs:

> Often the crowd is hard to hear and gauge response from. . . . I feel this is a vital part of providing a quality performance - gauging audience reception and responding accordingly. Crowd mics can be used to combat this.

Participant 3 explained that "wireless packs [IEM receiver belt packs] can be unreliable as the battery can run out and there can be interference with the receiver (had a radio station interfere once)". Participant 43 explained the potential danger of using IEMs:

> Possibility of hearing loss becomes an issue as you can not "walk away" from the ear pieces. Singers sometimes do not perform as well due to the fact that they do not need to project their voice due to the easy to achieve loudnes [*sic*] of the systems [IEM system], creating a problem for FOH engineers. In a rock music setting, the use of IEM systems alone may be a vibe killer.

These responses suggest that whilst IEMs can be a useful tool for performers and audio engineers, there can be a feeling of disconnect between a performer and fellow performers and, the performers and the audience. This disconnect can be reduced by utilising ambient microphones and audience microphones to restore a natural audio representation for performers (Sigismondi, 2008). IEMs, when not used correctly can additionally damage the hearing of those using the apparatus.

Advantages of loudspeaker foldback.

Moving forward to the next monitoring apparatus, participants were asked: *what are the advantages of using loudspeaker foldback (wedges)?* Participant 16 suggested that wedges create a "greater feeling of raw energy on stage, feeling of bass frequencies right through you is a great way of feeling the music deeper". This respondent has proposed that the physical connection between the bass frequencies on stage and connection to their music is a great advantage when performing. Participant 97 expanded on this concept further indicating that monitoring "through wedges is more natural for most people (who haven't used IEMs frequently). Can be a good visceral experience with loud wedges, physically moving more air, the performer can experience a more physical response to what they are monitoring". Participant 48 identified that wedges "can be used generally for all performers (i.e. a festival). Creates a better connection with the audience and performers and is less isolating". This universal accessibility is a key advantage of wedges. Participant 27

added that wedges maintain "a good sense of connection and space to the room and audience". Participant 26 noted that wedges are "more reliable" and have "less points for failure". Participant 84 suggested that "some musicians prefer to feel the vibe and not have stuff stuck into there [*sic*] ears as some in ears … can be uncomfortable with extensive use". Finally, participant 87 explained that wedges are "fast, effective and dependable helps with band energy".

These respondents have indicated that the use of wedges puts them in an advantageous position to balance within the room they are playing in and remain connected to both their fellow performers and the audience (Mulder, 2010; Sigismondi, 2008).

Disadvantages of loudspeaker foldback.

The next open question asked participants to consider the following: *what are the disadvantages of using loudspeaker foldback (wedges)?* Acoustic feedback was a major concern to survey respondents with over half identifying it is a primary disadvantage of wedges. Participant 84 explained:

> Feedback can be an issue. . . . Amateur operators can easily deafen artists by accident by routing something wrong and opening[22] the wrong channel. They [the wedges] also take longer to setup and labour is involved with cabling cost and maintenance.

Like IEMs, wedges can also cause severe hearing damage for performers. Participant 3 discussed this in detail:

[22] Un-muting a source (for example, un-muting a microphone on a mixing console).

> While it could also be true with using IEMs, albeit less severe, using wedges long-term runs the risk of hearing loss and if the SPL[23] is too high for a gig, the performer could even become nauseous and pass out (happened once with the band leader of a Latin band).

Participant six identified that "musicians will not be able to hear their mix if moving away from the projection of the wedge they are receiving a mix from". Whilst, participant 91 acknowledged two profound disadvantages:

> Two big ones - They're [wedges] not a universally good solution. Big stage outdoors - awesome. Small club, crammed in a corner with harsh surfaces all around? One way ticket to feedback town and unhappy performers. Second that comes to mind is you can't run a click through wedges.

Excessive SPL on stage can also affect the FOH sound. Participant four highlighted that wedges generate "more on stage sound, resulting in a "Muddier" FOH mix".

Parallel to IEMs, wedges can also cause hearing damage if not operated correctly. Feedback, lack of portability and excessive SPL on stage can detract from the clarity of a FOH mix (Davis & Jones, 1989). Additionally, due to an increasing deployment of backing tracks in popular music live performance, wedges make it very difficult to run such tracks and the subsequent click tracks required to stay in time.

[23] Sound pressure level, or SPL, measured usually measured in decibels (dB).

Further participant insight.

Finally, the participants were offered the opportunity to provide any further information. The final survey question asked: *is there anything else you would like to add regarding monitoring and its influence on live performance?* Participant 82 provided discernment over using both wedges and IEMs:

> In the modern age a blend between the two types of monitoring is becoming more popular. An artist might require IEMs to wander around the stage and into the audience, but remove them in front of their wedge so they can engage with the band and audience more naturally. But without any monitoring, contemporary music styles become almost impossible to perform when on an amplified stage.

Participant 80 expanded on this, stressing that monitoring is "the single biggest factor when it comes to a musician performing at their best". Participant 77 identified that monitoring design is subjective:

> Every performer and act is different, and what they need/want will differ too. Every aspect of a performance needs to be considered when deciding what an artist needs to hear and how to deliver that to them. That includes the style of music, the intimacy … with the audience, the size of the performance space, the temperament of the performer.

Moreover, participant 37 simply stated that "Good monitoring. Happy performers. Good gig". Participant 30 found that "younger generations are much easier to feel comfortable on in Ears than older [*sic*]". Participant six concluded in saying:

> The actual mixing of IEM's (and wedges) is very important. Clarity, and correct EQ, compression and FX all drastically add to the quality of the

> response of the musician … in turn adding to the quality of the performance. Words like 'stale' and 'dead' are often used to describe IEM mixes in my experience - usually a result of a lack in clarity, untreated frequencies or lack in compression or reverb for musicians to 'vibe' off.

By comparing participants' qualitative responses with the literature on this topic some key points have become apparent. The importance of a high-quality monitoring design and monitor mix for performers has become more prominent in the current popular music live performance environment (Benediktsson, 2009; Davis & Jones, 1989; Sigismondi, 2008). Similarly, the subjectivity of monitoring has dictated that performers and audio engineers must consider each performance scenario on its own accord (Benediktsson, 2009; Laveglia, 2019; Mellor, 2005). Additionally, the craft of creating the monitor *mix* itself is incredibly important in assisting the performer to generate a quality live performance (Davis & Jones, 1989; Frink, 1999; Gibson, 2005; Izhaki, 2008; Sigismondi, 2008).

Qualitative Investigation: Semi-Structured Interviews

The semi-structured interviews involved three experienced industry professionals (*three primary participants*) and were undertaken following the completion of the survey. The interviews enabled the generation of a deeper understanding of the concepts of this research. Additionally, the interviews facilitated a systematic discussion on the themes that arose from the survey responses. The semi-structured interview questions are available at Appendix C.

Monitoring design disclosure.

After discussing the participants' background with them to gain an in depth understanding of their experience, I asked the three primary participants the following: *what monitoring systems have you been exposed to in your professional experience?* Sam explained that he has been exposed to a variety of monitoring system designs over the years:

> For many years … I just used stage monitors [wedges]. . . . Two or three years ago I started … dipping my toes in in-ear monitoring. At first it was just … the monitor engineer or the front of house engineer providing a mix. But pretty soon after … we [Caligula's Horse[24]] realised that the safest bet was to start looking towards a *closed system* [emphasis added]. So, we invested … into building a system that allows us to do our whole mix [monitor mix] from stage splits[25] from the ground up (Interview, August 27, 2019).

I asked Sam to explain what a *closed* monitoring[26] system was. He explained that a closed monitoring system gives him and his band complete control of their own monitor mix and they are not "at the peril of the monitor engineer" (Interview, August 27, 2019).

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[24] Sam's progressive metal band based in Brisbane, Australia.

[25] Stage splits, are a cable that split the signal of a sound source for distribution to different destinations. Most commonly used to split on stage sound sources to go to the monitor console and FOH console (Davis & Jones, 1989).

[26] A *closed* monitoring system is completely operated by the performers, often using an iPad/tablet, smart phone or laptop to control individual monitor mixes.

Ben identified that he has used wedges, IEMs and both apparatuses simultaneously (Interview, September 12, 2019).

Alan explained that he has used wedges and IEMs (Interview, September 12, 2019).

Appropriately, all three primary participants had used wedges and in-ear monitors.

Quality live performance.

Similar to the survey, the interview participants were asked: *how would you define and describe a 'quality' live performance?*

Sam identified that a quality live performance, in the context of Caligula's Horse, would incorporate "tightness [amongst the band] … interactivity … getting a holistic sense of what the live performance is like … and being able to critically appraise my own performance" (Interview, August 27, 2019).

Alan stated that a quality live performance "depends on how good you're sounding, or how comfortable you are on stage" (Interview, September 12, 2019).

Ben, is an audio engineer and he explained that a quality live performance is "all the parts [technical] coming together without error to enable the artist to perform. . . . So they can have a direct engagement with the audience" (Interview, September 12, 2019).

What embodies a quality live performance is somewhat subjective to the individual. However similar to the survey responses, reoccurring themes of performer comfortability and satisfaction, musical proficiency and audience engagement was presented as definitions.

Monitor mixes' influence on the generation of a quality live performance.

The interview participants were then asked: *with your definition of a quality live performance in mind, to what extent does monitoring technology play a role in the generation and cultivation of a quality live performance?*

Sam explained some holistic viewpoints:

> On one hand, you almost hope it [monitoring technology] wouldn't at all, you'd almost hope that it would be invisible. The thing is, when you're using stage monitors [wedges] of course it isn't. . . . When I'm running a stereo in-ear mix and I've spent ages on … the balance of everything … the EQ of the different parts and it's the same night after night, sometimes you forget you have a mix. . . . You can set it [in-ear monitoring system] up to such a degree that I think it's basically equivalent to the album. . . . You cannot do that with stage wedges (Interview, August 27, 2019).

I asked Sam a follow up question: *does the consistency of using a closed in-ear monitoring system aid in your comfort level on stage, better positioning you to provide a quality live performance night-in-night-out?*

Sam replied with, "exactly right. To the point where once you've set it up, it doesn't necessarily enter your thoughts … the technology is doing such a good job. . . . I feel very safe with this rig [closed IEMs system]" (Interview, August 27, 2019).

Ben explained his view on monitoring technology's influence on the generation and cultivation of a quality live performance:

> Oh … it's everything. If that performer cannot pitch or they have something distracting them from focussing … monitoring is … absolutely key to them performing to the level that they need to … to enable them to engage with that audience (Interview, September 12, 2019).

Alan answered the question suggesting:

> Since I've been using in-ear monitors it's actually more comfortable and more inspirational to play to. It actually makes you play better if you're getting a good sound … You're more relaxed, you actually enjoy playing more then as to the opposite if it's sounding too loud or if you can't hear someone else. . . . Sometimes that didn't happen when we were using wedges. Cliff [Richard] loved in-ear monitors, he never went back [to wedges], once he tried them once (Interview, September 12, 2019).

These responses suggest that a high-quality monitor mix assists performers in the generation and cultivation of a quality live performance by providing a comfortable and enjoyable environment to perform in. By facilitating a consistent, high-quality monitoring situation, performers are able to be less aware of monitoring technology and engage with the audience.

Differences between loudspeaker foldback and in-ear monitors.

The next question asked the interview participants: *what are the differences between loudspeaker foldback and in-ear monitors?*

Sam highlighted geographical restrictions (stage), consistency and connection to the recorded music of his band:

> The first thing that comes to mind is that *tether* [emphasis added] … the idea that if I am on a stage wedge, I'm not moving anywhere, I'm kind of locked there. Of course, I can move if I want, but the moment I do I lose something pretty significant (Interview, August 27, 2019).

Furthermore, Sam stated that wedges must be "tuned properly[27]" as he has seen "many gigs just tarnished by hearing feedback". Whereas, he explained that an in-ear monitoring system "lives with you, it moves where you move, it's malleable enough … to have a mix that is quite close to the album". Sam explained that the final difference between wedges and IEMs is that "you can have a mix of the band, rather than just a mix of what can I have before I'm overloading … the speaker and it's just turning into a mess" (Interview, August 27, 2019).

Ben explained that in a rock band scenario, wedges are "vital to provide feel and power to the stage sound … each performer is feeding off the other and with wedges, it gives you a vibe … on stage of power through sound pressure level". Additionally, he explained that IEMs can provide "separation and bring your stage levels down" (Interview, September 12, 2019).

Alan stated that the main difference is that "you're in full control [when using IEMs]". He highlighted that with a closed in-ear monitoring system, as opposed to wedges, "you don't have to look to a monitor engineer to say, 'turn him up' or 'turn him down' … you've got the control right there" (Interview, September 12, 2019).

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[27] The tuning of a wedge (using an EQ) in order to prevent feedback and shape the wedge sound appropriately.

Wedges and IEMs have a wide range of differences. The closed system, referred to by Sam and Alan is a major benefit for them when performing. However, as explained by Ben, wedges are also suitable in similar environments.

Monitoring system design preference.

The next question asked participants: *do you have a monitoring system design preference (loudspeaker foldback or in-ear monitors)? a) If so, why do you prefer one over the other? b) If not, could you explain why?*

Sam stated firmly, "definitely in-ear monitors. . . . I'm totally comfortable with them now" (Interview, August 27, 2019). Ben explained that he does not have a monitoring system design preference. He clarified that "it's [the monitoring system design] down to the application of what kind of show you're doing" (Interview, September 12, 2019).

Alan asserted his preference towards IEMs:

> I absolutely prefer the in-ears. That system [the closed system he uses] is … close at hand so you're in full control right away. Even as soon as the band starts playing … a couple of tweaks here and there [on his tablet] and that's it (Interview, September 12, 2019).

I asked Alan a follow up question: *because you are using IEMs in a closed system format, does that make it more preferable then having a dedicated monitor engineer?* Alan replied with, "Yes, exactly" (Interview, September 12, 2019).

A closed in-ear monitoring system makes performers solely accountable for their own monitoring and as such, gives performers complete control. However, a

consideration of the requirements of the performance is imperative when designing a monitoring system.

Importance of the monitor mix.

A monitor mix is tailored to suit each, or groups of, performers (Davis & Jones, 1989). Therefore, the participants were asked: *how important do you believe the monitor mix itself is? And, what elements make up a good monitor mix for you?*

Sam highlighted some key elements:

> It's huge. . . . I run a very small amount of room reverb on my guitar … to simulate the idea that I am hearing a cab [guitar speaker cabinet] behind me. . . . When it comes to things like the drums … I EQ it like I would on an album … and it's compressed so the dynamic of each transient is going to be similar enough that it's not smashing my ears, but I can lock in with it (Interview, August 27, 2019).

Sam clarified that "a big part of being able to put that mix together for the most amount of clarity … is signal processing, so EQ and compression work in that capacity". Sam concluded in saying that the construction of a monitor mix, including the use of EQ, compression and effects is important "for vibe" on stage (Interview, August 27, 2019).

Ben provided an audio engineers perspective:

> Again, I think it's absolutely vital. As a monitor operator [monitor engineer], generally you've built a rapport with the band or the musician, so there's a definite relationship. . . . I've worked for bands or musicians specifically because we've built up a relationship over many, many years. I just know

> what they want [in their monitor mix]. . . . An example of that would be using audience mics into in-ears. . . . Joe Bloggs up in the balcony… might go, "I love you", and that performer can actually look up to that person and go, "I love you too"… so it depends on what that performer is trying to achieve (Interview, September 12, 2019).

Alan explained that the monitor mix is integral and placed emphasis on signal balance:

> It's all about the balance of hearing everyone equally and hearing yourself … I like to feel part of the overall mix. I don't like to hear myself way above everyone else … Because if you're too far up in the mix, you tend to lay back on your playing. I like to have it a little bit quieter so you're more positive in your actual playing (Interview, September 12, 2019).

All three primary participants deemed the monitor mix to be of importance. Sam placed emphasis on EQ, effects and the vibe on stage and Alan explained that the balance of the sound sources in a monitor mix is crucial. Ben noted that the role of the monitor engineer is one that must encompass interpersonal skills, rapport with the performers and the use of audience microphones (Gross, 1997; Sigismondi, 2008; Swallow, 2010).

Primary Participant Insight on the Survey Results

I asked the three primary participants to provide insight on certain information emerging from the survey's qualitative responses. This was aimed at achieving greater clarity and understanding on the concepts surrounding this research.

Combatting isolation when using in-ear monitors.

Question eight asked participants to consider why some qualitative survey responses suggested that whilst IEMs are great for clarity, precision and portability, there is sometimes a feeling of disconnect from the performers with their fellow band members and also the audience.

Sam explained that the "disconnect from the audience is really tangible … To circumvent that we'll … use crowd mics … but the fact that I can hear the band is really valuable" (Interview, August 27, 2019).

Alan explained the need for stage and audience microphones:

> They need some kind of ambience channel to pick up … the general ambience from on stage and the audience, that's very important. . . . You can get an overall sound like you're in the room, you're not just in a recording studio listening to other musicians. . . . There's nothing worse than when you finish a song, and the audience are applauding, and you can't hear them (Interview, September 12, 2019).

The use of ambient microphones such as audience and stage microphones is a tool to combat the isolation felt by performers wearing IEMs (Sigismondi, 2008).

High-quality monitoring = happy performers = happy audiences.

The final question posed a statement arising from the qualitative survey responses: high-quality monitoring = happy performers = happy audiences. The primary participants were asked: *do you agree with this statement? If so, why?*

Sam agreed and expanded on this:

> We [Caligula's Horse] sit in a kind of style of music where there's a real expectation for a high level of performance. I don't just mean a high level of vibe and excitement; I mean a high level of technical accuracy. . . . If we can hear everything … I know that our audience is going to be appreciating that. . . . We've had audience members … who've … said, "you guys just keep getting tighter", and I know that we do. . . . The experience that we give our audience is based very much on the tightness and the interactivity and it's something that I don't believe we can get without the kind of mix that we have now (Interview, August 27, 2019).

Ben agreed and explained why:

> Because that's what it's all about, it's about that performer engaging with that audience … If anything comes out of a show, that is the goal of the performer, to deliver their performance and engage with the audience. . . . That's what performance is all about (Interview, September 12, 2019).

Alan agreed and profoundly stated, "definitely. Because it makes the player play better and if the player is playing better than the audience are happier, it's that simple" (Interview, September 12, 2019).

All three primary participants agreed that there is a direct correlation between high-quality monitoring, happy performers and a happy audience. This demonstrated an explicit link between monitoring and a quality live performance.

Themes Arising

The seminal themes of this research were generated through the triangulation of analysis from the two qualitative data methods (survey and interviews) and the

literature (where applicable). These themes target the sub-questions of this study, which will in turn, inform a response to the central research question. The themes identified through the thematic analysis are located below in Table 1.

Table 1. *Themes*

Using solely wedges or IEMs respectively
Hybrid monitoring systems; using both wedges and IEMs
Closed in-ear monitoring systems
Performance connection felt by performers and audience facilitated by wedges
Potential for acoustic feedback when using wedges
Personal control, clarity and hearing protection when using IEMs
Ambient microphones to combat isolation when using IEMs
IEMs accommodate contemporary live performance strategies in popular music
High-quality monitoring equals happy performers which equals happy audiences
Monitor mix (and monitor engineer) facilitates performer comfortability
Musical competence in technique, interpretation, expression and communication
Engaging with the audience, maintaining a connection and providing an experience
Performer satisfaction, security and emotional affordances

The above themes suggest there is an interrelation between monitoring and a quality live performance. The findings and conclusions chapter will now follow and use these themes to present a response to the research questions.

Chapter 5: Findings

Performers and audio engineers in the popular music live performance industry have been subject to continual engagement with monitoring systems (Sigismondi, 2008). This dissertation has investigated monitoring design, application and its effect on a quality live performance. This chapter will respond to the sub-questions of this investigation in order to propose a response to the central research question. These findings are situated within: the principal advantages and disadvantages of loudspeaker foldback (wedges) and in-ear monitors (IEMs); the role of a monitor mix and; the elements of a quality live performance.

Advantages and Disadvantages of Loudspeaker Foldback and In-Ear Monitors

The first sub-question of this study asked: *what are the principal advantages and disadvantages of loudspeaker foldback and in-ear monitors?* There were four primary findings that emerged in this research relating to the advantages and disadvantages of wedges and IEMs which were: *performance connection, acoustic feedback, personal control* and *isolation*.

Wedges (advantage): Performance connection, physical and introspective.

This research found that a major advantage when using wedges was the *performance connection* experienced by performers and audio engineers. Such connection was identified as being physical (performer and instrument) and introspective (performer and fellow performers; performer and audience). When using wedges, the physical

vibration and movement of air (which creates sound waves) empowered performers to forge a deeper connection with their performance on stage; enabling them to 'feel' the music. As a result, this felt more natural and therefore more comfortable for some performers. These results correlate with Zhang's (2008) notion on psychoacoustics whereby he states the auditory idiosyncrasies of "pitch, loudness, [and] timbre … are subjective" (Zhang, 2008, p. 43).

Addressing the introspective aspect of performance connection, this research identified that performers are able to maintain an intrinsic relationship with their fellow performers on stage when using wedges. This holistic performance experience of using wedges helped performers balance their volume and dynamics when performing. This assisted them to develop synthesis with their fellow performers and consequently, balance appropriately on stage. Furthermore, wedges allowed performers to engage with their audience as they had their ears exposed to hear their natural surroundings. As such, this research found that wedges are advantageous for those wishing to achieve a more natural monitoring environment and an introspective engagement between performers and audience.

Wedges (disadvantage): Acoustic feedback.

Acoustic feedback was found to be a principal disadvantage when using wedges. The occurrence of feedback was problematic for performers and audio engineers cultivating and generating a quality live performance. Thus, this study saw a continual citation of feedback as a primary concern when employing wedges due to its potential to cause severe disruptions in a live performance. Additionally, the prospective of hearing damage over time when feedback occurs caused trepidation for performers and audio engineers. This finding is consistent with prior professional discourse that examines what causes feedback and ways to combat it (Berman, 1999;

Chevalier et al., 2013; Davis & Jones, 1989; Gross, 1997; Sigismondi, 2008; Soundcraft, 2001; Watkinson, 2013). In order to alleviate the potential for feedback, audio engineers must have comprehensive knowledge on microphone and loudspeaker (wedge) placement and tuning (Davis & Jones, 1989; Laveglia, 2019; Watkinson, 2013).

IEMs (advantage): Personal control.

Another finding of this research was the *personal control* of IEMs. The ability for performers and audio engineers to have absolute personal control of what they hear on stage was identified as a key advantage of IEMs. This allowed performers to hear themselves clearly, hear their fellow performers and as a result, feel comfortable and connected to their performance. Similarly, IEMs enabled performers to achieve greater personalisation of their monitor mix and a superior degree of clarity as compared to what they experienced with wedges. This research additionally found that due to the increasing regularity of backing tracks in popular music live performance, IEMs assisted performers with staying in tune and in time. Moreover, this research found that IEMs facilitated lower volume levels on stage and therefore assisted in the conservation of performers' hearing and a reduction in vocal strain. These results resonate with some of Sigismondi's (2008) assessment of the advantages of IEMs.

IEMs (disadvantage): Isolation.

The final finding of this sub-question was the *isolation* experienced by performers when using IEMs. Isolation between performers and the audience was found to be a crucial disadvantage facing performers and audio engineers employing IEMs. The isolating nature of IEMs, constrained the 'natural' ambience of a performance space,

limited communication amongst performers and hindered engagement with the audience. Sigismondi (2008) proposes that audio engineers can employ the use of audience and ambient microphones to "restore some of the 'live' feel that may be lost when using personal monitors [in-ear monitors]" (p. 1431). This research found the use of audience microphones alleviated the feeling of isolation from a crowd. Additionally, the use of ambient microphones on stage relieved some of the isolation felt among performers.

The Role of a Monitor Mix

The second sub-question considered: *how does the role of a monitor mix influence a quality live performance?* This research found that monitor mixes have a fundamental influence on the generation of a quality live performance. Findings showed that a high-quality monitor mix allowed performers to be more comfortable on stage and thus, derive greater enjoyment out of their performance. This finding correlated with the introspective connection explained in the first sub-question but, was found to be applicable to both wedges and IEMs. High-quality monitor mixes supported performers to focus on their performance and engage with their audience without worrying about monitoring issues. Audio engineers applying suitable monitor mixing techniques (such as EQ, compression, panning and effects) allowed for the cultivation of a positive monitoring environment for performers on stage. Similarly, audio engineers who nurtured appropriate interpersonal skills, were found to be able to communicate and develop a positive rapport with performers. Furthermore, this study found a direct parallel between a high-quality monitor mix and the satisfaction of performers and audiences. When a performer is exposed to a high-quality monitor mix, they are better positioned to provide an improved

performance and consequently, deliver the audience with a quality live performance. These findings provide tangible paradigms of how monitor mixes can promote a quality live performance as proposed in professional literature (Benediktsson, 2009; Davis & Jones, 1989; Mellor, 2005; Sigismondi, 2008). Therefore, the results of this study has found that a high-quality monitor mix utilises appropriate monitor mixing techniques and interpersonal skills between audio engineers and performers. These are key influences that benefit performers in their quest of delivering a quality live performance.

Components of a Quality Live Performance

The third sub-question asked *what are popular music performers' and audio engineers' perceptions of a quality live performance?* There were four crucial foundations that constructed a quality live performance as analysed in Chapter 4 which were: 1. Musical competency; 2. Connection with the audience; 3. Performer satisfaction and; 4. Popular music live performance production success and cohesion. Musical competency included proficiency in technique, interpretation, expression and communication which postulated a central musical pillar for the delivery of a quality live performance. Performers who were meticulous in these areas were better situated throughout their performance to portray a display of skill and finesse. Through sustaining a connection with the audience, performers were able to provide them with access to an experience. This cultivation of audience engagement was found to impact the quality of a live performance as performers were able to generate a deeper connection beyond the audible realm. Performer satisfaction encompassed comfortability and emotional affordances experienced when performing. This enabled performers to remain relaxed and enjoy performing in order to nurture a

quality live performance. Finally, the seamless integration of all live performance technological elements (audio, lighting, visual, staging and wardrobe) manifested popular music live performance production success and cohesion which in turn, promoted a quality live performance. Each of the four foundations of a quality live performance resonate with elements found in literature (Baym, 2018; Board of Studies, 2009; Duerksen, 1972; Gabrielsson & Lindström, 1985; McPherson & Schubert, 2004; Mills, 1991; Moore, 2002; Moylan, 2014). Consequently, providing a credible basis for a framework for a quality live performance.

A Nexus Between Monitoring and a Quality Live Performance

The central research question of this dissertation contemplated: *what are the considerations in application for loudspeaker foldback and in-ear monitors when designing monitor mixes that promote a quality live performance?* This investigation has documented an explicit connection between a quality popular music live performance and the design and application of monitoring. This nexus amalgamates cause and effect; in this instance, between monitoring and a quality live performance. Performers and audio engineers have become increasingly aware of the importance of monitoring in the popular music landscape and as such, this study has found a proliferation of appreciation for high-quality monitoring technology and the subsequent monitor mix. The implementation of a personalised monitoring experience promotes a physical and introspective performance connection which in turn, facilitates an engagement between performer and audience. The impact of a positive monitoring experience for performers can greatly escalate the quality of their performance and result in greater satisfaction from both them and their audience.

Considerations: Scope, performance goals, preferential monitoring design and a personalised monitor mix.

To design a monitor mix which promotes a quality live performance a consideration of four key areas is imperative. Firstly, performers and audio engineers need to consider the scope of the performance. A performance that is targeted at small, intimate venues where there is a small audience capacity will require a different monitoring design and monitor mix to that of an international touring act that is playing at large venues. This facilitates connection with the audience. Secondly, a contemplation of what the performance is trying to achieve is a vital monitoring concern. Performers who rely on volume to create power and vibe on stage will benefit from wedges, as opposed to performers who require the articulation and clarity of IEMs to support precision and tightness. This aids in musical competency and performer comfort on stage. Thirdly, preference of monitoring design is a crucial consideration. Simply, if a performer prefers to use wedges or IEMs, then allowing them to employ their preferred monitoring design will aid in their satisfaction and comfortability on stage. An understanding of the principal advantages and disadvantages of wedges and IEMs provides a necessary basis. Finally, providing a performer with exactly what they want in their monitor mix will aid in their delivery of a quality live performance. The use of appropriate monitor mixing techniques and interpersonal skills between performer and audio engineer facilitates popular music live performance production success and cohesion.

Applications and new findings.

The practical application of the above considerations is best framed through the identification of the new findings of this research. Two integral new findings of this research were: 1. 'Hybrid' monitoring systems and; 2. Closed in-ear monitoring

systems. This research found that there is an increasing employment of hybrid monitoring systems. Hybrid monitoring systems simply involved the use of both wedges and IEMs. This allowed performers to use their preferred monitoring design in a performance situation. This comprised of wedges for drummers and bassists (for example) as they wished to balance their dynamics on stage without feeling isolated and maintain a physical connection with their instrument. Whereas singers and keyboardists (for example) utilised IEMs to achieve a stereo sonic landscape, facilitate greater performance precision and protect their hearing. Therefore, this research found that performers and audio engineers do not have to employ solely wedges or IEMs, rather a system which fully enables performers to provide a quality live performance.

Secondly, closed in-ear monitoring systems, as witnessed in Chapter 4, was found to provide regular touring performers with more consistency show to show. A closed in-ear monitoring system offered performers complete control of their own monitor mixes and did not rely on an audio engineer (or monitor engineer) to provide a monitor mix. Performers were able to engage with monitor mixing techniques to craft their own monitor mix to personal preference. This delivered performers with a dependable monitoring experience with minimal variance in-between shows. In turn, this further facilitated an increase in preference for IEMs; especially for touring performers.

Conclusions

By conducting this research, I aimed to examine the nexus between monitoring and a quality popular music live performance. Through the application of these findings, popular music performers and audio engineers are able to make more informed

choices concerning monitoring. This includes, understanding the principal advantages and disadvantages of different monitoring designs (wedges and IEMs), appreciating the role of a monitor mix and cognising popular music performers' and audio engineers' perceptions of a quality live performance.

Existing research has predominately un-prioritised an examination into monitoring's influence on a quality live performance. As such, the professional discourse in this field has identified some of the themes in this study, but not scrutinised them holistically or in detail. Although there are explanatory professional texts which discuss monitoring from an audio engineering perspective, there is little scholarly research examining monitoring from a holistic, cross-discipline perspective. Consequently, this research has filled the void left by professional texts and provided substantial information for those in both the academic and non-academic realms wishing to gain an understanding on the unambiguous link between monitoring and a quality live performance.

Limitations and future research.

The primary limitation of this study was the geographical restriction imposed by the scope of this dissertation. Despite being able to collect data from a wide-range of sources, this information was primarily based in Australia and did not seek counsel from international sources. However, the participant population of this research was vast, yet repeatable on a global scale with regard to popular music performers and audio engineers. Thus, this concern did not impact the validity of this research. This study has the ability to form an essential basis for future, wider-ranging research that unpacks the importance of monitor mixes on popular music performance. Another avenue for future research is the investigation of monitoring in record production; examining the role of the headphone mix in the recording studio.

Final reflections and personal significance.

The overwhelming importance placed on monitoring in popular music live performance by performers and audio engineers was undeniable. The exposure that performers and audio engineers have to monitoring systems in today's context allowed for an abundant array of opinions and ideologies. The results demonstrated an explicit connection between monitoring and a quality live performance. This research and the succeeding findings left a philosophical impression with me. I have personally gained a much deeper understanding on the integral characteristics of monitoring as both a performer and an audio engineer making a living in the music industry. My hope is that the research may impart a holistic, empathetic understanding of monitoring's connection to a quality live performance and help to strengthen the scholarly discourse in this field. Whilst the theoretical information presented in this dissertation provides insight to performers and audio engineers alike, the importance of getting out there and trying new approaches is absolutely imperative for those wishing to design a monitor mix which promotes a quality live performance. I know I shall be continuing in my pursuit to do exactly that.

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Appendix A: Informed Consent Package

Monitoring Design and Application: An Examination into Monitoring's Influence on Popular Music Live Performance

6000QCM Honours Research Project

GU Ref No: QCM/09/12/HREC CONSENT FORM

Researcher:
Name: James Palmer
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School/Centre: Queensland Conservatorium Griffith University

Supervisor:
Name: Brendan Anthony
Contact Phone: 0403 062 798
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Why is the research being conducted?
This research concerns popular music live performance production and more specifically, monitoring (what a performer hears on stage). This research is covering the technological design of monitoring (loudspeaker foldback and in-ear monitors), the application of monitoring and popular music performers' and audio engineers' perceptions of a quality live performance. This will enable a discussion on the effects of different approaches and equipment, the role of the monitor mix and how these considerations impact a quality popular music live performance. This paves the way for an examination of the considerations in application for loudspeaker foldback and in-ear monitors when designing monitor mixes that promote a quality live performance.

The expected benefits of the research
Popular music performers and audio engineers of all experience tiers engage with monitoring. Readers of this study (popular musicians, academics, audio engineers) may be able to discover different approaches to monitoring and understand the considerations in application for monitoring design. This topic is one I have personally had extensive professional experience in and as such, I am passionate

about informing the popular music live performance/production realm further. This could prove beneficial in enlightening the school of thought concerning sonics and its connection with emotion, mood, vibe and creativity.

What you will be asked to do
Participants will be sent an anonymous, internet-based survey that will take approximately 10 minutes to complete. Three primary participants will then be interviewed in a semi-structured format which will last approximately 30 minutes each. The survey will be dispersed on 01/07/2019 and finalised by the 20/08/2019. The interviews will be undertaken between the 27/08/2019 and the 13/09/2019.

Risks to you
Participation in this research poses no risk and this study will not seek nor divulge any confidential, personal or sensitive information. The surveys will be anonymous, and you are protected through anonymity. At the conclusion of the interviews, ethical clearance will be sought as to whether the participant would like to be referred to by an alias or by their name.

Your confidentiality
The data collection involves an anonymous internet-based survey, completed online. Three primary participants will also undertake a semi-structured interview which will be audiotaped and transcribed. Data collected will be for research purposes only and will be stored and accessed by the research team as per Griffith University's Privacy Plan. Link to Griffith University's Privacy Plan at http://www.griffith.edu.au/about-griffith/plans-publications/griffith- university-privacy-plan or telephone (07) 3735 4375. Please retain this statement for their records.

Your participation is voluntary
Participation is voluntary and you are not under any obligation to consent to participate in the research. No person will be under any real or perceived pressure to participate. You have the right to withdraw your consent to participate at any time during the project.

Questions / further information
If you have any further questions relating to the project, please do not hesitate to contact the team leader, Brendan Anthony by mail, phone or by email at Queensland Conservatorium Griffith University, 140 Grey Street South Brisbane. Tel: 0403 062 798; Email: b.anthony@griffith.edu.au

The ethical conduct of this research
Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Human Research*. If potential participants have any concerns or complaints about the ethical conduct of the research project, they should contact the Manager, Research Ethics on 3735 4375 or research-ethics@griffith.edu.au.

Monitoring Design and Application: An Examination into Monitoring's Influence on Popular Music Live Performance

Semi-structured interview participants

6000QCM Honours Research Project

GU Ref No: QCM/09/12/HREC CONSENT FORM

Researcher:
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School/Centre: Queensland Conservatorium Griffith University

By signing below, I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include a semi-structured interview which will be audiotaped and transcribed;
- I will have the option to be referred to by name or by an alias;
- As required by Griffith University, research data in the form of an interview transcript and audio recording will be retained in a locked cabinet and/or a password protected electronic file at Griffith University for a period of five years before being destroyed;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions, I can contact the research team;

- I understand that I am free to withdraw at any time, without explanation or penalty;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 4375 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project;
- I agree to participate in the project.

Name	
Signature	
Date	

Monitoring Design and Application: An Examination into Monitoring's Influence on Popular Music Live Performance

Anonymous internet-based survey participants

6000QCM Honours Research Project

GU Ref No: QCM/09/12/HREC CONSENT FORM

Researcher:
Name: James Palmer
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Contact Email: info@jamespalmermusic.com
School/Centre: Queensland Conservatorium Griffith University

Supervisor:
Name: Brendan Anthony
Contact Phone: 0403 062 798
Contact Email: b.anthony@griffith.edu.au
School/Centre: Queensland Conservatorium Griffith University

By submitting this survey, I agree to participate in this project. I confirm that I have read and understood the information package and in particular have noted that:

- I understand that my involvement in this research will include an anonymous internet-based survey;
- As required by Griffith University, research data in the form of online survey responses will be retained in a locked cabinet and/or a password protected electronic file at Griffith University for a period of five years before being destroyed;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there will be no direct benefit to me from my participation in this research;
- I understand that my participation in this research is voluntary;
- I understand that if I have any additional questions, I can contact the research team;
- I understand that I am free to withdraw at any time, without explanation or penalty;

- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 4375 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project;
- I agree to participate in the project.

Appendix B: Survey Questions

About you!

What is your gender? *

- ○ Male
- ○ Female
- ○ Prefer not to say
- ○ Other: _____

What is your age? *

- ○ Under 12 years old
- ○ 12-17 years old
- ○ 18-24 years old
- ○ 25-34 years old
- ○ 35 years or older

What is your role in the music industry? Select multiple options if they apply *

- ☐ Musician/Performer
- ☐ Audio Engineer

What genre of music are you involved with the most? If you apply to a sub-genre of these categories, please select the principal genre. For example, Progressive Rock – please select Rock. *

- [ ] Blues
- [ ] Country
- [ ] Electronic
- [ ] Folk
- [ ] Hip-Hop
- [ ] Jazz and Latin
- [ ] Pop
- [ ] R&B and Soul
- [ ] Rap
- [ ] Rock
- [ ] Metal (incl. Hardcore, Punk, Deathcore etc)
- [ ] Other: _____

What is your range of experience/background in live sound and/or live performance? *

- ◯ Beginner/Amateur (still starting out)
- ◯ Intermediate (limited professional exposure)
- ◯ Professional (experienced national touring standard)
- ◯ Expert (long term experienced international touring standard)

In-ear monitors (IEM) vs loudspeaker foldback (wedges)

If you were given the option, how likely are you to use in-ear monitors (IEMs) instead of loudspeaker foldback (wedges) during a live performance? *

	Never	Very unlikely	Possibly	Likely	Very likely
How likely?	○	○	○	○	○

Monitoring technology (IEMs and wedges) plays an important role in generating a quality live performance *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

Monitor mixes play an important role in generating a quality live performance. [Combination of sound sources sent back to performers, use of EQ, compression and FX etc]. *

	1	2	3	4	5	
Strongly disagree	○	○	○	○	○	Strongly agree

Quality live performance

How would you define a 'quality' live performance? *

Your answer

How do monitor mixes promote the generation of a quality live performance? *

Your answer

IEMs - advantages and disadvantages

If you have no experience using IEMs, please leave these next two questions blank.

What are the advantages of using in-ear monitors?

Your answer

What are the disadvantages of using in-ear monitors?

Your answer

Wedges - advantages and disadvantages

What are the advantages of using loudspeaker foldback (wedges)? *

Your answer

What are the disadvantages of using loudspeaker foldback (wedges)? *

Your answer

And finally!

Is there anything else you would like to add regarding monitoring and its influence on live performance?

Your answer

Appendix C: Interview Questions

1. What is your background in the popular music industry (particularly with reference to popular music live performance and live sound)?

2. What monitoring systems have you been exposed to in your professional experience?

3. How would you define and describe a 'quality live performance'?

4. With your definition of a quality live performance in mind, to what extent does monitoring technology play a role in the generation and cultivation of a quality live performance?

5. What are the differences between loudspeaker foldback and in-ear monitors?

6. Do you have a monitoring system design preference (loudspeaker foldback or in-ear monitors)?
    a. If so, why do you prefer one over the other?
    b. If not, could you explain why?

7. How important do you believe the monitor mix itself is? What elements make up a good monitor mix for you?

8. Some participants from the survey suggested whilst IEMs are great for clarity, precision and portability, there is sometimes a feeling of disconnect from the performers with their fellow band members and also the audience. Why do you think this is?

9. In the survey a respondent suggested that: high-quality monitoring = happy performers = happy audiences. Do you agree with this statement? If so, why?